МЕСТНАЯ АНЕСТЕЗИЯ И УДАЛЕНИЕ ЗУБА

LOCAL ANESTHESIA AND TOOTH EXTRACTION

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LOCAL ANESTHESIA AND TOOTH EXTRACTION

учебно-методическое пособие

Рекомендовано учебно-методическим объединением по высшему медицинскому, фармацевтическому образованию в качестве учебно-методического пособия для студентов учреждений высшего образования, обучающихся на английском языке по специальности 1-79 01 07 «Стоматология»

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Учебное пособие «Local anesthesia and tooth extraction» подготовлено в соответствии с типовой учебной программой по челюстно-лицевой хирургии для студентов стоматологического факультета.

TOPIC: LOCAL ANESTHETICS IN DENTISTRY

Local anesthetics produce a reversible loss of sensation in a portion of the body. Local anesthetics may be used as the sole form of anesthesia, in combination with general anesthesia and/or to provide postoperative analgesia.

Mechanism of local anesthetics action

All local anesthetics are membrane stabilizing drugs; they reversibly decrease the rate of depolarization and repolarization of excitable membranes (like nociceptors). Though many other drugs also have membrane stabilizing properties, not all are used as local anesthetics (propranolol, for example). Local anesthetic drugs act mainly by inhibiting sodium influx through sodium-specific ion channels in the neuronal cell membrane, in particular the so-called voltage-gated sodium channels. When the influx of sodium is interrupted, an action potential cannot arise and signal conduction is inhibited. The receptor site is thought to be located at the cytoplasmic (inner) portion of the sodium channel. Local anesthetic drugs bind more readily to sodium channels in an activated state, thus onset of neuronal blockade is faster in neurons that are rapidly firing. This is referred to as state dependent blockade.

Local anesthetics are weak bases and are usually formulated as the hydrochloride salt to render them water-soluble. At a pH equal to the protonated base's pKa, the protonated (ionized) and unprotonated (unionized) forms of the molecule exist in equimolar amounts but only the unprotonated base diffuses readily across cell membranes. Once inside the cell the local anesthetic will be in equilibrium, with the formation of the protonated (ionized form), which does not readily pass back out of the cell. This is referred to as «ion-trapping». In the protonated form, the molecule binds to the local anesthetic binding site on the inside of the ion channel near the cytoplasmic end. Most local anaesthetics work on the internal surface of the membrane – the drug has to penetrate the cell membrane, which is achieved best in the non-ionised form.

Acidosis such as caused by inflammation at a wound partly reduces the action of local anesthetics. This is partly because most of the anesthetic is ionized and therefore unable to cross the cell membrane to reach its cytoplasmic-facing site of action on the sodium channel.

All nerve fibers are sensitive to local anesthetics, but due to a combination of diameter and myelination, fibers have different sensitivities to local anesthetic blockade, termed «Differential Blockade». Type B fibers (sympathetic tone) are the most sensitive followed by Type C (Pain), Type

A delta (temperature), Type A gamma (proprioception), Type A beta (sensory touch and pressure) and Type A alpha (motor). Although Type B fibers are thicker than Type C fibers, they are myelinated and thus are blocked before the unmyelinated, thin C Fiber.

The following sequence of the mechanism of the action of local anesthetics was proposed by Covino and Vassallo (1976):
1.   Displacement of calcium ions from the sodium channel receptor site.
2.   Binding of the local anesthetic molecule to this receptor sites.
3.   Blockade of the sodium channel.
4.   Decrease in the sodium permeability.
5.   Depression of the rate of the electric depolarization.
6.   Failure to achieve the threshold potential.
7.   Lack of development of propagated action potentials.
8.   Conduction blockade.

Chemical structure

The basic chemical structure of a local anesthetic molecule consists of 3 parts:

1. Lipophilic group- an aromatic group, usually an unsaturated benzene ring.

2. Intermediate bond- a hydrocarbon connecting chain, either an ester (-CO-) or amide (-HNC-) linkage. The intermediate bond determines the classification of local anesthetic.

3. Hydrophilic group- a tertiary amine and proton acceptor.

Classification of local anesthetics

On the basis of chemical structure:
1.   Esters:
   – Esters of benzoic acid, e.g. cocaine, benzocaine (ethylaminobenzoate), butacaine.
   – Esters of para-aminobenzoic acid, e.g. procaine, chloroprocaine, propoxycaine.
2.   Amides: articaine, bupivacaine, lidocaine, mepivacaine, prilocaine.
      On the basis of duration of action:
1.   Short-acting: articaine, lidocaine, mepivacaine, prilocaine, etc.
2.   Long-acting: bupivacaine, etidocaine, bucricaine, etc.

Properties of an ideal local anesthetic agent

The properties that are desirable in a local anesthetic solution are as follows:

1. It should be non-irritating and produce no local reaction to the tissues to which it is applied.
2. It should not cause any permanent change in the nerve structure.
3. It should cause minimal systemic toxicity.
4. It must be effective when injected into the tissues and should have sufficient penetrating properties to be effective as a topical anesthetic, when applied topically to the mucous membrane.
5. It should have a short time of onset, if possible.
6. The duration of action must be long enough to allow completion of procedure.

Bennett (1974) has added some properties which are as follows:

1. It should have enough potency to give complete anesthesia without the use of harmful concentrated solutions.
2. It should be relatively free from producing allergic reactions.
3. It should be stable in solution and readily undergo biotransformation in the body.
4. It should either be sterile or be capable of being sterilized by heat without deterioration.

Procaine (novocaine)

It is a diethyl aminoethyl ester of para-aminobenzoic acid (PABA). It was first synthesized by Einhorn in 1905. It is non-irritant and as effective as cocaine as a local anesthetic agent. It is much less toxic and does not produce drug dependence. It is now seldom used in dentistry because of availability of more potent local anesthetic agents.

Procaine can reduce the effectiveness of sulfonamides; because excessive amounts of PABA, which is a metabolite of procaine, can reverse the action of sulfonamides. Excessive amounts of this entity reverses the inhibition and decreases effectiveness of the antibiotic. Procaine is compatible in solution with all vasoconstrictors.

Pharmacology. Procaine had been the standard of comparison for potency and toxicity with other local anesthetic agents for over 50 years. It has been assigned a potency and toxicity of 1. The vasodilation caused is more profound than all other local anesthetic agents. The effect is very brief if used without a vasoconstrictor. A major nerve block with procaine may have a duration of 5 minutes; however, the duration is extended to 1 hour if a suitable vasoconstrictor is used. Procaine is readily absorbed when injected into the tissues. The ability to diffuse through interstitial tissues is

poor. Hence, a good injection technique; particularly an accurate placement of needle; is essential to produce profound anesthesia.

Hydrolysis. Procaine is hydrolysed to PABA and diethyl aminoethan. It is a reaction that is catalysed by an enzyme, plasma choli in plasma and liver.

Availability in Dentistry. Procaine is used alone in dentistry as 4% solution; and is 2% solution. It is available as 4% solution. It is marketed a combination of 0,4% propoxycaine and 1:30,000 levarte levonordefrin.

Onset and Duration of Action. The onset of action takes 3-5 minutes and the duration of is 30 minutes.

Maximum Recommended Dose. It is 15-20 mg/kg body weight not to exceed 1000 mg.

Lignocaine (lidocaine, xylocaine, octocaine, dentocaine)

It is the most commonly used local anesthetic agent in dentistry.

Pharmacology. Diffusion: it rapidly diffuses through interstitial tissues, into lipid rich nerve, giving a rapid onset of anesthesia. Dissociation constant (pKa) = 7.85. It favours deprotonisation and produces more available unionised free base for action on the nerve membrane and for production of conduction block.

Biotransformation. Lidocaine undergoes biotransformation in liver.

Metabolism: it is metabolised in liver by microsomal fixed-function oxidases. Lidocaine and other amide-type local anesthetic agents are not affected by enzyme plasma cholinesterase. Hence, these are the agents of choice in patients with abnormal or insufficient amounts of this enzyme. Use of ester-type of local anesthetic agents should be avoided or greatly reduced in these patients. Since mechanism for their degradation is deficient, excessive amounts could accumulate in blood stream leading to toxic manifestations.

Excretion: lidocaine and its breakdown products are excreted to some extent in urine, by kidney; < 10% unchanged, > 80% by various other mechanisms.

Potency: 2 times as potent as procaine. Today, it is taken as the standard for comparison of various other local anesthetic agents.

Toxicity: 2 times as toxic as procaine. Action on blood vessels: The action on blood vessels is less than that of procaine but more than those of mepivacaine and prilocaine.

Time of onset of action: rapid (2-3 minutes).

Duration of action is depends upon: type of injection (Nerve block has longer duration than infiltration), amount of vasoconstrictor used in the solution.

Effective dental concentration: 2%

Anesthetic half-life: 1,6 hours.

Topical anesthetic action: it has topical anesthetic effect. It forms an excellent surface anesthetic. It is used in the following forms topically:

- 2% in the form of jelly
- 5% in the form of ointment
- 10% and 15% in the form of spray (aerosol).

Local Anesthetic Agents

Maximum Recommended Dose (MRD). Lidocaine is the most commonly used local anesthetic agent, hence it is necessary to consider the instructions of the manufacturers and the recommendations of American Dental Association are worth following.

Instructions of the Manufacturer. To understand the concept of Maximum Recommended Doses, we need to understand the concentration of local anesthetic agents. Consider the example of lignocaine which is the most commonly used local anesthetic agent. It is used in the concentration of 2%. It simply means 2 g of solute is contained in 100 ml of solution, which means 2000 mg of the solute are present in 100 ml of solution. Hence, it means 20 mg of the solute is contained in 1 ml of solution. In other words 1 ml of 2% lignocaine solution contains 20 mg of the local anesthetic agent (lignocaine).

The instructions for the local anesthetic agents with or without a vasoconstrictor, are as follows:

1. Local anesthetic agents with a vasoconstrictor:
− As per the manufacturer, the recommended dose of lidocaine with a vasoconstrictor, such as epinephrine, is 7,0 mg/kg BW, but not to exceed 500 mg.
− A 2% lidocaine solution contains 2 g/100 ml or 2000 mg/100 ml or 20 mg/ml of local anesthetic solution.

2. Local anesthetic agents without a vasoconstrictor: Similarly, as per the manufacturer, the recommended dose of lidocaine, without a vasoconstrictor is 4.4 mg/kg BW, but not to exceed 300 mg. A lesser dose is recommended because of faster absorption of the local anesthetic agent. This dose will be contained in 15 ml or 7½ cartridges of the local anesthetic solution.

Recommendations of the American Dental Association (ADA). However, the dosage regimen as suggested by the Council on Dental Therapeutics of the American Dental Association and the USP Convention, the Maximum Recommended dose for lidocaine with or without a vasoconstrictor is 4.4 mg/kg body weight.

The Maximum Recommended Doses are mentioned here as shown in Table 7,1, for individuals with their body weights ranging from 10 to 70 kg.

The dental cartridges contain 2 ml of local anesthetic solution, 1,8 ml in USA and France and 2,2 ml in UK and Australia. Other local anesthetic agents used in dentistry are in various concentrations.

Mepivacaine hydrochloride stabilizes the neuronal membrane and prevents the initiation and transmission of nerve impulses, thereby effecting local anesthesia.

Mepivacaine hydrochloride is rapidly metabolized, with only a small percentage of the anesthetic (5 to 10 percent) being excreted unchanged in the urine. Mepivacaine because of its amide structure, is not detoxified by the circulating plasma esterases. The liver is the principal site of metabolism, with over 50 percent of the administered dose being excreted into the bile as metabolites. Most of the metabolized Mepivacaine is probably resorbed in the intestine and then excreted into the urine since only a small percentage is found in the feces. The principal route of excretion is via the kidney. Most of the anesthetic and its metabolites are eliminated within 30 hours. It has been shown that hydroxylation and N-demethylation, which are detoxification reactions, play important roles in the metabolism of the anesthetic. Three metabolites of Mepivacaine have been identified from adult humans: two phenols, which are excreted almost exclusively as their glucuronide conjugates and the N-demethylated compound (2´,6´- pipecoloxylidide).

The onset of action is rapid (30 to 120 seconds in the upper jaw; 1 to 4 minutes in the lower jaw) and Mepivacaine hydrochloride 3% injection without vasoconstrictor will ordinarily provide operating anesthesia of 20 minutes in the upper jaw and 40 minutes in the lower jaw. Mepivacaine hydrochloride does not ordinarily produce irritation or tissue damage.

Articaine (Ultracaine and Septocaine). It was prepared by H. Rusching et al. in 1969. In USA, it is used in the formulation of 4% articaine HCl with 1:100 000 epinephrine bitartarate in 1,7 ml glass cartridges. In Canada, it is marketed under the brand names of Ultracaine and Septanest; and in USA as Septocaine. US FDA has approved its use in USA, in the year, 2000.

Chemical structure. It is classified as an amide. It is the only amide type of local anesthetic agent containing a thiophene (sulphur-containing) ring. In addition it also contains an ester group.

Onset and duration of action. The time of onset, duration of action and depth of anesthesia is similar to 2% lidocaine with 1:100,000 epinephrine. A 4% articaine solution with epinephrine is reported to have an onset of 1,5-3,0 minutes for maxillary infiltrations and slightly longer for inferior alveolar nerve blocks. While the duration of soft tissue anesthesia ranges from 2-3 hours for maxillary infiltration anesthesia and 3-4 hours for mandibular block anesthesia.

Effective dental concentration: 4% with 1:100 000 or 1:200 000 Epinephrine.

Indications. It is indicated in cases of extended minor oral surgical procedures, or for long appointments for cosmetic dentistry, full mouth restoration, full mouth periodontal surgery, or multiple implant placements.

Adverse effects. Articaine does not have a greater allergenecity than other available local anesthetic agents, probably because the ester metabolite is not the allergen PABA. Reports of toxic reactions following the use of articaine for dental anesthesia are extremely rare. The rapid inactivation of articaine by plasma esterases may explain the apparent lack of overdose reactions reported following its administration, even though, it is marketed as a 4% solution. Articaine and prilocaine have been associated with a slightly higher incidence of mandibular and lingual paresthesia.

Vasoconstrictors

Most LAs (except cocaine) cause blood vessel dilatation and, therefore, a vasoconstrictor is added to diminish local blood flow and slow absorption of the LA. In practice, LAs still enter the systemic circulation quite rapidly but vasoconstrictors are useful to accelerate the onset, lengthen the duration and increase the depth of anaesthesia. They also reduce the local haemorrhage, which can be very helpful during surgical procedures. However, vasoconstrictors should never be used for infiltration of the ears, fingers, toes or penis as ischaemic necrosis may result. The concentration used is higher in dentistry than in medicine, particularly in the UK.

It is used along with a local anesthetic agent, as a vasoconstrictor: for achieving hemostasis, to decrease the absorption of local anesthetic agent into cardiovascular system and to prolong duration of action.

The selection of an appropriate vasoconstrictor is based on following factors:
1. Length of the surgical or dental procedure
2. Requirement for hemostasis during the surgical procedure
3. Requirement for postoperative pain control
4. Medical or physical status of the patient and concurrent medications taken

Adrenaline (epinephrine).
- Natural catecholamine.
- Constricts arterioles in skin and mucosa.
- Increases cardiac output by raising stroke volume and heart rate, but this effect is difficult to accomplish with the doses in dental cartridges.

Epinephrine is available in the following dilutions: 1:50,000, 1:100,000 and 1:200,000 for use in dentistry.

Felypressin (octapressin).
- Synthetic analogue of naturally occurring vasopressin.
- Constricts venous outflow and, therefore, is less effective in haemorrhage control than adrenaline (epinephrine).
- Contraindicated in pregnancy as it is similar to oxytocin and there is a possibility of uterus contraction, although the dose is actually very small compared with the dose of oxytocin used by obstetricians to induce labour.

Prilocaine with felypressin is often recommended for use in patients with ischaemic heart disease rather than lidocaine with adrenaline (epinephrine), but there is no evidence that it is any safer.

The maximum doses of felypressin as recommended by New York Heart ssociation and as suggested by Bennette (1983) and Malamed (1997) are as follows:

A. Normal healthy adult patients (0,2 mg per appointment):
10 ml of a 1: 50,000 dilution (5 cartridges)
16 ml of a 1: 80,000 dilution (8 cartridges)
20 ml of a 1: 100,000 dilution (10 cartridges)
40 ml of a 1: 200,000 dilution (20 cartridges)

B. Patients with clinically significant cardiovascular disease (0,04 mg per appointment) (approximately 1/5th of the dose for normal patients):
2 ml of a 1: 50,000 dilution (1 cartridge)
3.2 ml of a 1: 80,000 dilution (1,6 cartridges)
4 ml of a 1: 100,000 dilution (2 cartridges)
8 ml of a 1: 200,000 dilution (4 cartridges)

The benefits and risks of including a vasoconstrictor in a local anesthetic solution in patients who are medically compromised, must be weighed against benefits and risks of using plain local anesthetic solution.

Contraindications. In cases of significant cardiac and non-cardiac diseases, it is essential to:
1. Determine the degree of severity of underlying medical problems.
2. Determine whether or not vasoconstrictor can be safely included or exclude from the local anesthetic solution.

3.   Obtain a medical consultation and the necessary information from the treating physician regarding the existing medical problem.

Once the medical status of the patient is improved or corrected, dental or surgical procedures requiring administration of local anesthetic agents with vasoconstrictors are indicated.

The groups where inclusion of vasoconstrictor is contraindicated are given below:

1. Patients with significant cardiovascular disease such as ischemic heart disease, hypertension and cerebral strokes.
2. Patients with certain uncontrolled non-cardiovascular diseases, such as: thyrotoxicosis or hyperthyroid states and diabetes mellitus.
3. Patients receiving non-specific beta-blockers, monoamine-oxidase inhibitors (MAOIs), tricyclic antidepressants (TCAs) and phenothiazines.
4. Patients with sulfite sensitivity.
5. Patients who are undergoing general anesthesia with halogenated agents.
6. Pregnancy.

Epinephrine and other vasoconstrictors can be used in moderate amounts in patients with mild to moderate cardiovascular disease. Felypressin has minimal cardiothoracic stimulatory actions and is nondysrhythmogenic; it is recommended for patients with significant cardiovascular disease.

Patients with severe cardiovascular diseases are at too great a risk for elective dental therapy, such as:

1. Ischemic heart disease
–   Patients with history of acute myocardial infarction within last six months.
–   Patients with history of acute anginal episodes on daily basis or where signs and symptoms are increasing in severity (angina pectoris) (pre-infarction stage or unstable angina).
–   Patients with cardiac dysrhythmias despite appropriate antiarrhythmic drug therapy.
–   Post-coronary artery bypass surgery, less than six months.
2.   Hypertension: Patients with systolic BP greater than 200 mm of Hg and diastolic BP greater than 110 mm of Hg should not receive any dental care unless BP is corrected.
3.   Cerebral strokes: patients with history of less than six months after cerebrovascular accident.

Local anesthetic cartridges and vials

It contains primarily the local anesthetic drug and also the other ingredients, which are as follows:
1. Local anesthetic drug
2. Vasopressor/vasoconstrictor drug
3. Preservative for vasopressor
4. Sodium chloride (NaCl) or Ringer's solution
5. Distilled water
6. General preservatives.

Local anesthetic drug. It provides pain control during dental therapy. It interrupts propagation of impulse preventing it from reaching brain. Drugs are listed by their percentage (%) concentration. The number of mg of an agent contained in the cartridge can be calculated by multiplying the percentage (%) concentration (e.g. 2% = 20 mg/ml) by 2 (the number of ml in a cartridge). Thus, a cartridge containing 2 ml of 2% local anesthetic solution contains 40 mg of local anesthetic agent.

The local anesthetic solution is quite stable, capable of being autoclaved, heated or boiled without deterioration. However, other contents of cartridge, such as vasopressor and cartridge seal are more labile. These are broken down easily.

Vasopressor/vasoconstrictor drug. It is added in various concentrations, to some dental cartridges to increase safety and prolong duration of action of local anesthetic agents. It also helps in controlling bleeding. The pH of dental cartridge containing local anesthetic agent with a vasoconstrictor is lower (more acidic) than that without a vasoconstrictor (pH of 3.3-4.0 v/s 5.5-6.0). Because of this pH difference plain anesthetics have somewhat more rapid or clinical action and are more comfortable (less burning on injection).

Preservative for vasopressor. Local anesthetic solutions containing vasoconstrictors also contain a specific agent, an antioxidant, that acts as a preservative for vasoconstrictors. The most frequently used antioxidant is sodium-bisulfite or sodium metabisulfite. It prevents biodegradation of vasopressor by O_2 which might be present in the cartridge either introduced during manufacture, or which got diffused through semipermeable membrane or the rubber diaphragm after filling at the time of storage of the cartridge. Sodium-bisulfite reacts with O_2 before O_2 can destroy vasopressor. Sodium-bisulfite is oxidised to sodium-bisulphate, a chemical with even lower pH (acidic), than before oxidation.

Sodium chloride (Nacl) or Ringer's solution. It is added to the contents of dental cartridge to make the solution isotonic with the tissues of the body. Hypertonic solution produces tissue edema, paresthesia, sometime lasting for several months following drug administration.

Distilled water. It is used as a diluent to provide the volume of solution in the dental cartridge.

General preservatives. A number of chemicals are used as general preservatives. These are added to increase the shelf-life and include: Methylparaben, Thymol and Chlorbutol.

Methylparaben: it is a bacteristatic and fungistatic agent. It has been excluded from cartridges in USA, from 1st January 1984, following reports of allergy. However, it is still used in multidose vials in some countries.

Thymol: it is antiseptic, fungistatic and antihelminthic.

TOPIC: INSTRUMENTS FOR LOCAL ANESTHESIA

The essential components of armamentarium for local anesthesia are as follows:
1.   syringe
2.   needle
3.   local anesthetic solution in the form of a cartridge or a multidose vial.

Syringe. It is an instrument or a vehicle whereby the local anesthetic solution is delivered through the needle into the tissues of the patient.
The various types of syringes used in dentistry are as follows.
I. Non-disposable (Reusable) syringes:
1. Breech-loading, cartridge type syringe.
These syringes are available in the following forms:
   − metallic or plastic,
   − aspirating or non-aspirating,
   − self-aspirating types.
2. Side loading, aspirating and non-aspirating syringes.
3. Pressure syringe.
4. Jet injector.
5. Luer-Lock syringes.
II. Disposable or plastic syringes.
III. Safety syringes.
The requirements of an ideal syringe include the following:
1. It should be durable and be able to withstand repeated sterilization without deterioration and it should allow repeated use.
2. The disposable syringe should be easily sterilizable and be packaged.
3. It should accept a wide variety of cartridges and needles of different manufacture.
4. It should not be expensive.
5. It should be light-weight and easy to handle with one hand.
6. The aspirating type should have effective aspiration and should be so designed that the blood may be easily seen in the cartridge.

Breech-loading cartridge type, aspirating syringe. Breech-loading implies that cartridge is inserted into the syringe from one end or from the top of the barrel of the syringe. Aspirating syringe has a device such as a tip or a harpoon, attached to the piston; which penetrates the thick rubber silicone stopper at the other end of the cartridge. When negative pressure is applied to the thumb ring by the operator, blood will enter the lumen of the

needle and is seen in the cartridge; only if the tip of the needle lies within a blood vessel and if the needle gauge is adequate. When a positive pressure is applied to the thumb ring, it forces the local anesthetic solution into the lumen of the needle and in turn, into patient's tissues around the area of the tip of the needle.

Breech-loading cartridge type, plastic aspirating syringe. Recent advances in the field of plastic industry has led to the production of this plastic syringe, which is both autoclavable and chemically sterilizable.

Breech-loading cartridge type, self-aspirating syringe. Aspiration test is advisable, prior to administration of local anesthetic drugs.

These syringes rely on the property of elasticity of rubber diaphragm in the cartridge to obtain the required negative pressure for aspiration. The self-aspirating syringes allow multiple aspirations to be performed easily throughout the period of deposition of local anesthetic solution.

Non-disposable syringe (Metallic and Plastic) (Aspirating)
Advantages:
1.   Aspiration is possible with one hand
2.   Autoclavable
3.   Long-lasting with proper maintenance
4.   Lower cost in the long run.
      Disadvantages:
1.   Metallic syringes are heavier than plastic disposable syringes
2.   Possibility of infection with improper care
3.   Deterioration of plastic with repeated autoclaving.

Pressure syringes. Used for intraligamentary injection and also for pulpal anesthesia of one isolated tooth in mandibular arch.

Principle: liquids forced through very small openings called jets, at very high pressure can penetrate skin or mucous membrane.

Calibration: the syringe is calibrated to deliver 0,05 to 2,0 ml of solution at 2000 psi.

Primary use: topical anesthesia prior to insertion of a needle.

Secondary use: may be used to obtain mucosal anesthesia of the palate.

Regional nerve blocks or paraperiosteal injections are still required for complete anesthesia.

Advantages:
1. Does not require use of a needle. Hence, recommended for needlephobics and especially for young children.
2. Deposits very small volumes of local anesthetic solution with calculated amount of force.
3. Used in topical anesthesia.
4. Complete intraligamentary anesthesia can be achieved for individual tooth.
Disadvantages:
1. Inadequate for pulpal or regional anesthesia.
2. Some patients are disturbed by the «jolt» of jet injection and it upsets them.
3. Expensive.

Disposable/Plastic syringes. Disposable/Plastic syringes are available in variety of sizes and with an assortment of needle gauges. Most often used for IM or IV drug administration, but may also be used for intraoral injections.
Advantages:
1. disposable; meant for single use.
2. sterile until opened.
3. light-weight, better tactile sensation.
4. decreased chances of transmitting infections.
Disadvantages:
1. does not accept prefilled cartridges.
2. difficult aspiration with one hand, requiring two hands
3. increased cost in the long run.

Safety syringes. These syringes minimise risk of accidental needle-stick injuries.
Advantages:
1. disposable; meant for single use.
2. sterile until opened.
3. light-weight, better tactile sensation.
4. decreased chances of transmitting infections.
Disadvantages: more expensive than reusable syringes.

Needles. The needles permit the local anesthetic solution to travel from the dental cartridge into the soft tissues surrounding the tip of the needle. The needles used for regional analgesia in dental surgery, range

from 24, 25, 27 and 30-gauges; and from 25 mm (1") to 38-40 mm (1½ or 15/8") in length.

Needles in dental practice are made up of stainless steel, platinum and iridium-platinum or ruthenium alloys. The stainless steel needle is most commonly used and is highly recommended. Needles currently available are usually pre-sterilized and disposable.

The advantages of this needle are as follows:

−   rigidity: it is rigid and hence can be easily guided into the tissues.
−   sharpness: it maintains the sharpness of the point.
−   cost: it is not expensive and therefore can be discarded after using for each patient.
−   breakage: it rarely occurs, if these are handled properly.
−   availability: it is available in variety of lengths and gauges.
−   sterilization: it withstands boiling and autoclaving without corrosion and becoming weak.

The needles used for administration of local anesthetic solutions have the following components: bevel, shaft or shank, hub, syringe adaptor and cartridge-penetrating end.

Bevel: it defines the point or the tip of the needle. The bevels, as described
by manufacturers are: long, medium and short.

The recommended bevel is 12° and it influences the degree of deflection. The greater the angle of the bevel with the long axis of the needle; the greater will be the deflection as needle is passed through the soft tissues. Bennett advised that the short-beveled needle is superior to the long tapering bevel for regional analgesia, such as block anesthesia as it is less likely to be deflected from its intended path during insertion. Needles with point centered on the long axis, deflect less than beveledpoint needles whose point is eccentric.

Shank/Shaft: the length of shank is measured from the hub to the point of the bevel.

Hub: it is a plastic or metal piece through which the needle is attached to the syringe. The interior surface of plastic syringe adaptor is not prethreaded. Therefore, to attach a plastic hubbed needle to a syringe, the needle must be pushed onto syringe while being screwed on. Metallic-hubbed needles are usually prethreaded.

Syringe adaptor: it is adapted to the needle adaptor end of the syringe.

Cartridge-penetrating end: it is placed into the needle adaptor of syringe and perforates the rubber diaphragm of glass cartridge. Its tip rests within the cartridge.

Dental needles are available in two lengths: short – 25 mm and long – 38-40 mm. Short needles are recommended for paraperiosteal injections in entire maxilla; and anterior mandible. Long needles are preferred for all injection techniques requiring penetration of significant thickness of soft tissues. For example, pterygomandibular block, Vazirani-Akinosi mandibular nerve block, Gow-Gate's mandibular nerve block.

Larger gauge needles have distinct advantages over smaller gauge needles:
1. Less deflection: it occurs as needle passes through tissues. This leads to greater accuracy and higher success rates, especially in those techniques in which there is significant soft tissue depth, as in Pterygomandibular Block, Gow-Gate's Mandibular Nerve Block, Akinosi Mandibular Nerve Block and Infraorbital Nerve Blocks.
2. Needle breakage: it is not common with disposable needles and is less likely to occur with larger gauge needles.
3. Aspiration: it is easier and more reliable through larger lumen.

Local anesthetic solutions are available in the form of multidose vials and cartridges. Local anesthetic solutions are available in multidose vials of 30 ml in different potencies of local anesthetic agents, i.e. 0,5%, 1%, 2%, 3% and 4%, etc.

Dental cartridge. It is a glass tube sealed at one end by a rubber stopper (plunger); while the other end is sealed by an aluminium cap over the rubber diaphragm. The rubber stopper is forced into the tube by the plunger of the cartridge syringe, while the rubber diaphragm is punctured by the cartridge end of the needle. It is available in the form of a presterilised glass cylinder. The capacity of cartridges 2 ml, while that in USA and France is 1,8 ml and that in UK and Australia is 2,2 ml.

The local anesthetic cartridge should be stored as aseptically as possible. These should be stored dry in their original container and covered with a lid all the time; or in another suitable sterile container, that is kept covered all the times, preferably at room temperature and in dark place. Local anesthetic dental cartridges should not be left exposed to direct sunlight, because some contents may undergo accelerated deterioration. Cartridge warmers are not necessary. Local anesthetic agents in dental cartridge, maintained at room temperature do not cause any discomfort on

injection into the tissues, nor do patients complain of solutions being too cold.

Cartridge should not be permitted to soak either in alcohol or other cold-sterilising solutions, because the permeable rubber plunger will allow diffusion of these solutions into dental cartridge. This leads to contamination of the local anesthetic solution resulting in post-injection pain, edema and trismus.

The prefilled dental cartridge consists of four parts:
− cylindrical glasstube,
− rubber stopper (plunger),
− aluminium cap,
− rubber diaphragm.

Cylindrical glass tube. A small bubble of approximately 1-2 mm is frequently seen in the cartridge. It is composed of nitrogen gas, which is bubbled into the local anesthetic solution during its manufacture to prevent oxygen from being trapped in the cartridge and potentially destroying the vasopressor or vasoconstrictor.

Rubber stopper. It is located at the end of cartridge that receives the harpoon of syringe. The harpoon is embedded in plunger by gentle finger pressure on thumb ring of syringe. The rubber plunger occupies little more than 0,2 ml of volume of entire cartridge. In a normal intact dental cartridge, the rubber plunger is slightly indented from lip of the glass cylinder. Cartridges that contain plungers, which are equal with or extruded beyond the glass of the cylinder should not be used.

Aluminium cap. It is located at the opposite end of cartridge from rubber plunger. It fits snugly around the neck of glass cartridge holding thin rubber diaphragm in position. It is silver colored in all cartridges.

Rubber diaphragm. It is a permeable membrane through which the cartridge end of needle penetrates. The permeability of diaphragm allows solution in which dental cartridge is stored to diffuse into cartridge, contaminating the local anesthetic solution.

TOPIC: TYPES OF LOCAL ANESTHESIA

The various types of techniques used for deposition of these agents, in dentistry are as follows:
1. surface or topical anesthesia,
2. infiltration anesthesia,
3. field block,
4. nerve block or conduction anesthesia.

SURFACE OR TOPICAL ANESTHESIA

By this method small terminal nerves in the surface area of the intact mucosa
or the skin up to the depth of about 2 mm are anesthetised by application of a local anesthetic agent directly to the area.

Nerves anesthetised – superficial nerve endings.

Indications:

– prior to the infiltration injection techniques or nerve blocks for making the insertion of the needle painless
– prior to carrying out incision and drainage of abscesses
– prior to removal of sutures.

Forms.

Spray:

1. The active ingradient is a suitable local anesthetic agent, such as 10% or 15% lignocaine hydrochloride in water base. The agent is expelled in small quantities from an aerosol container.

Advantage: rapidity of onset. The onset of time of anesthesia is approximately 1 minute and the duration of anesthesia is approximately 10 minutes.

Disadvantage: when used as a spray, the solution is spread over more extensive area than desired.

Method of application: it is used as a spray on the area in which the needle penetration is proposed to be made; or it can also be sprayed on a small cotton pellet or roll and then placed on the proposed site of injection for about one minute.

II. Ethyl chloride spray: it produces anesthesia by refrigeration. When sprayed onto either mucous membrane or skin, it gets volatilized rapidly and produces rapid anesthesia.

Method of application: The spray is directed over a limited area until "snow" appears.

Care: undue inhalation of vapours by the patient should be avoided.

Use: occasionally used to produce surface anesthesia prior to taking an incision for fluctuating abscesses.

Ointment. It is used for similar purposes as spray. The active ingredient is a suitable local anesthetic agent, such as 5% lignocaine hydrochloride.

Time of onset: 3-4 minutes.

Application: ointments are used for application over tender and inflamed gingivae prior to deep scaling.

Emulsion. The active ingredient is a suitable local anesthetic agent, such as 2% lignocaine hydrochloride.

Indications:

− when full mouth impressions are to be taken in patients who are prone to retching.

− relief of postoperative pain or tenderness following mucogingival surgical procedures such as gingivectomy.

Method of application: one teaspoonful of the emulsion is swished around

in the mouth and oropharynx for 1-2 minutes; and later is spat out immediately prior to taking impressions.

Jet injection. It is a technique by which a small amount of local anesthetic solution is expelled as a jet into submucosa without the use of a hypodermic needle. Specialised syringes are used for this technique. These techniques depend upon discharge of a small quantity of local anesthetic solution from a reservoir. It produces a fine jet of solution which penetrates the mucosa through a small puncture wound and produces surface anesthesia. The hypodermic needle is then inserted painlessly through the same wound. This technique is particularly useful prior to palatal injections.

TOPIC: INFILTRATION ANESTHESIA

There are various types of infiltration anesthesia depending upon the site of deposition of the local anesthetic solution. The solution can be deposited below the mucosa or in the submucosal layers, or in the subcutaneous connective tissue, just above the periosteum, beneath the periosteum, in the periodontal ligament, in the cancellous bone, in the interdental septum or in the pulpal tissues of the tooth. On the basis of deposition, these techniques can be categorised in the following ways:

1. Submucosal or subcutaneous anesthesia
2. Paraperiosteal or supraperiosteal anesthesia
3. Subperiosteal anesthesia
4. Intraligamentary
5. Intrapulpal anesthesia
6. Intraosseous anesthesia
7. Intraseptal anesthesia

Submucosal injection

Technique: the local anesthetic solution is deposited in the immediate submucosal tissue layers. The solution diffuses through the interstitial tissues and reaches the terminal fibers of the nerve in the area of deposition of the local anesthetic solution.

Procedure: the needle is inserted beneath the mucosal layers. Care should be exercised to avoid injecting too superficially. Excessive amounts injected superficially may lead to sloughing of the overlying tissues. Usually 0,25-0,5 ml of the local anesthetic solution is deposited.

Paraperiosteal or supraperiosteal injection

It is commonly called the local infiltration and is the most frequently used local anesthetic technique. The paraperiosteal injection is commonly used injection technique for obtaining anesthesia in the region of all maxillary teeth and mandibular anterior teeth because of thin cortical plates and abundant cancellous bone.

Site of insertion: the needle is inserted through the mucosa and the solution is deposited in close proximity to the periosteum or along the periosteum, in the vicinity of the apex of the tooth to be treated, as close to the bone as possible. This facilitates diffusion through the periosteum and penetration through the haversian canals of the cortical bone. These canals are numerous; near apices of teeth near the surfaces.

Technique: by this method the local anesthetic solution is deposited just above or besides the periosteum. It does not always produce

satisfactory anesthesia due to distension of tissues due to superficial injection. In this method, the local anesthetic solution is not carried quickly from the area of deposition of the local anesthetic solution, through the alveolar bone; so that sufficient amount of local anesthetic solution does not diffuse through cortical layer into cancellous bone, which is necessary to produce satisfactory anesthesia. This is in particular, in cases of extirpation of pulp or preparation of a cavity. In these situations, it is necessary for the alveolar bone to be anesthetised but the local anesthetic solution should diffuse through apical foramen into the pulp chamber.

Advantages: only two punctures are made labially. Similarly, if it is desired to anesthetise all mandibular incisors, only one labial puncture is made. The needle insertion takes place well down the vestibular mucosa of mandibular labial frenum; and is directed towards one canine fossa. About 1 ml of solution is deposited. The needle is then withdrawn to a point permitting its course to be directed to other canine fossa. Deposit 1ml of local anesthetic solution. Massage the solution to enhance absorption through numerous foramina.

Other common names: local infiltration, supraperiosteal injection.

Nerves anesthetised: large terminal branches of superior dental plexus.

Areas anesthetised: the region innervated by the large terminal branches such as the pulps of the maxillary teeth, labial/buccal periodontium, supporting alveolar bone and labial/buccal mucoperiosteum; that includes labial/buccal periosteum, overlying connective tissue and mucous membrane.

Indications. this method is used for procedures in the entire maxilla and anterior mandible. In these areas, the cortical plates are thin and there is abundant cancellous bone. The local nesthetic solution penetrates bone through Haversian canals. These canals are numerous near the apices of teeth near the surfaces.
1.   Pulpal anesthesia when treatment is limited to one or two teeth in maxilla and anterior mandible.
2.   Soft tissue anesthesia for surgical procedures in a circumscribed area.
3.   Children and young adults. In children, this technique can be used in the posterior mandible to anesthetise deciduous molars as the cortical bone is thin in this region.

Contraindications:
1.   Presence of acute inflammation or infection in the area of injection.
2.   Presence of dense bone covering the apices of teeth, as in maxillary first molar, because of overlying buttress of zygoma.

Advantages:
1.   High success rate
2.   Technically easy injection
3.   Usually atraumatic

Disadvantages: the technique is not recommended for large areas because of: need for multiple penetrations, the necessity to administer larger volumes of anesthetic solution and satisfactory anesthesia cannot be always produced.

Technique. A 25 or 27 gauge short needle is recommended.

Point of insertion: it is at the height of mucobuccal fold in the vicinity of the tooth to be anesthetised.

Target area: the apical region or above the apex of the tooth to be anesthetised.

Depth of insertion: few millimeters.

Bevel: the position of the bevel of the needle should be facing the bone.

Landmarks:
−   mucobuccal fold in the region of the tooth to be anesthetised.
−   crown of the tooth.
−   root contour of the tooth.

Position of the patient: the occlusal plane of maxillary teeth should be at an angle of 45° to the floor.

Position of the operator:
−   for maxillary injections, for the right side, the operator stands by the side of the patient; and for the left side, the operator stands in front of the patient.
−   for mandibular injections, the operator stands by the side of the patient for the left side; and in front of the patient for the right side.

Preparation of the tissues at the site of injection with an antiseptic.

Application of topical anesthetic at the site of injection.

Retract the lip/cheek, pulling the tissues taut.

Take a preloaded syringe. Initially, hold it at an angle of 45° to the long axis of the tooth to be anesthetised, with the bevel of the needle facing the bone. Insert the needle at the height of mucobuccal fold, or a few millimeters away from the labial cortex.

Aspirate, if negative, deposit approximately 0,5 ml of the solution slowly over 20 seconds.

Wait for 2-3 minutes, check for the signs and symptoms of anesthesia and start the procedure.

Signs and symptoms:
1. Subjective: feeling of numbness in the area of distribution of the nerve anesthetised.
2. Objective: absence of pain with instrumentation and during the procedure.

Subperiosteal injection

In this method, the local anesthetic solution is injected beneath the periosteum. Subperiosteal injection has superiority over supraperiosteal injection. It confines the solution below periosteum; obviates permeating the pulp. The solution is under pressure enabling it to penetrate the cancellous bone, periodontal membrane and finally diffuses through apical foramen into the pulp.

Technique. Needle: recommended length and gauge are 1" and 25 respectively. The needle is inserted midway between gingival margin and the approximate apex of the tooth; and at right angle to the buccal alveolar plate, in order to penetrate mucous membrane, gingival tissue and periosteum. The needle is then placed at an angle of 45º to the alveolar plate, bevel facing the bone and then it is advanced towards the apex of the tooth, beneath the periosteum. As the needle progresses, about 0,3-0,5 ml of local anesthetic solution is injected slowly. The periosteum will force the solution through the cortical plate and into the cancellous bone.

The same procedure is repeated lingually. The amount of solution deposited is 0,5 ml. The diffusion of solution through the lingual alveolar plate is faster because of presence of numerous foramina. The length of the needle inserted is between 5 and 7 mm.

Periosteum: there is an aspect, associated with the method of subperiosteal injection, which needs discussion. One theory advanced was that a subperiosteal injection may produce persistent or prolonged pain due to "tearing" of the periosteum from bone. Contrary to general belief, the periosteum is not closely attached to bone in the same way a glove covers a hand.

According to Gray, the periosteum in the young bones, is thick and is vascular and is less closely connected with the body of the bone from which it is separated by a layer of soft tissues containing osteoblasts. Later in life, the periosteum becomes thinner and less vascular and the osteoblasts are converted into a layer of epithelial cells. Only at the ends of bones, the periosteum is closely adherent. This is quite well known that there is comparatively more resistance for raising mucoperiosteal flap at gingival margins; and once detached at this point, the separation of the rest of the mucoperiosteum is comparatively easy. On the other hand, the

periosteum and gingival tissues are merged together and cannot be separated from one another.

If deposition of a small amount of the solution tears the periosteum, then lifting of mucoperiosteal flap should be considered to be more injurious. However, it is well known that the procedure of raising a flap causes little pain.

Advantages:
1.   It is more appropriate, more specific and definite in region.
2.   There is no great trauma, contrary to belief.
3.   It is safe and much more effective than supraperiosteal injection.
4.   Less solution is required to produce the desired results. Total amount of solution sufficient to produce satisfactory and profound anesthesia is 0,3-0,5 ml.
5.   The onset of action is rapid. The depth of anesthesia for extraction is achieved immediately, however, for conservative restorative procedures such as preparation of cavities and crowns and extirpation of pulps, it is advisable to wait for five minutes to allow the solution to reach pulp chamber and anesthetise the neural component.
6.   This method greatly reduces the incidence of intravascular administration.
7.   Reduces needle punctures.

Disadvantages: there is theoretical damage to the periosteum. No greater trauma is created by injecting local anesthetic solution beneath the periosteum.

Supplementary injections

Intraligamentary, intrapulpal, intraosseous and intraseptal injection techniques:

These are the other methods of producing anesthesia. These are satisfactory when executed properly. Each has its place of application in dentistry. Sometimes, these will produce anesthesia where all other methods fail. The abovementioned techniques numbered: 4, 5, 6 and 7 are not advised for beginners. These techniques give good results in experienced hands.

Intraligamentary (periodontal or peridental) injection

As the name suggests, the local anesthetic solution is deposited into the periodontal ligament or membrane. This injection technique is claimed to be safe, provided the point of insertion of the needle is thoroughly cleaned and strict aseptic precautions are undertaken. The local anesthetic

solution is carried from the alveolar bone and through the apical foramen into the pulp chamber.

Indications: it is a very efficient method of producing anesthesia especially for cavity preparation, crown preparation, pulp extirpation, etc.

Advantages:

− Rapid onset of action.

− Specific analgesia to isolated teeth. Single mandibular tooth can be anesthetised without performing a pterygomandibular block. This avoids numbness of the lip and tongue. There is less likelihood of inadvertently traumatising these structures in the immediate post-injection phase.

− Useful adjunct to conventional local anesthesia; and in experienced hands for minor surgical procedures.

Disadvantages:

− Post-injection discomfort due to temporary extrusion.

− Apparent increase in the incidence of «dry socket».

Technique. Needle: 25-gauge is recommended. The local anesthetic solution is injected along periodontal membrane of maxillary and mandibular teeth, using small amounts of local anesthetic solution, usually 0,2 ml, delivered via a specifically designed system, which comprises of high pressure syringes and ultrafine needles. The high pressure forces the solution rather than causing diffusion, through the periodontal ligament to the nerves in that area. This technique can also be carried out by the conventional syringes, however, care should be exercised to avoid shattering of the glass cartridges. The needle is inserted into the gingival sulcus and into the periodontal ligament. This technique can anesthetise only single individual tooth. The single rooted tooth should be injected on the mesial and the distal sides; or buccal and lingual sides; while multirooted teeth are injected over each root. The amount of local anesthetic solution injected is 0,1-0,2 ml. Some studies have shown that application of excessive pressure and the injection of excessive amounts can cause avulsion of teeth.

Procedure:

1. Strict aseptic precautions.
2. The needle is inserted on the mesial side of the tooth to be treated, beneath the free margin of gingivae, or into the circular ligaments.
3. A few drops of local anesthetic solution are injected for superficial anesthesia. Solution is deposited in tissues to render further insertion of the needle painless.
4. The needle is then forced into periodontal ligament, directing it parallel to the long axis of the tooth.

5.   Usually 0,2-0,4 ml of anesthetic solution is sufficient to achieve profound anesthesia (1 ml contains 15,419193 drops). Hold the syringe close to needle and reach into the membrane. Needle is held at an angle of 15º to the long axis of the root and inserted until interdental septum is reached at a point midway labiolingually or buccolingually, according to the location of tooth. Using the septum as a guide from this point, deflect the needle towards the desired tooth to be anesthetised, then force the needle into mucous membrane. Solution is deposited with pressure, sufficient to rupture tissue and cause leakage of solution. If anesthesia has not taken place after 2-3 minutes, the flap on the other side of the tooth may be punctured and proceeded as above.

Intrapulpal anesthesia

This technique is indicated for obtaining anesthesia for procedures which require direct instrumentation of the pulpal tissue. First, put a cotton ball soaked in local anesthetic solution in the cavity, wait for a minute; and then a 25 or 27-gauge needle is inserted directly into the pulp chamber. The needle should be held firmly or wedged into the pulp chamber or the root canal. Initially, slight discomfort is felt by the patient which subsequently gets subsided. Sometimes the needle is bent to get a proper angle for good approach.

Intraosseous injection technique

In this method, the local anesthetic solution is deposited directly into the cancellous bone adjacent to the tooth to be anesthetised, between the two cortical plates of bone of maxilla and mandible.

Intraosseous injection is usually an adjunct and is used when conventional methods have been tried and failed. Sometimes, it is impossible to obtain profound anesthesia of teeth and jaws by ordinary methods, not at least of sufficient intensity to allow extirpation of pulp and preparation of cavities, etc.

This may be due to one of the following reasons: abnormal location of foramen and unusual density of external cortical plate. These difficulties are overcome by intraosseous technique.

Advantage: it produces profound single tooth anesthesia.

Disadvantage: specialised equipment and technique is needed.

Technique: the soft tissues overlying the apex of the tooth are first anesthetized with paraperiosteal injections. This injection should be made either mesial or distal to the tooth to be anesthetised and slightly above the roots, in order to avoid injury to the teeth. An incision is made in the mucosa and the periosteum. A small opening or perforation is made in the

outer cortical layer of bone with the help of SS White HP-8 round bur. The drill is similar to 25-gauge needle. The local anesthetic solution is placed through outer cortical plate into cancellous bone with the help of a needle, which is inserted through the perforation made in the bone. That allows the local anesthetic solution to reach the nerve immediately. The needle with a blunt point is used. The needle should not be forced against resistance at any time. The needle used should be of such a gauge (usually 23 or 25-gauge), that it fits snugly into the opening made in the bone to avoid possible leakage around the needle, while the local anesthetic solution is being injected. Here usually enough anesthesia is present to permit drilling through outer cortical plate painlessly. The drilling can be done either on the mesial or the distal side of the tooth to be treated.

Procedure:
1.   Preliminary infiltration: In order to prevent trauma, a preliminary injection of a few drops of infiltration is made at the selected site before making a perforation.
2.   A small incision is made in the mucosa. The mucoperiosteum is elevated and then the buccal alveolar plate is perforated.
3.   The outer cortical plate is perforated at the point with a round bur numbered in a straight handpiece.
4.   The drill is directed almost at an angle of 45° to the long axis of the teeth directing it slightly palatally or lingually. Drill the external plate until it reaches cancellous bone. Stop drilling and withdraw the drill, until a drop of blood oozes out. The drill should not enter more than 2 or 3 mm.
5.   The needle is inserted into the opening created; and approximately 0,5-1 ml of solution is slowly injected under pressure. Anesthesia by intraosseous method will not be of very long duration, possibly between 10 and 20 minutes. If the operation is not completed, inject more solution and anesthesia will be re-established immediately.

Precautions to be taken:
1. Deposition of too much solution rapidly may produce signs and symptoms of toxic reactions, as the solution is rapidly absorbed in the cardiovascular system from cancellous bone.
2. If for any reason, it is necessary to operate on the tooth at a later date, it is easy to find the drill hole and inject a small amount of solution.
3. Never attempt to anesthetise more than one tooth on each side of the drill opening. This requires too much of local anesthetic solution which may produce toxic symptoms. The technique for intraosseous injection is essential in upper jaw, especially in anterior and bicuspid region. The beginners should get acquainted with upper anterior region before attempting lower teeth. To obtain intraosseous anesthesia in the mandible,

make drill opening in the retromolar triangle with a drill in straight handpiece.

Intraseptal anesthesia

It is considered as a variation of intraosseous anesthesia. A needle is forced gently into the porous interseptal bone on either side of the tooth to be anesthetised. The local anesthetic solution is then forced under pressure into the cancellous bone. The solution is taken up by the pericementum and the apical nerves. The superficial mucous membrane should be anesthetised before the needle is inserted into the interseptal bone. This technique is more effective in children and young adults. The interdental septum is of cancellous bone and the solution quickly diffuses through the alveolar bone.

Indication: in older patients, there is a great degree of recession of gingivae, wherein the intraligamentary anesthesia is not quite effective.

Technique 1: the injection is given in the septum of two adjoining teeth, in between the two cortical plates.

Procedure: the syringe with the needle is inserted into the interdental septum, exerting sufficient pressure on the dense outer layer of bone to reach the deeper cancellous structures.

Technique 2: some operators advocate drilling the outer cortical plate similar to that for intraosseous injection. Then the needle is inserted into the opening made and then local anesthetic solution is deposited. The few drops of local anesthetic solution are injected slowly under pressure.

TOPIC: NERVE BLOCKS IN THE MANDIBLE

1. Intraoral
2. Extraoral nerve blocks

Intraoral nerve blocks
Pterygomandibular block

Other common names. Inferior alveolar nerve block, mandibular nerve block.

Nerves anesthetised
- Inferior alveolar nerve, along with its terminal branches such as incisive nerve and mental nerve
- Lingual nerve
- Long buccal nerve.

Areas anesthetised

1. Inferior alveolar nerve
- pulps of all mandibular teeth from the last molar up to the central incisor in the midline
- body of the mandible
- inferior portion of the ramus of the mandible
- buccal mucoperiosteum, in the region of mandibular anteriors, anterior to mandibular second premolar or anterior to the mental foramen
- skin of the chin, skin of lower lip and mucosa of lower lip.

2. Lingual nerve
- mucosa of anterior 2/3rd of the tongue, for both the general sensation as well as the special sensation (gustation; sensation of taste)
- mucosa of floor of the oral cavity
- lingual mucoperiosteum from the last molar tooth up to the central incisor in the midline
- sublingual and submandibular salivary gland.

3. Long buccal nerve
- buccal mucoperiosteum in the region of mandibular molars or buccal mucoperiosteum posterior to mental foramen
- adjacent part of vestibular mucosa
- adjacent part of buccal mucosa
- mucosa of retromolar fossa.

Indications:
1. Surgical procedures in the region of mandibular teeth in one quadrant.
2. When buccal soft tissue anesthesia in the region posterior to mandibular second premolar is required.

3. When lingual soft tissue anesthesia is required.

4. Restorative procedures in mandibular second premolar and molars.

Contraindications:

1. Presence of acute inflammation or infection in the area of injection.

2. Patients who might bite either the lip or the tongue such as young children or mentally handicapped adults.

Anatomical Landmarks

- Mucobuccal fold in the region of premolars and molars
- External oblique ridge
- Anterior border of ramus of the mandible
- Coronoid process
- Coronoid notch
- Retromolar triangle or fossa
- Internal oblique ridge
- Pterygomandibular raphe
- Pterygomandibular space
- Sulcus mandibularis
- Occlusal plane of mandibular molars
- Contralateral premolars
- Buccal pad of fat.

The most important bony landmark in the opinion of the author is the internal oblique ridge. The needle has to be on the medial side of the ridge to approach sulcus mandibularis or the inferior alveolar nerve; and on the lateral side for the long buccal nerve.

Techniques. There are two techniques practised from time immemorial (Halstead).

1. Direct technique: in this technique the inferior alveolar nerve is anesthetised first, hence it is known as «direct technique».

2. Indirect technique: in this technique the inferior alveolar is anesthetized in the third position, hence it is known as «indirect technique» or «threepositional block technique».

It is strongly recommended that the beginners should learn and master the indirect technique first; as it is easier, step by step and the chances of injury to inferior alveolar nerve are minimized. Further, in direct block technique, since the inferior alveolar nerve is anesthetised first, it is experienced that if the point of the needle is very close to or touching the nerve, the patient tends to jump because of shock-like pain and closes his mouth. This creates psychological fear for the later part of the injection technique. However, in case of indirect block technique, having deposited local anesthetic solution, for the long buccal nerve as well as for lingual

nerve, the subsequent penetration of the needle in the third position for inferior alveolar nerve is rendered painless.

Direct technique. The nerves anesthetised are as follows:

1st position: the direction is from the opposite side – for inferior alveolar nerve.

2nd position: the direction is from the same side or opposite side – for lingual nerve.

3rd position: the direction is from the opposite side – to inject between the external and internal oblique ridges-for long buccal nerve with separate injection

Needle: a 25-gauge long needle is recommended.

Target area: the target area is the inferior alveolar nerve as it passes downward through sulcus mandibularis towards the mandibular foramen before it enters the foramen.

Position of the patient: semi-supine with mouth open; and the occlusal plane of the mandibular molars is parallel to the floor.

Position of the operator: for the right inferior alveolar nerve block, the operator stands in front of the patient; and for the left inferior alveolar nerve block, the operator stands slightly behind and by the side of the patient.

Height of injection

−   Place the index finger or thumb of the left hand on the external oblique ridge or the anterior border of the ramus of the mandible.

−   When the finger contacts the anterior border of the ramus, it is moved up and down until the greatest depth of the anterior border of the ramus is identified. This area is called the coronoid notch.

−   An imaginary horizontal line extends from the coronoid notch to the pterygomandibular raphe and determines the height of injection and is parallel to and 6-10 mm above the occlusal plane of mandibular molars.

The palpating finger is then moved lingually across the retromolar triangle and onto the internal oblique ridge.

The finger, still in line with the coronoid notch and in contact with the internal oblique ridge, is moved to the buccal side, taking with it the buccal pad of fat. This gives better exposure to the internal oblique ridge, the pterygomandibular raphe and the pterygotemporal depression.

When palpating the intraoral landmarks with the thumb, the operator may place the index finger extraorally behind the ramus of the mandible, thus holding the mandible between the thumb and the index finger. In this manner the anteroposterior width of the ramus may be assessed.

The depth of the needle penetration can be determined by estimating anteroposterior width of the mandibular ramus when the needle tip has

been advanced half the distance between the palpating thumb and the index finger.

The syringe and the needle is then inserted at the previously described height of insertion from the opposite mandibular premolars, at a level bisecting the finger and penetrating the tissues of the pterygomandibular space. The flaring nature of the ramus of the mandible should be kept in mind.

During insertion, the patient is asked to keep the mouth wide open. The needle is penetrated into the tissues until gently contacting bone on the medial surface of the ramus of the mandible.

The needle is then withdrawn about 1 mm, aspiration done, to avoid intravascular administration of the local anesthetic solution and 0,8-1.0 ml of the solution is deposited slowly.

The needle is then withdrawn slowly and when about one-half of its inserted depth has been withdrawn, 0,5 ml of the solution is injected in this area to anesthetise the lingual nerve.

The long buccal nerve is anesthetised with a separate insertion; and is described in the indirect technique.

Wait for 3-5 minutes and commence with the surgical or the dental procedure.

Signs and Symptoms
1. Tingling and numbness of the lower lip on the side of injection indicates anesthesia of the mental nerve, a terminal branch of inferior alveolar nerve.
2. Tingling or numbness of one-half of the tongue on the side of injection indicates anesthesia of the lingual nerve.
3. Absence of pain during the surgical procedure or the dental therapy.

Failure of Anesthesia
1. Deposition of solution below the level of the mandibular foramen.
2. Deposition of solution too far anteriorly on the ramus.
3. Accessory innervation to the mandibular teeth, such as, cervical accessory nerve (cutaneous coli), buccal nerve and mylohyoid nerve.
4. Anatomical aberration, such as a bifid inferior alveolar nerve, with second mandibular foramen located more inferiorly, on the medial aspect of ramus of the mandible.
5. Cross innervation: incomplete anesthesia of central incisors due to innervation from the contralateral inferior alveolar nerve or mylohoid nerve.

Complications. Hematoma, trismus, transient facial paresis.

Indirect Technique. This technique of anesthetising the branches of mandibular nerve is also known as «three-positional nerve block technique».

1st position: the direction is from the opposite side-to inject between the external and internal oblique ridges-for long buccal nerve.

2nd position: the direction is from the same side-for lingual nerve.

3rd position: the direction is from the opposite side-for inferior alveolar nerve.

1. Place the index finger in the mucobuccal fold in the region of mandibular premolars and molars.

2. Move the index finger posteriorly, until it is deflected upwards by the external oblique ridge and the ascending part of the ramus until the coronoid process is reached.

3. Keeping the ball of index finger in contact with the anterior border of the coronoid process, move the finger downward until the deepest part of the ascending ramus is located. This is known as «coronoid notch».

4. Keep the bulbous portion of the index finger in contact with the external oblique ridge. At the coronoid notch, rotate the finger so that the fingernail is turned towards the sagittal plane.

5. Maintain pressure against the coronoid notch, slide the index finger lingually. First a depression will be felt which is the retromolar triangle; and next another ridge, the internal oblique ridge.

6. Keep the distal phalanx of the index finger in contact with both the external and internal oblique ridges and move the finger lingually for about ½" and then buccally, carrying under the distal phalanx the buccal pad of fat back to the cheek, away from the internal oblique ridge, which is partially covered.

7. When the tip of the finger rests over the internal oblique ridge, ask the patient to open the mouth as wide as possible.

8. Take a preloaded syringe with the local anesthetic solution, mounted with a 15/8 needle, in a pen grasp, with the barrel over the contralateral bicuspid area, insert the needle in the mucous membrane at the center of the index finger nail. Keep the syringe parallel to the occlusal plane of the mandibular teeth or the mandibular ridge. Again, the flaring nature of the ramus of the mandible should be borne in mind.

9. The tissues should be penetrated in such a way that 1/4th or 1/3rd of the needle should remain outside the soft tissues. In majority of patients this will result in the tip of the needle resting directly over the sulcus mandibularis. In patients with exceptionally large or small skeleton, the width of the ramus can be measured by placing the thumb over the coronoid notch on the anterior border of the ramus and the index finger on the posterior border of the ramus outside the mouth.

10. The patient is asked to keep his mouth open wide until injection is completed. The operator must not attempt to contact bone. The operator's left index finger is held in position. Deposit local anesthetic solution slowly and watch the patient for abnormal reaction. At least 2 minutes should be taken to deposit 2 ml of solution for all the three positions (rate of deposition: ideal rate: 1 ml/min. recommended rate: 1,8 ml/min).

11. Withdraw the needle slowly until approximately ¼ of the needle is in the tissues.

12. Deposit 0,5 ml of local anesthetic solution, to anesthetise the lingual nerve. Many times the long buccal nerve is also anesthetised at the same point.

13. Long buccal nerve injection: Hold the syringe with a 25-gauge and 1" needle, ready to inject at an angle of 45° to the body of the mandible keeping the bevel of the needle facing the bone. The tissue in the mucobuccal fold is entered just distal to the most posterior tooth or the area to be subjected to surgery. About 0,25-0,5 ml of local anesthetic solution is deposited. The anesthesia is obtained within 2-3 minutes.

14. Wait for subjective symptoms. These are: a feeling of warmth or tingling sensation in the lip, which starts at the corner of the mouth and spreads until it reaches the midline of the lip. The tingling changes into a gradually increased feeling of profound numbness; the lip may also feel swollen; the tip and side of the tongue tingle and then become numb. For profound anesthesia, the operator must wait for 5 to 10 minutes.

Long buccal nerve block

The long buccal nerve is usually anesthetised as a part of pterygomandibular block in indirect technique.

Other common names. Buccinator nerve block, buccal nerve block.

Nerves anesthetised. Long buccal branch of the mandibular nerve.

Areas anesthetised. Mucoperiosteum buccal to the mandibular molar teeth, vestibular mucosa, adjacent part of buccal mucosa and mucosa of the retromolar fossa.

Indications. When anesthesia of buccal soft tissues in the mandibular molar region is required for oral or periodontal surgical procedures.

Contraindications. Presence of acute inflammation or infection in the area of injection.

Advantage: high success rate. Technically easy

Disadvantag. It has a potential for pain if the needle contacts periosteum during injection.

Anatomical landmarks:
- Ascending ramus of the mandible
- External oblique ridge
- Retromolar triangle
- Internal oblique ridge
- Last molar tooth.

Technique

Area of insertion: it is the area of mucous membrane distal and buccal to the most distal tooth or the last molar tooth.

Target area: the long buccal nerve as it crosses the anterior border of the ramus.

Needle: a 1 inch 25-gauge needle is inserted into the mucosa just distal and buccal to the last molar tooth between the external and internal oblique ridges and 0,25 to 0,5 ml of solution is deposited in this area.

Alternative Techniques

1. Insert the needle and deposit the solution directly into the retromolar triangle.

2. Insert the needle in the mucoperiosteum just buccal to the last molar tooth.

Signs and symptoms. The patient rarely experiences any subjective symptoms. Lack of demonstration of pain with instrumentation in the anesthetised area.

Complication. Hematoma.

Mental nerve block and incisive nerve block

Nerve anesthetised. The terminal branches of inferior alveolar nerve: Mental nerve and Incisive nerve.

Areas anesthetised

1. Labial mucous membrane anterior to the mental foramen, usually from the first premolar up to the midline.

2. Skin of the lower lip and chin.

3. Pulpal nerve fibers of the first premolars, canines and incisors.

4. Periodontium and the supporting alveolar bone of these teeth.

Indications

1. Dental restorative procedures requiring pulpal anesthesia of multiple mandibular anterior teeth.

2. When inferior alveolar nerve block is not indicated, e.g. when six or eight anterior teeth are treated, the incisive nerve block is recommended in place of bilateral inferior alveolar nerve blocks.

3. When buccal soft tissue anesthesia is required for procedures in the mandible anterior to the mental foramen, such as: soft tissue biopsies and suturing of soft tissues.

Contraindications. Presence of acute inflammation or infection in the area of injection.

Advantages
1.   High success rate.
2.   Technically easy.
3.   Usually entirely atraumatic.
4.   Produces pulpal anesthesia, as well as soft and hard tissue anesthesia without lingual anesthesia. It is useful instead of bilateral inferior alveolar nerve blocks.

Disadvantages
1. It does not produce lingual anesthesia
2. Partial anesthesia may develop at the midline because of the overlap of the nerve fibers from those of the opposite side.

Anatomical landmarks
Mandibular bicuspids; since the mental foramen usually lies below the apex of the second bicuspid or below and between the apices of first and second bicuspids.

Technique
The positions of the apices of the bicuspid teeth should be estimated.
A 1 inch, 25, gauge needle is inserted into the mucobuccal fold after the cheek has been pulled laterally.
The tissue is penetrated until the periosteum of the mandible is gently contacted slightly anterior to the apex of the second bicuspid.
About 0,5 to 1,0 ml of local anesthetic solution is deposited in the area.

Signs and symptoms. Tingling or numbness of the lower lip. Lack of pain during the surgical or dental restorative procedure.

Failure of anesthesia
1. Inadequate volume of anesthetic solution in the mental foramen, with subsequent lack of pulpal anesthesia.
2. Inadequate diffusion of the solution into the mental foramen. To correct this, apply firm pressure over the injection site for 2 minutes, in order to force anesthetic solution into the mental foramen.

Complications. Complications are rare, with rare occurrence of hematoma.

Gow-Gates' mandibular nerve block
Nerves anesthetised. The entire mandibular branch of trigeminal nerve is anesthetised, which includes the following: inferior alveolar nerve

along with its terminal branches; mental and incisive nerves, lingual, mylohyoid, auriculotemporal and long buccal nerves.

Areas anesthetised
1. All mandibular teeth up to the midline on the side of injection
2. Buccal mucoperiosteum on the side of injection
3. Mucosa of the anterior 2/3rds of the tongue and floor of the mouth
4. Lingual mucoperiosteum from the last standing molar tooth up to the central incisor in the midline
5. Body of the mandible and inferior portion of the ramus, etc.
6. Skin over the zygoma, posterior portion of the cheek and temporal regions, etc.

Indications
1. Surgical procedures on mandibular body and the ramus.
2. When buccal soft tissue anesthesia from the third molar up to the midline is required.
3. Surgical procedures in the tongue and the floor of the mouth.
4. When conventional inferior alveolar nerve blocks are unsuccessful.
5. Restorative procedures on multiple teeth.

Contraindications
1. Presence of infection or acute inflammation in the area of injection.
2. Patients who might bite either their lip or the tongue, such as young children and mentally challenged adults.

Anatomical landmarks
Extraoral landmarks: external ear, intertragic notch of the ear, corner of the mouth.

Intraoral landmarks: ANTERIOR border of the ramus of the mandible, tendon of temporalis muscle, mesiopalatal cusp of maxillary second molar.

Technique
Target area*:* LATERAL side of the condylar neck, just below the insertion of the lateral pterygoid muscle.

Procedure
Position of the patient: the patient is placed in semi-supine position.
Position of the operator: the operator stands in front of the patient for right-sided block; and by the side of the patient for left-sided block.

Identification of the landmarks:
The operator visualises the landmarks and an imaginary line is drawn from the corner of the mouth to the intertragic notch of the ear.

The anterior border of the ramus and the coronoid process is palpated with the help of the thumb of the left hand. This helps in retraction of tissues and determination of the site of nerve penetration.

Configuration of the needle: the recommended gauge and length of the needle are 25 and 40 mm respectively.

The patient is advised to keep mouth widely open and to remain in that position until the injection is completed. This position moves the condyle anteriorly, thus facilitating the injection.

The operator takes a preloaded syringe and aligns the barrel of the syringe with the plane extending from the corner of the mouth to the intertragic notch directing the syringe from the corner of the mouth on the opposite side.

The needle is gently inserted into the mucous membrane just distal to the last maxillary molar tooth present, at the height of the mesiopalatal cusp of maxillary second molar. When the third molar is present, the site of penetration is distal to the third molar lateral to pterygotemporal depression and medial to the tendon of temporalis muscle.

Site and height of penetration: depth of penetration: the needle is advanced slowly until bone is contacted at the neck of the condyle. The average depth of soft tissue penetration is 25 mm.

If bone contact is not established, the needle should be withdrawn slightly and redirected until the bone contact is made.

If aspiration is negative, then 3 ml of local anesthetic solution is deposited slowly over 60-90 seconds.

Withdraw the syringe and keep the needle covered.

Ask the patient to keep the mouth open for 2-3 minutes to allow adequate diffusion of local anesthetic solution and bathing of the nerve trunk with the solution.

The onset of anesthesia with this technique is somewhat slower, requiring 5-7 minutes.

Signs and symptoms
1.   Numbness or tingling sensation of the lower lip
2.   Numbness or tingling sensation of the tongue
3.   No pain felt during surgical procedure.

Complications
1.   Hematoma
2.   Trismus
3.   Temporary paralysis of cranial nerves II, IV and VI.

Failure of anesthesia:
1.   Too little volume of local anesthetic solution is deposited.
2.   Anatomical difficulties.

Akinosi (closed mouth) mandibular nerve block

It was described by Joseph Akinosi in 1977.

Nerves anesthetised

The entire mandibular branch of trigeminal nerve, comprising of inferior alveolar nerve along with its terminal branches; mental and incisive nerves, lingual and mylohyoid nerves are anesthetised, except the long buccal nerve.

Areas anesthetised

1.	All mandibular teeth on the side of injection up to the midline.
2.	Body of the mandible and inferior portion of the ramus.
3.	Buccal mucoperiosteum and mucous membrane in front of the mental foramen.
4.	Mucous membrane of the anterior 2/3rd of the tongue and floor of the oral cavity.
5.	Lingual soft tissues and periosteum.

Indications

1. Limited mandibular opening.
2. Multiple procedures on mandibular teeth.
3. Inability to visualise the landmarks for inferior alveolar nerve block.

Contraindications

1. Presence of acute inflammation or infection in the area of injection.
2. Patients who might bite their lip or tongue, such as young children and mentally challenged adults.
3. Inability to visualize or gain access to the lingual aspect of the ramus.

Advantages

1. Relatively atraumatic.
2. Patient need not be able to open his mouth.
3. Fewer postoperative complications (i.e. trismus).
4. Lower aspiration rate than with inferior alveolar nerve block.
5. Provides successful anesthesia where a bifid inferior alveolar nerve and bifid mandibular canals are present.

Disadvantages

1. Difficult to visualise the path of the needle and the depth of insertion.
2. No bony contact, so the depth of penetration is somewhat arbitrary.
3. Potentially painful if the needle is too close to periosteum.

Anatomical Landmarks

1. Occlusal plane of teeth in occlusion.
2. Mucogingival junction of maxillary molar teeth.
3. Anterior border of ramus of the mandible.
4. Maxillary tuberosity.

Technique

Needle: the recommended length is 1½" or 38-40 mm and the gauge is 25.

Bevel: the position of the bevel of the needle in the closed mouth mandibular block is very significant. It must be facing away from the bone of mandibular ramus and towards the midline.

Height of injection: with Akinosi's technique it is below that of Gow-Gates' technique but above that of inferior alveolar nerve block.

Target area: the soft tissues on the medial border of ramus of the mandible in the region of inferior alveolar nerve as it travels towards the mandibular foramen, lingual nerve and mylohyoid nerves and vessels.

Procedure

Position of the patient: the patient is seated in semireclining position with head, neck and shoulder adequately supported.

Position of the operator: the operator stands in front of the patient for both right-sided as well as left-sided block.

Preparation of the tissues: the site of penetration is prepared by topical application of antiseptic and anesthetic solutions.

The patient is asked to bring teeth in occlusion. This aids in relaxation of cheek musculature and helps in good visualization of the landmarks.

The operator retracts the patient's lips and cheek exposing the maxillary and the mandibular teeth on the ipsilateral side.

The preloaded syringe with the recommended needle is taken and the barrel of the syringe is aligned parallel to the occlusal and sagittal plane but positioned at the level of the mucogingival junction of the maxillary molars.

The needle penetrates the mucosa in the embrasure just medial to the ramus lateral to maxillary tuberosity and is inserted approximately 1½ or 25-30 mm. The tip of the needle lies in the target area in the midportion of pterygomandibular space, close to the branches of mandibular nerve.

Following negative aspiration, about 2 ml of local anesthetic solution is slowly deposited approximately 1 minute.

Motor nerves paralysis will develop as quickly or more quickly than sensory anesthesia. The patient with trismus will begin to notice increased ability to open the jaws shortly after the deposition of local anesthetic solution.

Anesthesia of the lips and tongue will be noticed in 40-90 seconds and the surgical procedures can be usually started within 5 minutes

Signs and symptoms. Same as of Gow-Gates technique

Failure of anesthesia

1. Failure to appreciate the flaring nature of the ramus which deflects the needle more medially if, internal oblique ridge is not negotiated by keeping the syringe nearly at an angle of 90º (perpendicular) to the medial surface of ascending ramus. This can be easily achieved by retracting the angle of the mouth posteriorly with the barrel of the syringe.

2. Point of needle insertion is too low.

3. Underinsertion or overinsertion of the needle as no bone is contacted in this technique, the depth of soft tissue penetration is somewhat arbitrary. Akinosi recommended a penetration depth of 25 mm in the average sized adult measuring from the maxillary tuberosity.

Complications

1.   Hematoma, rarely.

2.   Trismus, rarely.

3.   Transient facial nerve paresis due to overinsertion of the needle and deposition of the solution into the body of the parotid gland, near the posterior border of the ramus of the mandible.

Extraoral techniques
Anesthetic technique for mandibular nerve

Nerves anesthetised. Mandibular nerve and its subdivisions; composed of branches from the anterior trunk and branches from the posterior trunk.

Areas anesthetised. The entire region innervated by mandibular nerve and its subdivisions. Temporal region, auricle of the ear, external auditory meatus, temporomandibular joint, salivary glands, anterior 2/3rd of the tongue, floor of the mouth, mandibular teeth, gingivae, buccal mucosa, lower portion of the face (except the angle of the jaw).

Indications

1. Presence of acute inflammation or infection at the site of injection for the subdivisions of mandibular nerve.

2. Presence of trauma that would contraindicate or make it difficult or impossible to anesthetise the subdivisions of mandibular nerve.

3. Whenever there is need to anesthetise the entire mandibular nerve and its subdivisions, with one single penetration and minimum of local anesthetic solution for extensive surgical procedures.

4. For diagnostic and therapeutic purposes.

Anatomical Landmarks

These are common to those for extraoral maxillary nerve block; and are as follows:

−   Midpoint of zygomatic arch.

–   Coronoid process of the ramus of the mandible; and prominence of the lateral pole of the condyle; which is located by having the patient open and close his mouth.

–   Lateral pterygoid plate.

Technique

The technique for mandibular nerve block is essentially the same as that for maxillary nerve block. The difference is that the marker is placed on the needle at a distance of 5 cm.

The needle contacts the lateral pterygoid plate, then it is withdrawn exactly in the same way as in the maxillary nerve block; however, when it is reinserted, the needle is directed upward and slightly posteriorly; in order for the needle to pass posterior to lateral pterygoid plate. The needle should not be introduced to a depth greater than measured 5 cm.

Structures. The structures through which the needle passes and the structures adjacent to the needle when it is in contact with the lateral pterygoid plate are:

a. Structures through which the needle passes: skin, subcutaneous tissue, masseter muscle, sigmoid notch, lateral pterygoid muscle.

b. Structures in the vicinity of the needle when the needle is in contact with lateral pterygoid plate.

Superiorly: base of the skull.

Internal maxillary artery; as it crosses inferiorly and curves upwards anterior to it, entering the lower part of pterygomaxillary fissure.

Temporal vessels for internal maxillary artery that may lie on either side of it.

Superficially: the transverse facial artery which may lie above or below it.

Posteriorly: foramen ovale and posterior to it foramen spinosum.

Anteriorly: pterygomaxillary fissure through which the needle may pass into pterygopalatine fossa.

Signs and Symptoms

Subjective: tingling sensation and numbness of lower lip and anterior 2/3rd of the tongue.

Objective:

–   Demonstration of difference in feeling of lower teeth while opening and closing the jaws.

–   Lack of demonstration of pain with instrumentation.

–   Absence of pain during surgical procedure.

Complications. 1. Failure of anesthesia. 2. Trismus.

TOPIC: NERVE BLOCK ANESTHESIA IN THE MAXILLA

1. Intraoral nerve blocks:
   – infraorbital nerve block,
   – posterior superior alveolar nerve block,
   – nasopalatine nerve block,
   – greater palatine nerve block,
   – maxillary nerve block.
2. Extraoral blocks.

Intraoral nerve blocks
Infraorbital nerve block

There are two approaches to execute the infraorbital nerve block; the bicuspid and the central incisior. The nerves and the areas anesthetised, indications, contraindications and advantages are same for both the approaches. A good knowledge of anatomical landmarks and adherence to injection protocol are essential for this procedure.

Other names. Anterior superior alveolar nerve block.

Nerves anesthetized

1. Anterior superior alveolar nerve.
2. Middle superior alveolar nerve.
3. Infraorbital nerve-along with its terminal branches on the face: Inferior palpebral, lateral nasal and superior labial nerves.

Areas anesthetized

The following structures, on the side of injection, are anesthetized:
1. Pulps of maxillary central and lateral incisors and canine.
2. Pulps of maxillary premolars and mesiobuccal root of first molar.
3. Supporting alveolar bone and the labial or buccal periodontium of these teeth.
4. Overlying labial or buccal mucoperiosteum in the region of incisors, canine and premolars.
5. Skin of lower eyelid and both surfaces of conjunctiva, skin of lateral aspect of the nose and skin and mucosa of upper lip.

Indications

1. Oral and periodontal surgical procedures in the soft and hard tissues involving more than two maxillary teeth, such as apicoectomies, alveolectomies of maxillary anterior regions, impacted canines and cysts.
2. Restorative and endodontic procedures involving more than two maxillary teeth.
3. Presence of acute inflammation or infection at the site of injection.

4. Presence of dense cortical bone that makes any infiltration technique ineffective.

Contraindications

1. Discrete treatment areas (one or two teeth only).
2. When hemostasis in the area of surgery is desirable. In such situations, an additional local infiltration into the area is indicated.

Advantages

1. The techniques are comparatively simple, easy and safe.
2. The techniques minimize the volume of solution to be injected and the number of needle punctures to be made in order to achieve the desired anesthesia.
3. The incisor approach lessens possibility of inadvertently entering the orbit.
4. It permits deeper penetration into the infraorbital canal, since the direction of the needle is parallel to the direction of the canal.

Disadvantages

Bicuspid approach:

1. Psychological: fear of injury to the patient's eye
2. Anatomical: difficulty in defining landmarks.

Incisor approach:

1. There are higher chances of injuring the infraorbital neurovascular bundle with deeper penetration into the infraorbital canal.

Anatomical Landmarks

Bicuspid approach: all the following structures on the ipsilateral side, such as (1) infraorbital margin, (2) infraorbital depression, (3) infraorbital foramen, (4) first bicuspid, (5) mucobuccal fold in the region of this tooth, (6) pupil of the ipsilateral eye in the forward gaze, (7) angle of the mouth and (7) mental foramen.

Incisor approach: other additional landmarks: (1) central incisor and canine on the ipsilateral side and (2) mucobuccal fold in the region of canine.

Approximating structures with the tip of the needle in the final position

The structures in the vicinity of the tip of the needle in the final position when the infraorbital nerve comes out of infraorbital foramen are: (i) the infraorbital head of quadratus labii superioris muscle is above and (ii) the origin of levator anguli oris (caninus) muscle is below.

Approaches

Bicuspid approach: THIS technique is comparatively easy and is recommended for the beginners. The bicuspid approach is simple and causes minimal complications. The needle passes through the mucosa and

areolar tissue and during insertion should pass beneath and lateral to the facial artery and facial vein.

Technique:

Position of the patient: the patient is placed comfortably in the chair so that the maxillary occlusal plane is at an angle of 45° to the floor.

Position of the operator: the operator stands on the right side of patient for right-sided block; and stands in front of the patient for the leftsided block.

Preparation of the tissues: the tissues at the site of injection are prepared with an antiseptic.

Needle: long and 25-gauge needle is recommended.

Bevel: the bevel is positioned in such a way that it is facing the bone.

Depth of penetration: 3/4th of an inch of the needle penetrates the soft tissues.

Area of insertion: At the height of mucobuccal fold, or 4-5 mm away from the buccal cortex of maxilla in the region of first bicuspid.

Target area: infraorbital nerve as it comes out of infraorbital foramen.

Procedure

Palpation of the anatomical landmarks: locate the infraorbital margin.

Move your finger downward from the margin, applying gentle pressure to the tissues. As the finger continues inferiorly, a concavity will be felt. This is the infraorbital depression. The deepest part of the depression is the infraorbital foramen.

Maintain your finger on the foramen or mark the skin at the site.

Retract the lip, pulling the tissues in the mucobuccal fold taut, thus increasing the visibility.

Take a preloaded syringe and insert the needle into the height of the mucobuccal fold over the first bicuspid with the bevel facing the bone.

Orient the syringe towards the infraorbital foramen.

The needle should be held parallel to the long axis of the tooth as it is advanced to avoid premature contact with the bone, initially.

Advance the needle until bone is gently contacted.

Care should be taken to protect the eye with thumb/finger to limit the passage of the needle towards the eye.

Central incisor approach: The needle passes through mucosa and areolar tissue and beneath the levator labii superioris (angular head of the quadratus labii superioris) muscle. It then passes anterior to the origin of levator anguli oris (caninus) muscle and beneath the facial artery and facial vein.

Technique. There are certain steps which are common to both the approaches, such as position of the patient, position of the operator,

preparation of the tissues, configuration of the needle and palpation of the anatomical landmarks; and are mentioned with the bicuspid approach.

Area of insertion: In the central incisor approach, the direction of the needle is such that it bisects the crown of the ipsilateral central incisor from the mesioincisal angle to the distogingival angle. The area of insertion is at the height of mucobuccal fold, or 4-5 mm away from the labial cortex of maxilla in the region of ipsilateral canine. The needle is inserted about 5 mm from the mucobuccal fold in the region of ipsilateral canine.

Target area: Infraorbital nerve, as it comes out of infraorbital foramen, between levator labii superioris muscle above and levator anguli oris muscle below.

Procedure:

Palpation of the anatomical landmarks: this is done in the same way as for the bicuspid approach.

The needle is guided into the position by the thumb pressing over the infraorbital depression and marking the location of the infraorbital foramen).

In either approach, the needle should not penetrate more than 3/4th of an inch. Approximately, 1 ml of solution is slowly deposited in this area and the thumb is held in position until the injection is completed.

The surgeon will be able to feel the anesthetic solution, as it is deposited beneath the finger on the foramen, if the needle tip is in the correct position.

Maintain firm pressure with the finger over the injection site both during and for at least one minute after the injection.

Massage the tissue postero-superiorly so that the solution can easily diffuse through into the infraorbital foramen.

Wait for 3-5 minutes after completion of the injection before commencing the dental procedure.

Signs and symptoms:

1. *Subjective:* Tingling and numbness of the lower eyelid, side of the nose and upper lip.

2. *Objective:* comparing the sensation produced with tapping of anesthetized and adjacent unanesthetised teeth with an instrument; no pain during oral surgical or periodontal surgical procedures or dental therapy.

Complications.

1. Hematoma: it may rarely develop.

2. Paresis of face: it occurs when the injection is given superficially, when the needle lies in the vicinity of muscles of facial expression or the nerves innervating them. The effects disappear as the local anesthetic effect wears off.

Failure to obtain anesthesia:

1.   Poor injection technique:
−   needle contacting bone below the infraorbital foramen. to correct, withdraw the needle a little, keeping the tip of the needle inside the soft tissues, redirect upwards towards the infraorbital foramen.
−   needle deviation medial or lateral to the infraorbital foramen. to correct, withdraw the needle a little, keeping the tip of the needle inside the soft tissues, redirect towards the infraorbital foramen.
2.   Intravascular administration: Deposition of the local anesthetic solution into a vessel.

Posterior superior alveolar nerve block

Factors to be considered. The factors to be considered prior to giving a posterior superior alveolar nerve block are as follows:

1. Nerve supply of first molar: the posterior superior alveolar nerve block is effective for the anesthesia of maxillary third, second and first molar. However, the mesiobuccal root of the maxillary first molar is not consistently innervated by the posterior superior alveolar nerve.
Therefore, a second injection, usually a paraperiosteal, is indicated following the Posterior Superior Alveolar Nerve Block, when effective anesthesia of the first molar does not develop.

2. Risk of hematoma formation: in the target area, the needle lies in close proximity with the pterygoid plexus of veins. In order to reduce the incidence of hematoma, the following measures are recommended:
−   Use short needles (1" or 25 mm in length). With this length overinsertion is avoided.
−   Always aspirate before deposition of the solution to avoid inadvertent intravascular injection.
−   Use 25-gauge needle, as it facilitates aspiration.
−   The needle should be oriented at an angle of 45° to the maxilla, in posterior, superior and medial direction.

3. Patient's skull size: this gives an idea of the depth of soft tissue penetration.

Other Names. Tuberosity block, Zygomatic block.

Nerves Anesthetised Posterior superior alveolar nerves and its branches.

Areas Anesthetised

1. Pulps of maxillary third, second and first molar (except the mesiobuccal root).
2. Adjoining alveolar bone of these teeth, buccal periodontium and buccal mucoperiosteum.

3. Adjacent lining of maxillary sinus.

Indications

1. Oral surgical or periodontal surgical procedures in the area of maxillary molars.

2. Restorative procedures involving two or more maxillary molars.

3. When paraperiosteal injection is contraindicated as in the presence of acute inflammation or infection.

4. When paraperiosteal injection has failed.

Contraindication

When the risk of hemorrhage is high, as in a case of hemophilic. In such cases, a paraperiosteal or intraligamentary injection is recommended.

Advantages

– atraumatic,

– high success rate,

– minimizes the number of penetrations required,

– minimizes the total volume of anesthetic solution injected.

Disadvantages

– risk of hematoma,

– technique is somewhat arbitrary, as there are few bony landmarks during insertion,

– second injection is required for anesthetising the first molar.

Technique

Needle: a 25-gauge, short needle of 25 mm in length is recommended.

Bevel: the position of the bevel of the needle should be facing the bone.

Point of insertion: it is at the height of mucobuccal fold in the region of the distal surface of maxillary second molar.

Depth of insertion: it is approximately 16 mm.

Target area: the posterior superior alveolar nerve as it enters the posterior or the infratemporal surface of maxilla. This nerve is located posterosuperior and medial to maxillary tuberosity.

Anatomical landmarks:

– mucobuccal fold in the region of maxillary second molar

– maxillary tuberosity

– zygomatic process of maxilla or the buttress of zygoma

– infratemporal surface of maxilla

– anterior border and coronoid process of the ramus of the mandible.

Procedure

Position of the patient: the patient is placed in semi-supine position with the occlusal plane of maxillary teeth at an angle of 45° to the floor.

Position of the operator:
− for right-sided injection the operator stands by the side of the patient.
− for left-sided injection the operator stands in front of the patient.
Preparation of the tissues: The site of injection is prepared with the application of an antiseptic, followed by application of a topical anesthetic. Partially open the patient's mouth, pulling the mandible to the side of injection and maxillary occlusal plane at an angle of 45° to the floor.
Retract the cheek, pulling the tissues taut.
Palpation of the landmarks.

Technique I

Place the index finger in the mucobuccal fold in the region of bicuspids and move it in the posterior direction till the prominence of the buttress of the zygoma is reached, which is approximately located above the first molar. At this point the index finger is rotated so that the fingernail is facing the attached gingiva, but the finger tip is still in contact with the prominence of the buttress. Pass the finger over the prominence and it will dip superiorly in the sulcus posterior to the buttress.

Retract the finger laterally to expose the depth of the sulcus posterior and superior to the buttress. Adjust the finger so that it is in a plane at right angle to the occlusal plane of the maxillary teeth and at an angle of 45° to the patient's sagittal plane, posterior to the buttress of the zygoma.

The point of the needle in this position should be located in the depth of the sulcus, above the roots of the third molar and anterior to the maxillary tuberosity close to the lateral surface of the maxilla.

The needle of the preloaded syringe is inserted into the tissue in a line parallel to the index finger and bisecting the fingernail with the bevel of the needle facing the bone.

Technique II

Take a preloaded syringe. Insert the needle at the height of the mucobuccal fold, in the region of maxillary second molar.

Advance the needle slowly superiorly, posteriorly and medially, in one movement.
Superiorly: At an angle of 45° to the occlusal plane.
Medially: At an angle of 45° to the sagittal plane.
Posteriorly: At an angle of 45° to the coronal plane.

In an adult of normal size, penetration to a depth of 16 mm will place the needle tip in the target area, in the immediate vicinity of the foramina through which the posterior superior alveolar nerves enter the posterior surface of maxilla.

Aspirate, if negative, deposit approximately 0,5-1,0 ml of local anesthetic solution slowly.

Withdraw the syringe slowly.

Cover the needle with its sheath and keep it in a safe place.

Wait for 3-5 minutes and start the procedure.

Signs and symptoms of anesthesia

1. Subjective: it is difficult to determine the extent of anesthesia subjectively. Feeling of numbness in the area of distribution of posterior superior alveolar nerve.

2. Objective: absence of pain with instrumentation and during the procedure.

Failure to Achieve Anesthesia

1. Poor injection technique:

−   needle too lateral: to correct, withdraw a little and redirect the needle tip medially.

−   needle too low: to correct, withdraw a little and redirect the needle tip superiorly.

−   needle too far posterior: to correct, withdraw the needle and redirect it anteriorly.

2. Intravascular administration: Deposition of the local anesthetic solution in pterygoid plexus of veins and in posterior superior alveolar artery.

Complications. Hematoma: it is due to insertion of the needle too far posteriorly into the pterygoid plexus of veins. It is recommended that we use short needles to minimise the risk of puncturing the pterygoid plexus of veins and posterior superior alveolar artery. This can be seen immediately with the appearance of bluish swelling at the puncture point or copious bleeding on withdrawal of the needle.

Mandibular anesthesia: the mandibular division of trigeminal nerve is located lateral and posterior to posterior superior alveolar nerves. Deposition of local anesthetic agent lateral to the desired location can produce varying degrees of mandibular anesthesia. In such situations patients will complain of anesthesia in the lip and tongue.

Nasopalatine nerve block

It is a potentially painful injection.

Other common names. Incisive nerve block, sphenopalatine nerve block.

Nerves anesthetised. Nasopalatine nerves bilaterally. These nerves emerge from incisive foramen beneath the incisive papilla 1 cm behind maxillary central incisors in the midline.

Areas anesthetised. Anterior portion of the hard palate (palatal mucosa) from the mesial of the
right canine/first premolar to the mesial of the left canine/first premolar.

Indications

1. Oral surgical or periodontal surgical procedures involving palatal soft and hard tissues.

2. When anesthesia of palatal soft tissues is required for any restorative procedure on more than two teeth.

Contraindications

1. Presence of acute inflammation or infection at the site of injection.

2. Whenever there are smaller areas of dental or surgical procedures (one or two teeth).

Advantages

1. It minimises multiple needle penetrations and reduces the volume of local anesthetic solution to be deposited.

2. It minimises patient discomfort from multiple needle penetrations.

Disadvantages

1. There is no hemostasis except in the immediate area of injection. For achieving hemostasis in the areas away from deposition of the solution additional infiltration has to be given in the area of surgery.

2. It is potentially the most painful intraoral injection, if the preliminary preparatory injections are not employed.

Anatomical Landmarks

• Maxillary central incisor teeth

• Incisive papilla in the midline of the palate

• Incisive foramen.

Technique

Needle: the recommended gauge is 25 or 27 and the recommended length is 1" or 25 mm.

Area of penetration: the palatal mucosa or the halo surrounding the incisive papilla.

Target area: the nasopalatine nerve as it comes out of incisive foramen, beneath the incisive papilla.

Path of insertion: making an angle of 45° to the incisive papilla, approaching from the side.

Bevel: it is facing the palatal soft tissues or facing the palatal bone.

Procedure. The nasopalatine nerve block is an extremely painful injection and hence a preparatory injection is necessary. It is recommended that the needle should not penetrate incisive papilla directly.

Preparatory injections. There are two methods of giving preparatory injections. These make the entrance into papilla less painful.

Labial approach: the preparatory injection is made by inserting the needle into the labial intraseptal tissues in between the maxillary central

incisors. The needle is inserted at a right angle to the labial cortical plate and passed into the tissues until resistance is felt. Then 0,25 ml of local anesthetic solution is deposited.

Palatal approach: the tip of the needle should be placed in the halo or the depression surrounding incisive papilla and a small amount or a few drops of local anesthetic solution is injected until papilla blanches. In both the palatal and labial approaches, it is advisable to start injecting slowly as soon as the needle enters the mucosa. The palatal preparatory injection is preferred as the second injection needle prick is avoided. After the preparatory injections are over, the needle is then withdrawn and reinserted slowly into the crest of the papilla. The needle is advanced slowly into the incisive foramen to an extent of about 0,5 cm into the canal and about 0,25 to 0,5 ml of local anesthetic solution is injected.

Signs and symptoms
1. Numbness in the anterior portion of the palate.
2. No pain during surgical procedures or dental therapy.

Complications
1. Necrosis of soft tissues is possible, if highly concentrated vasoconstrictor solution is used for hemostasis repeatedly.
2. The local anesthetic solution may «squirt» back out of the needle puncture site either during administration or after needle withdrawal, because of the density of soft tissues.

Greater palatine nerve block
Other common names. Anterior palatine nerve block.
Nerves anesthetised. Greater palatine nerve (anterior palatine nerve).
Areas anesthetised. The posterior part of the hard palate and its overlying soft tissues, anteriorly as far as the canine/first premolar and medially upto the midline or the median palatine raphe.

Indications
1. For pain control during oral surgical or periodontal surgical procedures involving the palatal soft and hard tissues.
2. When palatal soft tissue anesthesia is required for restorative therapy on more than two teeth.

Contraindications
1. Presence of acute inflammation or infection at the site of injection.
2. Smaller areas of surgical procedures or restorative therapy.

Advantages
1. It minimises the volume of solution to be deposited and the number of needle penetrations.
2. The technique is simple and easy.

3. Success rate is very high.

Disadvantages

1. It is a potentially painful injection technique.
2. No hemostasis. Hemostasis occurs only in the immediate area of injection. Additional infiltration will have to be given in the area of surgery for achieving hemostasis.

Anatomical landmarks

• Greater palatine foramen
• Maxillary second and third molars
• Palatal gingival margin of second and third maxillary molars
• Median palatine raphe
• An area, approximately at a distance of 1 cm from the palatal gingival margin towards the median palatine raphe.

Technique

Needle: a needle of 25 or 27-gauge and 25 mm in length is recommended.

Point of insertion: it is in the palatal soft tissues slightly anterior to the greater palatine foramen.

Target area: the greater palatine nerve as it comes out from the greater palatine foramen and passes anteriorly between the palatal mucoperiosteum and the bone of the hard palate.

Bevel of the needle: it is facing the palatal soft tissues.

Location of anatomical landmarks: locate the greater palatine foramen with a cotton swab which is most frequently located distal to the maxillary second molar about 1 cm from the palatal gingival margin towards the midline.

Path of insertion: the greater palatine foramen is approached from the opposite side at right angle to the curvature of the palatal bone.

Procedure

The needle is inserted slowly until the palatal bone is contacted.

Aspirate, to avoid inadvertent intravascular injection.

Deposit 0,25-0,5 ml of local anesthetic solution very slowly.

Withdraw the needle slowly and cover it with its sheath.

The nerve may be blocked at any point along its anterior course after emergence from the foramen.

Signs and symptoms

1. Numbness in the posterior portion of the palate.
2. No pain during dental surgical procedure.

Complications

1. Ischemia and necrosis of soft tissues: when highly concentrated vasoconstrictor is used for hemostasis, or if excessive amount of local anesthetic solution is used.

2. Discomfort: it can cause discomfort to the patient if the soft palate becomes anesthetised.

3. Hematoma: it is rare, as the palatal mucoperiosteum is firmly adherent to the bone of the hard palate.

4. Failure to obtain anesthesia:

Poor injection technique: if the local anesthetic solution is deposited too far anterior or too far posterior to the greater palatine foramen. In the area of the maxillary first premolar there is overlapping of fibers from the nasopalatine nerve.

Nerve blocks for maxillary nerve

A. Intraoral Maxillary Nerve Block

B. Extraoral Maxillary Nerve Block.

These blocks are used for achieving anesthesia of half of the maxilla.

Indications

−   Extensive oral and periodontal surgical procedures.

−   Restorative procedures involving a quadrant of maxilla.

Intraoral Nerve Blocks

Approaches. There are two approaches:

−   High tuberosity approach,

−   Greater palatine canal approach. Both the approaches are considered to be technically difficult. These should be attempted only if definitively indicated; and by experienced hands.

Major Difficulties

1. The difficulty encountered with greater palatine canal approach is in locating the canal and negotiating it completely.

2. The difficulty encountered with the high tuberosity approach is the higher incidence of hematoma. This occurs as a result of damage to the pterygoid plexus of veins with the needle.

Other names. Second division (VII) Nerve Block

Nerves anesthetised. Maxillary division of trigeminal nerve and its branches.

Areas anesthetised. The block anesthetises all the following structures on the ipsilateral side of the block.

1. The pulps of all maxillary teeth and the buccal periodontal tissues, supporting alveolar bone and the overlying soft tissues on the side of injection.

2. The bone of the hard palate and part of the soft palate, maxillary sinus and the lateral wall of nasal cavity.

3. Skin of the lower eyelid, side of the nose, cheek and the upper lip.

Indications

1. Control of pain during extensive oral surgical and periodontal surgical procedures and restorative dental procedures to be carried out in the ipsilateral maxilla.

2. Presence of inflammation or infection at the site of injection that contraindicates the use of other regional block techniques, such as infraorbital nerve block, or posterior superior alveolar nerve block techniques.

3. Diagnostic and therapeutic procedures for trigeminal neuralgias involving the second division of trigeminal nerve.

Contraindications

1. When the administrator is inexperienced.

2. Child patients.

3. Uncooperative patients.

4. Presence of acute inflammation or infection at the site of injection.

5. Increased possibility of hemorrhage, especially in a hemophilic.

Advantages

1. The high tuberosity approach is less painful.

2. Success rate is high.

3. It minimises the number of needle penetrations.

4. It minimises the total volume of local anesthetic solution injected.

Disadvantages

1. Increased risk of hematoma, especially with high tuberosity approach.

2. The high tuberosity approach is a little arbitrary, as there is absence of bony landmarks.

3. Lack of hemostasis: There is no hemostasis at the site of surgery. It requires deposition of additional amount of local anesthetic solution at the site of surgery.

4. The greater palatine approach is painful.

Technique

High tuberosity approach:

Needle: The recommended gauge of the needle is 25 and the length is 1 1/2 of an inch or 38-40 mm.

Bevel of the needle: It should be facing the bone.

Point of insertion: It is at the height of mucobuccal fold above the distal aspect of maxillary second molar tooth, as for posterior superior alveolar nerve block technique.

Depth of insertion: 1 ¼ of an inch

Target area: It is the maxillary nerve as it passes through the pterygopalatine fossa. It is superior and medial to the target area of posterior superior alveolar nerve block.

Anatomical landmarks:
−   maxillary second molar tooth
−   height of mucobuccal fold above the distal aspect of the crown of maxillary second molar tooth
−   maxillary tuberosity
−   zygomatic process of maxilla or buttress of the zygoma.
        Procedure
Marking the length of the needle: mark the length of the needle to be inserted in the soft tissues (about 30 mm).
Position of the patient: supine or semisupine, the latter is preferable.
Position of the operator: for the right-sided block, the operator stands on the side of the patient; and for the left-sided block, the operator stands in front of the patient. Request the patient to keep the mouth partially open.
Preparation of the tissues: prepare the tissues in the region of the height of mucobuccal fold above the distal aspect of maxillary second molar tooth, by application of topical antiseptic and topical anesthetic agents.
Retract the cheek to increase visibility of the area.
Take a preloaded syringe and place it in the soft tissues at the height of mucobuccal fold above the distal aspect of maxillary second molar tooth.
Advance the needle slowly in a superior, medial and posterior direction as previously described for posterior superior alveolar nerve block, to a depth of 30 mm. At this depth the tip of the needle lies in pterygopalatine fossa in proximity to the maxillary division of trigeminal nerve.
Aspirate and deposit about 1-1,5 ml of local anesthetic solution slowly.
Withdraw the needle slowly.
Wait for 3-5 minutes and commence with the oral surgical or dental procedure.
        Greater palatine canal approach:
Location of greater palatine foramen: It is at the junction of horizontal and vertical processes of hard palate in the area of distal surface of the crown of maxillary second molar.
Needle: the recommended gauge of the needle is 25; and the recommended length is 11/2 " or 38-40 mm.
Bevel of the needle: it should be facing the palatal soft tissues.
Point of insertion: the palatal soft tissues directly over the greater palatine foramen.
Palpation of the area of insertion: palpate the area with a slight depression directly over the greater palatine foramen with index finger. Needle is inserted into palatal mucosa in a posterolateral direction at a level of distal half of maxillary first molar.

Target area: It is the maxillary nerve as it passes through the pterygopalatine fossa. The needle passes through the greater palatine canal to reach pterygopalatine fossa.

Anatomical landmarks:

−	greater palatine foramen (junction of maxillary alveolar process and palatine bone)

−	maxillary second molar tooth

−	palatal gingival margin in the area of this tooth

−	median palatine raphe.

Procedure:

Length: mark the length of the needle (30-35 mm).

Position of the patient: the patient is positioned in such a way that the occlusal plane of maxillary teeth is at an angle of 45° to the floor, when the mouth is fully opened.

Position of the operator: for the right-sided block, the operator stands in front of the patient and for the left-sided block, the operator stands by the side of the patient.

Mouth: request the patient to keep the mouth wide open and the neck extended.

Location of the foramen: Locate the greater palatine foramen at the distal aspect of maxillary second molar tooth.

Preparation of the tissues: prepare the tissues directly over the foramen with application of topical antiseptic and topical anesthetic agent.

Take a preloaded syringe and direct it into the mouth from the opposite side with the needle at an angle of 45° to the palatal bone, posteriorly and enter the greater palatine foramen.

Bevel: orient the bevel of the needle against the soft tissues over the foramen.

Penetrate the needle into the mucosa. Deposit a small volume of local anesthetic solution.

Advance the needle slowly into the greater palatine canal to a depth of 30-35 mm. Do not attempt to force the needle against resistance. If resistance is felt, withdraw the needle slightly and change the angle slightly and advance it further into the canal. Always keep a few mm of needle outside the tissues.

Aspirate and deposit about 1 ml of local anesthetic solution slowly.

This will anesthetise greater palatine nerve almost immediately and maxillary nerve later, allowing for relatively painless probing of greater palatine foramen.

Withdraw the needle slowly and keep it safe.

Wait for 3-5 minutes and commence with the oral surgical or the dental procedure.

Signs and symptoms

1. Numbness of lower eyelid, side of the nose and upper lip.
2. Numbness in the teeth, buccal and palatal soft tissues on the side of injection.
3. Absence of pain during the procedure.

Failures of anesthesia

1. Partial anesthesia: it is due to underpenetration of the needle. To correct, withdraw the needle a little and readvance the needle into the greater palatine canal up to a proper depth and deposit the local anesthetic solution.
2. Inability to negotiate the greater palatine canal. In the presence of obstruction in the canal, it is advisable to try with tuberosity approach. The greater palatine canal approach can be successful if the needle has penetrated at least 2/3rd of its length into the canal.

Complications

1. Hematoma: it occurs due to the injury to the maxillary artery and injury to the pterygoid plexus of veins, via the tuberosity approach.
2. Penetration of orbit: it is very rare. It may occur in patients with smallsized skulls.
3. Penetration of the nasal cavity: the needle may penetrate the thin medial wall of the pterygopalatine fossa and thus the needle enters the nasal cavity.

Extraoral nerve blocks

Indications

There are various occasions, when an operator has to resort to extraoral injections. In these situations, the opening of the mouth is either very painful or impossible. These are as follows:

1. Wounds sustained due to accidents.
2. Swellings of head and neck, etc.
3. Presence of trismus due to various reasons.

Extraoral injections

1. Are not difficult than intraoral injections
2. The technique can be mastered easily
3. Have easier accessibility
4. Have easier achievement of asepsis
5. Larger areas can be anesthetised.

Infraorbital nerve block

The nerves and the areas anesthetised are the same as that for the intraoral infraorbital nerve injection technique.

Indications

1. When the anterior and middle posterior superior alveolar nerves are to be anesthetised; and the intraoral approach is not possible either because of presence of infection or trauma or any other reason.
2. When attempts to achieve anesthesia by the intraoral methods have been ineffective.

Anatomical Landmarks.

−   infraorbital margin,
−   infraorbital depression,
−   infraorbital foramen,
−   pupil of the ipsilateral eye.

Technique

Aseptic precautions: the procedure should be carried out under strict aseptic conditions.

Preparation of skin: the skin is prepared with an antiseptic.

Location of the infraorbital foramen: with the help of the anatomical landmarks the foramen is located.

Anesthesia of the skin and the subcutaneous tissue: it is achieved by deposition of a few drops of local anesthetic agent below the skin.

Needle: long or short 25-gauge needle is used.

Procedure

It is introduced through the marked anesthetised area into infraorbital canal. The needle is inserted at an angle of about 45° through the skin medially and inferiorly to the foramen to compensate for the thickness of overlying tissues.

With a slight probing action with the tip of the needle, the opening of the foramen is located. It is directed slightly upward and laterally to facilitate its entry into the foramen. Once found, needle is slowly advanced into the canal, to a depth not to exceed 1/8th, keeping in mind their orientation. The foramen and the canal, normally open downwards, forwards and medially. Incisors and canine are most easily anesthetised, as solution is injected close to anterior superior alveolar nerves.

Carefully aspirate and slowly deposit 1 ml of local anesthetic solution.

Subsequently, withdraw the needle slowly, wait for about 10 minutes and begin with the procedure.

Advantages. It is more precise; since anesthesia does not depend on diffusion of solution into the canal.

Relations

•   when the infraorbital nerve block by means of extraoral approach is being performed, the needle passes through the following structures: Skin, subcutaneous tissue and quadratus labii superioris muscle.

•   when the needle is in final position for this injection the important structures in the vicinity of the tip of the needle are: Facial artery and vein. Since these vessels are tortuous, they may lie on either side of the needle. When the tip of the needle is in the canal, it is very close to the infraorbital nerve and vessels.

Infrequent Occurrence

There is spasm of internal maxillary artery, resulting in blanching of face over the area of distribution of lateral nasal, inferior palpebral and superior labial arteries. This condition does not cause any discomfort to the patient and it passes away in short time.

Signs and Symptoms

Subjective: tingling and numbness of the lower eyelid, side of the nose and upper lip.

Objective: demonstration of absence of pain with instrumentation and no pain during the surgical procedure or the dental therapy.

Maxillary Nerve Block

Nerves anesthetised. Maxillary nerve and all of its branches peripheral to the site of injection.

Areas anesthetised

Anterior temporal and zygomatic regions, lower eyelid, side of the nose, upper lip, maxillary teeth, maxillary alveolar bone and overlying structures, hard palate and part of soft palate, tonsils, part of the pharynx, nasal septum and floor of the nose and mucosa of the posterolateral part of the lateral wall of the nose and turbinate bones.

Anatomical landmarks

• midpoint of zygomatic arch
• zygomatic notch
• coronoid process of the ramus of the mandible
• lateral pterygoid plate.

Indications

1. Where anesthesia of the entire distribution of the maxillary nerve is required for extensive surgery.

2. When it is desirable to block all the subdivisions of the maxillary nerve with only one needle insertion; and with a minimum of anesthetic solution.

3. When local infection, trauma, or other conditions make nerve blocks of the more terminal branches difficult or impossible.

4. For diagnostic or therapeutic purposes, such as tics or neuralgias of the maxillary divisions of the fifth cranial nerve.

Technique

Asepsis: this procedure should be carried out under strict aseptic conditions. these include preparation of the hands of the operator, including scrubbing and gloving; and surgical preparation of the field of surgery.

Palpation of the landmarks: the midpoint of the zygomatic arch is located and the depression in its inferior surface is marked. The coronoid process of the ramus of the mandible is located by opening and closing the lower jaw.

Needle: with a 25-gauge needle, a skin wheal is raised just below this mark in the depression, which the operator identifies by having the patient open and close the jaw.

Mark the needle: using a 4" (8,8 cm), 22-gauge needle attached to a leuerlock type of syringe, the operator measures 4,5 cm and marks with a rubber marker.

Insertion of the needle: The needle is inserted through the skin wheal, perpendicular to the skin surface and to the median sagittal plane. Inject a few drops of local anesthetic solution as the needle penetrates deeper into the tissues, until the needle point gently contacts the lateral pterygoid plate. The needle should never be inserted beyond the depth of the marker.

The needle is withdrawn, with only the point left in the tissues and redirected in a slight forward and upward direction until the needle is inserted to the depth of the marker.

After careful aspiration, 1-2 ml of local anesthetic solution is slowly injected. Care should be exercised to aspirate after each 0,5 ml of the solution is injected.

Relations

During the injection by means of an extraoral approach the needle passes through the following structures: Skin, subcutaneous tissue, masseter muscle, sigmoid notch and lateral pterygoid muscle.

When the needle is in contact with the lateral pterygoid plate; the following structures are in its vicinity:

− Superiorly, the base of the skull.

− Internal maxillary artery that crosses inferiorly and curves up anteriorly, entering the lower part of pterygomaxillary fissure.

− Temporal vessels from the internal maxillary artery, which may lie on either side of the artery.

− Superficially, transverse facial artery.

− Posteriorly, the mandibular nerve which passes through foramen ovale; and posterior to that, middle meningeal artery, which passes through foramen spinosum.

− Anteriorly, the pterygomaxillary fissure, through which the needle may pass into pterygopalatine fossa.

Signs and symptoms

1. Subjective symptoms: tingling and numbness of upper lip, side of the nose, lower eyelid and in some instances anesthesia of soft palate and pharynx, with gagging sensation.

2. Objective symptoms: absence of pain sensation with instrumentation.

TOPIC: LOCAL COMPLICATIONS OF LOCAL ANESTHESIA

Complications arising from drugs or chemicals used for local anesthesia
1. Soft tissue injury
2. Sloughing of tissues (Tissue ischemia and necrosis)
    Complications arising from injection techniques
1. Breakage of anesthetic cartridge
2. Breakage of needle
3. Needle-stick injuries
4. Hematoma
5. Failure to obtain local anesthesia
    Complications arising from both
1. Pain on injection
2. Burning on injection
3. Infection
4. Trismus
5. Edema
6. Mucosal blanching
7. Persistent paresthesia or anesthesia
8. Persistent or prolonged pain
9. Post-injection herpetic lesions or post-anesthetic intraoral lesions
10. Bizarre neurological complications
−   Facial nerve paresis or paralysis
−   Visual disturbances:
    • Diplopia, or double vision
    • Amaurosis or temporary blindness
    • Permanent blindness

COMPLICATIONS ARISING FROM THE DRUGS OR CHEMICALS USED FOR LOCAL ANESTHESIA

Soft Tissue Injury

Causes

It is seen in the form of self-inflicted trauma to lips, tongue and cheek.
It is common in children and mentally retarded adults.

Prevention

1. Use minimum effective dose of local anesthetic agent
2. Warn the patient's guardians or parents against biting of lips and tongue; and also against eating and drinking hot fluids; while the effect of anesthesia is still present.

Management

1. Symptomatic: it comprises of analgesics and if necessary antibiotics.
2. Topical application of petroleum jelly, or local anesthetic or antibiotic cream.

Sloughing of Tissues (Tissue Ischemia and Necrosis)

Various Forms
- Epithelial desquamation or ulceration.
- Sterile abscess.
- Tissue necrosis or sloughing.

Causes

1. Predisposition: commonly seen in hard palate, as in the region of distribution of nasopalatine and greater palatine nerves, because the mucoperiosteum is firmly attached to the bone. It occurs at the site of injection. Necrosis leads to painful ulceration and sloughing.
2. Deposition of excessive volume of local anesthetic agent with a vasoconstrictor.
3. Rapid deposition of the local anesthetic solution with undue pressure.
4. Application of topical local anesthetic agent for prolonged period (epithelial desquamation).
5. Use of high concentration of vasoconstrictors (usually epinephrine), resulting in tissue ischemia and necrosis. Sterile abscess occurs secondary to prolonged ischemia, resulting from epinephrine.

Prevention

1. Avoid using excessive amounts of local anesthetic agent (minimal effective dose).
2. Avoid using vasoconstrictors of high concentration.
3. Avoid rapid deposition and with excessive pressure. Excessive volume may have reaction secondary to excessive pressure.
4. Warn the patient against application of hot items; while the tissues are still anesthetised.

Management

Symptomatic: the management depends upon the extent of injury; and consists of analgesics, topical anesthetics and bland diet, etc. It usually resolves in 1-2 weeks. An established abscess may require incision and drainage.

COMPLICATIONS ARISING FROM INJECTION TECHNIQUES
Breakage of Anesthetic Cartridge
Causes

It occurs when there is resistance to flow of local anesthetic solution into the tissues.

It occurs due to following reasons:

- blockage of the needle.
- too rapid injection; especially during administration of palatal injection. it is due to the palatal mucoperiosteum which is firmly bound down to the underlying bone.
- point of the needle in close contact with bone.

Management

In case, the glass of the cartridge breaks while injection, care should be taken to ensure complete removal of all broken pieces from the mouth; so as to avoid risk of ingestion and injury to the soft tissues of the oral cavity.

Breakage of Needle

With the introduction of sterile, stainless steel disposable needles, the incidence of needle breakage within the tissues has become considerably less.

Causes

Primary cause: sudden unexpected movements by the patient, as the needle penetrates muscle or contacts periosteum. It is basically because of sudden pain on injection.

Secondary or other causes:

- size/diameter of the needle. Breakage is common in smaller (larger gauge, e.g. 27 G) needles. Smaller needles are more likely to break than larger needles. Gauge of the needle is inversely proportional to size or the diameter of the needle; e.g. 25 G is less in diameter than 22 G. It is a mistake to think that a needle, of a slightly lesser gauge will produce trauma or that trauma is proportional to gauge of a needle. The sharpness of the point is of more importance than the actual gauge of the needle. It is not the thickness of needle that creates trauma, but rather the blunt point and the barbs.
- previously bent needles. These are weak; and hence more likely to break.
- redirection of needles once inserted inside the tissues.
- needles with defect in the manufacture (poor quality needles).
- forcing needles against resistance.

- needle engaging the periosteum while giving nerve blocks, especially, the indirect pterygomandibular block technique with the bevel facing the bone.

Prevention

The following principles should be followed to prevent the possibility of breakage of a needle.

1. Inform the patient about the technique and the procedure. Avoid a sudden unexpected needle insertion. An informed patient is always a better patient and is much more co-operative. The patient should be warned not to move, as needle touches the mucous membrane. Injection of a small amount of LA solution in the tissues, slowly and carefully, in advance of needle, tends to lessen the pain associated with the insertion and injection.

2. Selection of proper gauge of needles.

- A needle of a very fine gauge (27 or 30) should not be used for nerve blocks. For nerve blocks, such as pterygomandibular block, posterior superior alveolar nerve block, maxillary nerve block, mandibular nerve block, use 25-gauge needles. For nerve blocks, especially mandibular injections, it is strongly recommended that 25-gauge needles should be used.

- For infiltration anesthesia: 25, or 27, or 30 G and 1" needles may be used. The use of fine gauge needles should be restricted to superficial injections.

3. Use presterilized disposable needles. Do not use resterilisable needles. These become dull and the shaft becomes weak.

4. The entire length of the needle should not be inserted into the tissues. Insertion of the needles must be up to a few mm away from the hub. In the past, when reusable needles were used; the junction of the shaft with the hub formed the weakest point of needle and therefore, was the site where breakage usually occurred. The needle should be long enough (adequate length) so that a sufficient portion will be allowed to project beyond tissues when the point of the needle reaches its final destination. This helps the operator, in case of breakage of the needle, to remove the broken needle by holding the portion of the needle outside the soft tissues. Therefore, in nerve blocks, 1½ (38-40 mm) needles should be used. The needle should not be embedded into the tissues up to the hub. It is vulnerable to breakage in this position. The average insertion/penetration in nerve blocks seldom exceeds one inch (25 mm).

5. Do not redirect the needle once completely embedded inside the tissues. Excessive lateral force on the needle is an important factor in breakage. Always withdraw the needle almost completely, to the submucosal layers and then redirect it.

6. Use needles of good quality and of a good manufacturer.

7. Gentle manipulation: At no time should there be any resistance to progress of needle during injection. If resistance is encountered, the technique of insertion is modified accordingly. Never force needles against resistance.

8. Do not permit the needle to engage the periosteum while giving a nerve block. There is always a danger of engaging the periosteum in mandibular injection, especially, if indirect approach is used. The needle may penetrate periosteum at the internal oblique ridge and when the syringe is swung to opposite bicuspids, the needle thus bound to bone may bend and break. This is the most frequent cause
of needle breakage in mandibular injection.

9. Stabilization of the jaw: Mandible should always be supported by fingers or thumb at the inferior border of mandible during the procedure of injection.

10. Needle point should be inserted in the shortest and the most direct line to mandibular foramen. In other words, needle should always be kept straight during injection procedure.

11. Thorough knowledge of anatomy of the region involved. Do not attempt injections if you are not well aware of the anatomy of the area of the technique employed. Familiarise yourself with all the necessary anatomical landmarks of the area.

12. Avoid multiple penetrations with the same needle.

Management

Information and reassurance

1. remain calm and do not panic.

2. inform the patient of the situation. Make an attempt to allay patient's fear and apprehension.

Localization of the broken needle

Various radiographs are taken in two different angles to localize the position of the broken needle, such as PA view, lateral view, or OPG, etc. Use of pilot needle/localizers or a radiopaque localizer or another needle can be used to facilitate localization or to pinpoint the site of the retained or the broken fragment. Once this relationship between localizing needle and the broken fragment is established radiographically, dissection is carried out to retrieve the broken needle under local or general anesthesia.

In case, the needle has broken and is not completely buried in the soft tissues: if the needle is visible and is outside the soft tissues, hold it with a hemostat and remove it. When giving injection, it is wise to have a pair of mosquito forceps, hemostat, or curved Spencer Well's forceps at hand so that if the needle breaks and the broken end is visible in the tissues, then without shifting the gaze, or the steadying finger, the operator can

pickup one of the above mentioned instruments and grasp the broken end of the needle to remove it slowly. When the patient moves or swallows then the broken fragment may shift deeper into the tissues and set out of sight.

In case, the needle has broken and is completely buried in the soft tissues: if the needle is not visible, inform the patient of the situation and give assurance. The patient should be advised not to move the jaw. The patient should be referred to Oral and Maxillofacial Surgeon for its removal. Usually the needle breaks when the tip of the needle is in contact with the bone. In case, if the needle end is buried, then use the curved hemostat, open it and press the convex tip of the hemostat above and below the bleeding point present where the needle is broken, there is a
good chance that the broken end will emerge out of soft tissues, grasp with another hemostat and remove.

Needle-stick Injuries
Definition
Accidental injuries occurring to dental staff caused by sharp instruments such as needles, blades, scalpels, explorers, root canal instruments and wires, etc. These injuries are not usually serious, unless, the instruments used were contaminated by blood from patients with conditions such as Hepatitis B virus (HBV) infection, Hepatitis C virus (HCV) infection, AIDS or AIDS Related Complex (ARC).

Causes. Careless technique.

Prevention
1. Careful handling of sharp instruments, needles and wires.
2. Prophylactic vaccination of HBV infection taken and maintained.

Management
If the injury involves a patient with HBV or HCV infection the following management protocols should be followed. The management depends upon immune status of the Health Care Worker (HCW).

• HCW who never took vaccination should receive Hepatitis B immunoglobulins (HBIG) within 48 hours of exposure and a course of HBV vaccination should be started as soon as possible.

• HCWs who have been vaccinated, the management depends upon the antibody titre. If the titre is more than 100 mu/ml within the previous year, no further treatment is required. If antibody titre was not done in the previous year, or if the titre is low; then a booster dose of the vaccine is taken, followed by testing of the antibody titre. Those HCW who fail to respond to the vaccine should be given protection by giving Hepatitis B immunoglobulins (HBIG). Presently, there are no guidelines for the

prophylaxis for HCV infection. The management, however, consists of monitoring liver functions and testing for anti-HCV antibodies. Interferon α is being used in such cases. If the injury involves a patient with HIV infection or AIDS or AIDS related complex, then the post-exposure prophylaxis (PEP) for HIV, as recommended by National AIDS Control Organization (NACO), should be followed.

Hematoma

Definition

Effusion of blood into extravascular spaces. Blood effusion continues until extravascular pressure exceeds intravascular pressure or until clotting occurs. Certain regions have a greater incidence of hematoma. The incidence is more in posterior superior alveolar nerve block and pterygomandibular block. The possible complications include pain, trismus, swelling and discoloration of the region. The density of the tissues surrounding the injured vessel is an important factor.

• secures withy adhesive strips (included)
• syringe is held ready for use in a convenient position and after use, syringe is replaced for recapping
• made with microban protection
• available in two sizes (standard – for X-short and short needles; long – for long needles)
• a disposable device, that securely holds a needle-cap in a ready position
• used to safely uncap and recap needles using onehanded technique

Causes

Nicking of blood vessels (artery and vein; usually an artery) during injection of local anesthetic solution.

Prevention

1. Good knowledge of anatomy.
2. Use short needle for posterior superior alveolar nerve block. It decreases the risk of hematoma.
3. Adherence to the protocol for the injection technique.
4. Minimise the number of needle penetrations.
5. Never use needle as a probe in the tissues.

Management

Explanation of the condition and assurance to be given to the patient. The swelling and discoloration usually resolve within 7 to 14 days.

Immediate treatment

In the immediate phase the hematoma manifests as swelling and discoloration. Hence, the following guidelines will be helpful:

Application of direct pressure: if the area is accessible, application of mechanical pressure at the site of bleeding for a few minutes will be helpful. In most instances, except for posterior superior alveolar nerve block, the blood vessels lie between skin and bone, on which pressure should be applied for at least 2 to 3 minutes. This effectively stops bleeding.

External application of ice: for a few hours will also control further formation of hematoma.

Delayed Treatment. Advise the patient of possible pain and limitation of movement. Pain is to be treated by analgesics. Treat the trismus with anti-inflammatory drugs and muscle relaxants. Do not apply heat to the area in the early phase as it produces vasodilatation and may lead to increase in the size of hematoma. External ice application is advised for at least one day, as it causes vasoconstriction. Later, heat application is indicated for vasodilatation to absorb the hematoma. Avoid dental treatment until there is resolution of symptoms.

Failure to Obtain Local Anesthesia
Causes
1. Operator-dependent
   - selection of local anesthetic agent (type and dose; too small a dose).
   - use of a local anesthetic solution which has crossed its date of expiry as recommended by the manufacturer.
   - improper injection technique:
   – wrong technique: inaccurate placement of solution (deposition of solution far away from the nerve).
   – not waiting long enough for anesthesia to act; before commencing the surgery.
   – injection of wrong solution
   – intravascular administration
   – intramuscular administration
2. Patient-dependent
   - anatomical:
   – barriers to diffusion
   – anatomical aberrations
   – additional innervation
   - psychological:
   – fear and apprehension
   – unco-operative patient, inadequate opening of the mouth, movement by the patient

- pathological:

– presence of infection: it is widely believed that there is alteration in the pH of tissues in the presence of infection; which leads to acidic environment. The local anesthetic solutions are not effective as these agents are alkaloids and are not dissociated in an active state there is an increased vascularity of acutely inflamed tissues, which may also be a factor

– presence of trismus.

Prevention

1. Good knowledge of anatomy.
2. Good injection technique:

– accurate placement of solution.

– deposition of adequate dose.

– wait for sufficiently long enough for anesthesia to act; and then commence surgery. Check for subjective and objective signs and symptoms.

– consider using aspiration technique.

Management

1. Repeat the injection.
2. Consider giving additional injections such as intraligamentary, intraosseous or intrapulpal injections; unless there is presence of infection surrounding the tooth.
3. Consider anesthetising additional nerves.
4. Avoid injection of a wrong solution.

Prevention. To avoid injection of a wrong solution, the following measures are recommended:

– multidose vials. All the local anesthetic solutions and other injectable drugs in the similar containers, should be adequately labeled; or the other injectable drugs should not be kept on the same trolley, or in the vicinity of local anesthetic agents.

– cartridges. Encourage use of cartridges. Now, with the introduction of cartridges universally, the injection of solutions other than local anesthetic agents is avoided. There hould be identifying marks on individual cartridges for easy identification by the dental practitioner.

Management. Antibiotics, local dressings, oral hygiene instructions, anti-inflammatory/ analgesics and diet restrictions.

COMPLICATIONS ARISING FROM BOTH
Pain on Injection

This increases patient's anxiety; and may lead to a sudden unexpected movement by the patient and increases the risk of needle breakage.

Causes

1. Careless injection technique.
2. Dull needles: Needles become dull due to multiple injections.
3. Rapid deposition of local anesthetic solution.
4. Needles with barbs: There is pain while withdrawal of the needle from the tissues.
5. Temperature: Extremes of temperature such as warm or hot or very cold (refrigerated) local anesthetic solution.

Prevention. Every effort should be taken to administer local anesthetic solution as painlessly as possible.

1. Proper injection technique. The basic principles of injection should be followed. The lip or the cheek is properly reflected so that the tissues are tensed, the sharp point of the needle is placed at right angle to the mucosa and the puncture is effected. The insertion of the needle should be slow and as atraumatic as possible. Multiple penetrations or insertion in the same area should be avoided.
2. Use sharp needles. Use good quality disposable needles supplied by a reputable manufacturer.
3. Use sterile local anesthetic solutions.
4. Apply topical local anesthetic agent prior to injection to the site of injection.
5. Inject local anesthetic solution slowly.
6. Temperature of local anesthetic solution should be the same as room temperature and hence, the local anesthetic solutions should be stored at room temperature.

Management. Not required. However, steps should be taken to avoid pain associated with njection of local anesthetic agent.

Burning on Injection
Causes

1. Altered pH of the solution
a. Presence of vasoconstrictor: The pH of local anesthetic solution without the vasoconstrictor is approximately 5 to 5.5; and that with a vasoconstrictor is approximately 3 to 3.5. It is more acidic.
b. Old solution: The end result of oxidation of Na-bisulfite is Na-bisulfate which is more acidic.
2. Non-isotonic local anesthetic solution.
3. Other causes:
•   Rapidity of injection: Especially in adherent tissues and confined areas, such as palatal mucoperiosteum.

- Contamination of local anesthetic solution, especially when cartridges are stored in alcohol or other cold sterilizing solutions; leads to diffusion of these solutions into the cartridge.
- High temperature of local anesthetic solution. Solutions warmed to body temperature are usually considered to be "too hot" by the patients.
- Deposition of excessive amount of local anesthetic solutions.

Prevention

1. Slow injection. Ideal rate is 1 ml/min; while recommended rate is 1.8 ml/min.
2. Cartridges should be stored in a suitable container at room temperature without alcohol or any other cold sterilizing solutions.
3. The excess of cold sterilising solution should be removed by dipping the cartridge in sterile water or normal saline.
4. Use recently manufactured cartridges, as far as possible, to circumvent the problem of increased acidic medium of the solution, because of oxidation of vasoconstrictor.

Management. The tissue irritation caused due to the high pH of local anesthetic agent, usually, does not require any treatment, as most instances are transient and do not cause tissue damage. It disappears as the action of local anesthetic agent takes place. Usually, there is no residual pain or burning after the action of local anesthetic agent subsides. With rapid injection, or injection of a contaminated or a warm solution, there is a greater chance of tissue damage, which subsequently may lead to other complications such as trismus, edema and paresthesia. In such situations, management of the specific individual problem is required. Persistent irritation or burning during or after the injection warrants an investigation of the local anesthetic solution. The matter should be brought to the notice of the concerned manufacturer.

Infection

The incidence of injection-related infection has become less following introduction of pre-sterilised disposable needles and cartridges.

Causes

1. Contamination of the needles. Needles touching mucous membrane other than the area of insertion of the needle result in contamination of the needle. It is the major cause of post-injection infection.
2. Contamination of the local anesthetic solution. It is also rare, as the solutions are pre-sterilized. Contamination of needles or solutions may cause a low-grade infection, if placed in the deeper tissues, which may lead to trismus. Low-grade infection is not recognized immediately. The patient

usually complains of pain and dysfunction in the immediate post-injection phase.

3. Improper injection technique: It includes the following:

a. Improper handling of local anesthetic equipment (storage of the cartridges).

b. Improper preparation of the site.

c. Inadequate washing of operator's hands.

d. Needle passing through an area of infection. It may disseminate infection.

4. Local anesthetic solution deposited under pressure; as in intraligamentary injection. It is claimed to deposit bacteria, in healthy tissues and thus spreading the infections.

   Prevention. Take measures for complete asepsis, as far as possible, which are as follows:

1. Preparation of the site prior to needle penetration: Apply antiseptic, dry the area and then apply topical anesthetic agent.

2. Careful handling of the needles. Avoid contamination of needles through contact with non-sterile surfaces.

3. Avoid multiple penetrations with the same needle.

4. Use pre-sterilized disposable needles.

5. Proper cleansing of operator's hands.

6. Avoid passing the needles through infected areas.

7. Proper handling of dental cartridges:

- Store cartridges aseptically, as far as possible, in a container covered with a lid all the time. Once the container is opened, cartridges should be stored dry in their original container or in another suitable sterile container that is kept covered at all times.

- Avoid contamination of plunger and the diaphragm prior to their use. The diaphragm-end of cartridge should be wiped with a sterile disposable sponge soaked with an antiseptic prior to its insertion into the syringe and fixing of the needle.

- Use cartridges available in blister packing.

- Use cartridges only once (one patient). An attempt to use a portion for one patient and the remaining for another patient increases the possibility of cross-infection.

   Management

The management is symptomatic and it consists of the following:

- analgesics
- antibiotics
- physiotherapy
- heat therapy

- anti-inflammatory drugs
- muscle relaxants and
- incision and drainage, if necessary.

Trismus

It is a fairly common complication of regional anesthesia, particularly while giving pterygomandibular block.

Causes

Primary cause

- trauma to muscles (medial pterygoid, temporalis and masseter), blood vessels in infratemporal and pterygomandibular fossae during insertion of the needle. It is the most commonest cause.

Secondary causes

- the following factors cause varying degree of trismus.
- injection of local anesthetic solutions containing irritating solutions, such as, alcohol or other cold-sterilizing solutions, which diffuse into the muscle tissue, producing irritation of the muscle leading to trismus.
- local anesthetic solutions have mild myotoxic properties on skeletal muscles. Injection of local anesthetic solutions intramuscularly, or extramuscularly leads to progressive necrosis of the exposed muscle fibers.
- hematoma (large volume of extravasated blood) leads to irritation of muscles fibers.
- low grade infection following injection.
- deposition of excessive amounts of local anesthetic solutions into a particular area. This occurs following multiple failed pterygomandibular blocks and which lead to distension of the tissues and may result in post-injection trismus.

Prevention

1. Use sharp, sterile and disposable needles. This avoids the trauma of injection and prevents subsequent low grade infection.
2. Proper handling of local anesthetic cartridges.
3. Proper handling of needles. Avoid contamination of needles.
4. Avoid multiple penetrations into the same area. It increases the incidence of post-injection trismus.
5. Use minimum effective volumes of local anesthetic solutions. Avoid deposition of excessive amounts of local anesthetic solutions into a restricted area. It produces distension of tissues. This may lead to postinjection trismus.
6. Good knowledge of anatomy of the region and fascial spaces.
7. Follow proper injection technique.
8. Use aseptic technique. Topical application of antiseptics.
9. Use atraumatic technique.

Management. It depends on the cause of trismus and consists of the following:

- heat therapy
- warm saline rinses
- analgesics
- anti-inflammatory
- muscle relaxants
- physiotherapy and, if necessary
- antibiotics.

Heat therapy: it includes application of heat, in various ways to the affected area, three to four times a day. For example, application of moist compresses for 15 to 20 minutes/hour for several days until the symptoms are relieved.

Warm saline rinses: these are made by adding a teaspoonful of salt to a glass of water. It is held in the mouth on the involved side for a few minutes and is spat out.

Analgesics.

Anti-inflammatory drugs: THE analgesics used belong to the group of non-steroidal anti-inflammatory agents (NSAIDs) such a aspirin, ibuprofen, codein (30-60 mg q6h), etc. which have both analgesic as well as anti-inflammatory actions.

Muscle relaxants: the commonly used muscle relaxants are Chlorzoxazone (250 mg in 2 to 3 divided doses, in combination with NSAIDs and Diazepam (5-10 mg bid), or any other benzodiazepines. Meprobamate 1,2 g in 3 to 4 divided doses can also be used.

Physiotherapy: it includes mouth opening exercises, as well as, lateral excursions (side to side movements), for 5 to 10 minutes every 3 to 4 hours.

Antibiotics: if the cause of the trismus is hematoma or low grade infection, suitable antibiotics should be prescribed. If the condition is due to trauma, mild physiotherapy, analgesics and muscle relaxants are advocated. If hemorrhage or low grade infection is the cause, then, antibiotics, anti-inflammatory drugs and warm saline mouthwashes are indicated. Avoid further dental treatment in the involved region until symptoms resolve and the patient is comfortable. If for any reason, the dental care has to be continued, an alternate method or technique for achieving local anesthesia may be employed. The Akinosi mandibular nerve block provides relief from the motor dysfunction and allows the patient to open the mouth and permits administration of an appropriate additional injection, if required. Complete resolution of post-injection trismus takes approximately

6 weeks, with a range of 4 to 20 weeks.

Edema

Edema of tongue, pharynx and larynx may develop into potentially lifethreatening situations.

Causes

1. trauma during injection
2. infection
3. allergy
4. hematoma
5. injection of irritating solutions such as cold-sterilising solutions. Each factor should be considered with regard to its prevention and management.

Prevention

1. Preoperative assessment: Complete medical evaluation of the patient, particularly history of allergy to any drug.
2. Careful handling of local anesthesia armamentarium.
3. Atraumatic anesthetic technique.

Management. Find out the cause.

1. In cases of traumatic injection and introduction of irritating solutions, the edema is minimal and resolves in a few days and therapy is sometimes not required.
2. Analgesics for pain.
3. In case of infection, start suitable antibiotics.
4. If allergy: administer antihistaminics orally and/or IM; sometimes it can be life-threatening. Consultation with an allergic specialist is mandatory. If breathing is compromised because of edema the following steps are taken:
- Patient is placed in supine position. In case of tongue or oropharyngeal region, right or left lateral position is taken.
- Institute Basic Life Support (BLS); Airway, Breathing and Circulation (ABC).
- Emergency Medical Services (EMS) are summoned.
- Administer O2.
- Administer epinephrine: 0,3 mg (adults), 0,15 mg (child) IM/IV every 5 minutes until respiratory distress resolves.
- Administer antihistaminics.
- Administer corticosteroids.
5. Refer to oral and maxillofacial surgeon.
6. Life-threatening situations may require cricothyroidotomy. Transfer the patient to a general hospital with an ICU facility in your vicinity.

Mucosal blanching

It is caused by the spasm of the artery accompanying the nerve at the point of injection.

Causes

1. Use of excessive amount of vasoconstrictor in the local anesthetic solutions.
2. Deposition of excessive volume of local anesthetic solution in firm or tight tissue.

Prevention

1. Good knowledge of anatomy.
2. Adherence to the anesthetic protocol.
3. Use of aspiration technique; and avoid intra-arterial administration of local anesthetic agents.

Management. Usually a transient phenomenon and no treatment is necessary.

Persistent anesthesia or paresthesia (nerve injuries)

Nerve injuries could be Post-injection, or Postoperative.

It is the prolonged loss of sensation (hypoesthesia or anesthesia) of the part of soft tissues of face, (including tongue and lip), for days, weeks, or months, following injection of local anesthetic agent or removal of tooth/ root. Paresthesia is altered sensation and may be with partial anesthesia. It is a disturbing and sometimes unpreventable complication of local anesthetic administration. The most common sites are lips and tongue in their descending order of frequency. Paresthesia is more common with prilocaine, followed by other injectable local anesthetic agents. When lingual nerve is involved, sense of taste may also be affected *(chorda tympani)*. Persistent paresthesia can lead to self-inflicted injury. Biting, or thermal or chemical insults can occur without the patient's awareness. The condition is more frequent as a result of operative procedure than injection itself. The sensory nerves most frequently traumatised are inferior alveolar nerve, lingual nerve and mental nerves in lower jaw; and infraorbital nerve in upper jaw. Prolonged anesthesia of lip, tongue or nose and cheek follows injury to these nerves; the part affected depending upon which nerve is injured. The duration of anesthesia depends on severity and extent of nerve injury.

Causes

1. Injection of local anesthetic solution contaminated with cold-sterilising solution, such as alcohol, near a nerve. It produces irritation, resulting in edema and increased pressure in the region of the nerve, leading to

paresthesia. Alcohol is neurolytic; and may cause paresthesia lasting for months and years.

2. Injection of a wrong solution. It may result from injection of a solution other than a local anesthetic solution, such as alcohol or other coldsterilising solutions. Only in severe cases the damage is permanent. In the absence of a known cause for prolonged anesthesia, this factor should always be considered, if cold-sterilizing solutions are used, at any time.

3. Trauma to a nerve: It is usually due to lack of knowledge of anatomy and faulty technique. It may lead to following situations:

• Trauma to a nerve or the nerve sheath: Initially the patient gets a feeling of an «electric shock» to the area innervated by the nerve. Insertion of the needle into a foramen also increases likelihood of nerve injury.

• Complete severing of the nerve fibers/trunk with a needle is extremely rare. The damage from the needle is hyperalgesia and not anesthesia.

4. Hemorrhage into or around the nerve sheath caused by mild trauma of the needle. The resultant hemorrhage is reabsorbed very slowly as a result of poor circulation in this area. This prolonged pressure may lead to degeneration of some of the nerve fibers and may lead to transient decreased sensation.

Prevention

1. Strict adherence to injection protocol.
2. Careful injection technique.
3. Proper handling of local anesthetic cartridges.
4. Good knowledge of anatomy.

Management. Most paresthesias resolve within 8 weeks without treatment.

Rare, only if the damage to the nerve is severe, then only the paresthesia may be permanent.

1. Reassurance to the patient.
2. Administer neurotropic vitamins (Vitamins B1, B6 and B12), parenteral and oral; or vitamin B12, oral and parenteral. Presently, the use of methylcobalamine, which is an active form of vitamin B12, which has got better absorption than other forms like cyanocobalamine, (also hydroxyl-, adenosyl-) and hence it is preferable to administer, in case of nerve injuries.
3. If dental treatment is to be continued, avoid readministration of the local anesthetic agent into the same region of traumatised nerve. Use alternate local anesthetic technique, if necessary and if possible.
4. Refer the patient to oral and maxillofacial surgeon, if necessary.

Persistent or prolonged pain
Causes
1. Poor injection technique. Subperiosteal injection of local anesthetic agent and tearing of the periosteum by the tip of the needle.
2. Needle tip with barbs.
3. Ischemic necrosis (use of vasoconstrictors: Excess amount, higher concentration).
4. Multiple penetrations.
Prevention
1. Good injection technique: avoid subperiosteal injection and tearing of periosteum. Infiltration anesthesia should be given paraperiosteally or supraperiosteally, but not subperiosteally.
2. Avoid needles with barbs.
3. Use vasoconstrictors with higher dilution.
4. Avoid multiple penetrations.
Management. It is symptomatic and comprises of analgesics.

Post-injection herpetic lesions or post-anesthetic intraoral lesions
Patients' reporting of development of ulcerations around the site of injection a few days after intraoral injection of local anesthetic agent. Patient complains of intense pain.
Causes
Recurrent aphthous stomatitis (RAS): it is a frequent manifestation, developing in gingival tissues (movable part, i.e. not attached to the bone) such as buccal vestibule.
Herpes simplex/herpes labialis: it is related to reactivation of dormant Herpes Simplex Virus (HSV) particles by the trauma of injection. It is usually seen in patients with history of recurrent herpes labialis, particularly, in the terminal area of distribution of trigeminal nerve (inferior alveolar nerve, or superior labial branch of infraorbital nerve), in a previously anesthetized nerve. HSV can develop intraorally, although it is commonly observed extraorally. It is manifested as small bumps on tissues attached to underlying bone; such as soft tissues of the hard palate. Trauma to the tissues by a needle, local anesthetic agent, cotton swab, or any other instrument, may activate the latent form of the disease process.
Prevention
1. Pre-anesthetic assessment: history of recurrent herpetic infections.
2. Delay surgical intervention in the active stage. In susceptible patients, intraoral lesions cannot be prevented from developing. Intraoral Herpes Simplex, may be prevented, or its manifestations may be minimized, if

treated in its prodromal phase (Prodrome: mild burning or itching sensation at the site where the virus is
present, e.g. lip.)

Management

Explanation and assurance are integral parts of the management. The management, otherwise is symptomatic and includes: analgesics, topical anesthetics, e.g. viscous lidocaine, applied topically to affected/ painful areas and antiviral agents, (acyclovir) applied QID over the affected area. It minimizes the acute phase.

Bizarre neurological symptoms

It is seen in the form of facial nerve paresis and visual disturbances.

Facial nerve paresis

Paresis of some of the muscles of facial expression which are supplied by some of the terminal branches of facial nerve, when the solution is deposited in their vicinity.

a. *Directly:* In the vicinity of terminal branches of facial nerve as (i) in infraorbital nerve block, or (ii) while giving a paraperiosteal injection for maxillary canine.

b. *Indirectly:* Into the deep lobe of parotid gland as in the pterygomandibular block. It is a transient phenomenon and lasts for a few hours; depending upon: The agent used, its volume injected and the proximity to the branches of facial nerve. There is usually minimal or no sensory loss.

Manifestations

• *Face:* It results in unilateral loss of motor function of the muscles of facial expression. The face appears to be lopsided; there is drooping of lips, etc.

• *Eyes:* It manifests in the form of inability to voluntarily close the ipsilateral eye. The protective lid reflex of the eye is abolished. Winking or blinking becomes impossible. Cornea, however, retains its innervations. Thus, if irritated, the corneal reflex is intact and tears will lubricate the eye.

• There will be no anesthesia in the area of injection.

Causes

1. Injection of local anesthetic solution in the capsule of, or the deep lobe of parotid gland, during a pterygomandibular block.

2. Injection, superficially, into the muscles of facial expression, or in the vicinity of the nerves innervating them, as in infraorbital nerve block.

Prevention

1. Good knowledge of anatomy.

2. Adherence to the standard protocol for local anesthesia technique, particularly, pterygomandibular block and infraorbital nerve block. In the pterygomandibular block, if the needle is advanced posteriorly and bone is not contacted, the needle should be withdrawn almost completely from the soft tissues; the barrel of syringe is shifted posteriorly, the needle is then advanced more anteriorly, until it contacts the bone.

Management

It does not require any treatment. The effect is transient and lasts as long as the effect of anesthesia.

1. Explanation of the situation, that it is transitory phenomenon; (as it lasts for a few hours) and reassurance given to the patient.

2. Eye dressing to be given over the affected eye. Until muscle tone returns, or ask the patient to close the eye manually; close the eyelids periodically to keep cornea lubricated.

3. Contact lenses, if any, should be removed, until muscular movements return.

Visual Disturbances

These complications are rare and difficult to explain. These complications are usually seen as unilateral or bilateral disturbances of vision; and are seen in the following forms:

• squint.

• diplopia or double vision.

• transient amaurosis (blindness without a demonstrable lesion in the eye).

• permanent blindness.

The probable explanations of the associated phenomena of these situations, are as follows:

• It is possible that vascular spasm.

• The accidental intra-arterial injection is most likely cause. In such situations, an unusual vascular distribution can be assumed to be the likely situation.

• It may be due to inadvertent anesthesia of the nerves in the region.

Diagnosis. These complications have to be diagnosed on the basis of clinical manifestations.

Prevention. Sound knowledge of anatomy and the landmarks for the injection technique. Strict adherence to the injection protocol.

Management. The best method is to prevent these complications.

Reassurance: the patient is assured that a normal region will be restored within 30 minutes.

Diplopia or double vision. The resultant disturbance in the vision will return back to normal as the solution gets diffused, usually within about 3 hours.

Example: the injection which may cause diplopia is infraorbital nerve block.

Explanations

- The most likely explanation given is that some of the maxillary injections may result in local anesthetic solution infiltrating into the orbit to anesthetise the extrinsic ocular muscles of the eye.

- An accidental intra-arterial injection of local anesthetic solution in patients with uncommon vascular patterns. In these situations, it is presumed that the orbit is supplied either wholly or partly by middle meningeal artery, a branch of internal maxillary artery.

Management. No treatment is necessary; other than reassurance. The vision usually returns to normal at the end of the anesthetic effect.

Transient squints and double vision. These complications have occurred following posterior superior alveolar nerve block and maxillary nerve block injections. These complications are due to paralysis of extrinsic muscles. The most likely explanation is that the local anesthetic solution gets diffused into the orbit from the pterygopalatine ganglion and infratemporal fossa via the infraorbital fissure. By these routes, the local anesthetic solution, may affect the oculomotor, trochlear and abducens nerves, which innervate the muscles attached to the eyeball.

Management. These complications pass off within 2 to 3 hours.

TOPIC: GENERAL ANESTHESIA IN MAXILLOFACIAL SURGERY

General anaesthesia is a medically induced coma and loss of protective reflexes resulting from the administration of one or more general anaesthetic agents.

A variety of medications may be administered, with the overall aim of ensuring unconsciousness, amnesia, analgesia, relaxation of skeletal muscles and loss of control of reflexes of the autonomic nervous system.

The optimal combination of these agents for any given patient and procedure is typically selected by ananaesthesiologist or another provider such as an anaesthesiologist assistant or nurse anaesthetist, in consultation with the patient and the medical or dental practitioner performing the operative procedure.

Methods of anxiety and pain control:

1.   Analgesia – the diminution or elimination of pain.
2.   Conscious sedation – a minimally depressed level of consciousness that retains the patient's ability to independently and continuously maintain an airway and respond appropriately to physical stimulation or verbal command and that is produced by a pharmacological or non-pharmacological method or a combination thereof. In accord with this particular definition, the drugs and/or techniques used should carry a margin of safety wide enough to render unintended loss of consciousness unlikely. Further, patients whose only response is reflex withdrawal from repeated painful stimuli would not be considered to be in a state of conscious sedation.
3.   Combination inhalation – enteral conscious sedation (combined conscious sedation) – conscious sedation using inhalation and enteral agents. When the intent is anxiolysis only and the appropriate dosage of agents is administered, then the definition of enteral and/or combination inhalation-enteral conscious sedation (combined conscious sedation) does not apply.
4.   Local anesthesia – the elimination of sensation, especially pain, in one part of the body by the topical application or regional injection of a drug. Note: Although the use of local anesthetics is the foundation of pain control in dentistry and has a long record of safety, dentists must be aware of the maximum, safe dosage limits for each patient. Large doses of local anesthetics in themselves may result in central nervous system depression, especially in combination with sedative agents.

5.   Minimal sedation – a minimally depressed level of consciousness, produced by a pharmacological method, that retains the patient's ability to independently and continuously maintain an airway and respond normally to tactile stimulation and verbal command. Although cognitive function and coordination may be modestly impaired, ventilatory and cardiovascular functions are unaffected.

Routes of administration:
•   enteral – any technique of administration in which the agent is absorbed through the gastrointestinal (GI) tract or oral mucosa (oral, rectal, sublingual).
•   parenteral – a technique of administration in which the drug bypasses the gastrointestinal (GI) tract (intramuscular (IM), intravenous (IV), intranasal (IN), submucosal (SM), subcutaneous (SC), intraosseous (IO).
•   transdermal – a technique of administration in which the drug is administered by patch or iontophoresis through skin.
•   transmucosal – a technique of administration in which the drug is administered across mucosa such as intranasal, sublingual, or rectal.
•   inhalation – a technique of administration in which a gaseous or volatile agent is introduced into the lungs and whose primary effect is due to absorption through the gas/blood interface.

General anaesthesia has many purposes including:
1.   Analgesia – loss of response to pain,
2.   Amnesia – loss of memory,
3.   Immobility – loss of motor reflexes,
4.   Unconsciousness – loss of consciousness,
5.   Skeletal muscle relaxation.

The Guedel's classification by Arthur Ernest Guedel described four stages of anaesthesia in 1937. Despite newer anaesthetic agents and delivery techniques, which have led to more rapid onset and recovery from anaesthesia, with greater safety margins, the principles remain.

Stage 1. Stage 1 anaesthesia, also known as the «induction», is the period between the initial administration of the induction agents and loss of consciousness. During this stage, the patient progresses from analgesia without amnesia to analgesia with amnesia. Patients can carry on a conversation at this time.

Stage 2. Stage 2 anaesthesia, also known as the «excitement stage», is the period following loss of consciousness and marked by excited and delirious activity. During this stage, respirations and heart rate may become

irregular. In addition, there may be uncontrolled movements, vomiting, breath holding and pupillary dilation. Since the combination of spastic movements, vomiting and irregular respirations may lead to airway compromise, rapidly acting drugs are used to minimize time in this stage and reach stage 3 as fast as possible.

Stage 3. Stage 3, «surgical anaesthesia». During this stage, the skeletal muscles relax, vomiting stops and respiratory depression occurs. Eye movements slow, then stop, the patient is unconscious and ready for surgery. It has been divided into 4 planes:

- eyes initially rolling, then becoming fixed
- loss of corneal and laryngeal reflexes
- pupils dilate and loss of light reflex
- intercostal paralysis, shallow abdominal respiration

Stage 4. Stage 4 anaesthesia, also known as "overdose", is the stage where too much medication has been given relative to the amount of surgical stimulation and the patient has severe brain stem or medullary depression. This results in a cessation of respiration and potential cardiovascular collapse. This stage is lethal without cardiovascular and respiratory support.

American society of anesthesiologists (ASA) patient physical status classification:

ASA I – a normal healthy patient.

ASA II – a patient with mild systemic disease.

ASA III – a patient with severe systemic disease.

ASA IV – a patient with severe systemic disease that is a constant threat to life.

ASA V – a moribund patient who is not expected to survive without the operation.

ASA VI – a declared brain-dead patient whose organs are being removed for donor purposes.

Neuroleptanalgesia – a form of analgesia achieved by the concurrent administration of a neuroleptic such as droperidol andan analgesic such as fentanyl. Anxiety, motor activity and sensitivity to painful stimuli are reduced; the person is quiet and indifferent to surroundings and is able torespond to commands. If nitrous oxide with oxygen is also administered, neuroleptanalgesia can be converted to neuroleptanesthesia.

Conscious sedation is – a technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which verbal contact with the patient is maintained throughout the period of sedation.

The drugs and techniques used to provide conscious sedation for dental treatment should carry a margin of safety wide enough to render loss of consciousness unlikely.

The level of sedation must be such that the patient remains conscious, retains protective reflexes and is able to understand and respond to verbal commands.

Sedation is a useful technique in anxious patients, children and in those undergoing more lengthy procedures. Patients often experience a sense of disorientation or detachment and may describe the experience as similar to being mildly drunk. In some it can induce sexual fantasies and a chaperone is essential.

Sedation is not a substitute for effective local anaesthesia. If local anaesthesia is inadequate, the patient will still experience pain and may become extremely agitated. Patients do not need to be starved before sedation (although a heavy meal is inadvisable) and any routine medication should be taken as normal. Patients must have an escort to take them home and look after them for 24 hours. Informed consent both for sedation and surgery is required, preferably written.

Sedation can be given in three ways.

Inhalational sedation. This is a relatively safe form of sedation used in dentistry although it has little role to play in more extensive surgery. It is particularly useful in children and can be helpful in quick procedures such as reduction of a dislocated mandible.

A variable percentage mix of nitrous oxide (N2O) mixed with oxygen (O2) is used for this technique. N2O is an extremely potent analgesic, rapidly taken up and excreted by the lungs. The N2O/O2 mix has both sedative and analgesic effects. The drug is not metabolized within the body to any significant extent, thus adding to its safety. This technique does not involve the use of injections and this may be an important factor for some patients.

Note that the terms 'relative analgesia' and 'inhalational sedation' both refer to N2O/O2 inhaled techniques. Relative analgesia involves titrating the N2O, dose whereas inhalational sedation uses a fixed dose of N2O. Both have a fixed minimum inhaled dose of 30% O2.

The mix of N2O/O2 is used as an adjunct to a local anaesthetic technique and is in no way meant to be used as the sole analgesic. With

correct patient selection, adequate local anaesthetic use, combined with reassurance, many dental procedures may be accomplished.

Following administration, patients make a quick recovery with no lasting effects.

Historically, when using N2O sedation, long-term exposure was thought to lead to vitamin B12 depletion and subacute degeneration of the spinal cord. With modern scavenging systems, extensive research has not found this to be a major concern. An additional concern is the potential for abuse of Diazepam is fairly rapidly absorbed from the gut. As a guide, a dose between 0,1 and 0,25 mg/kg of body weight will produce sedation.

Temazepam may be used, 10 to 20 mg 1 hour before treatment.

Intravenous sedation. In the United Kingdom the only recommended intravenous sedation method is the 'single injection of a single drug'. In this country the administration of multiple drugs should be carried out only by fully trained anaesthetists and in a hospital setting, with full monitoring and resuscitation equipment available.

The «single drug» in question is a benzodiazepine, usually midazolam. The advantages of the benzodiazepines are anterograde amnesia, anxiolysis and a degree of muscle relaxation. Midazolam has a wide margin of safety and is particularly suited to outpatient sedation. It causes minimal respiratory depression, although as patients relax they will often «forget» to breathe – vigilance is required.

Doses of midazolam for any individual patient are difficult to predict. Most patients reach an adequate degree of sedation with 10 mg or less. Bear in mind that the onset time may be delayed in elderly patients because of a slowed circulation time; patience will avoid inadvertent overdose.

GDC guidelines state that the patient's pulse, respiratory rate and O2 saturation must be monitored during the procedure. Noninvasive blood pressure recordings must be made at regular intervals and a defibrillator should be available in the procedure room. All staff involved must be proficient in cardiopulmonary resuscitation in the event of medical emergencies (regulations mandate a 'second appropriate person').

Skills need to be acquired in venipuncture to carry out intravenous sedation.

Flumazenil, a specific benzodiazepine reversal agent, must be available. It rapidly reverses all the effects of the benzodiazepines at a dose of 200 µg intravenously over 15 seconds, followed by 100 µg at 60-second intervals until reversal occurs. Bear in mind that flumazenil has a shorter duration of action, so multiple doses may be required.

Children may react with the opposite effect; paradoxical stimulation and agitation are well described following intravenous sedation. This method is therefore not recommended in the outpatient paediatric population. Both rectally and orally administered benzodiazepines are popular in paediatric wards for minor procedures such as suture removal.

Oral sedation. This is useful in mildly anxious patients and can be administered at home before the appointment. The advantage is acceptability to both patient and surgeon. However, it is essential that monitoring be used during any procedure if the patient has had oral sedation.

The disadvantage is that the surgeon has to rely on a compliant patient to self-administer the medication before coming to surgery, within an allotted period of time, for the sedative to be of benefit. This does require a motivated, cooperative patient.

Drugs administered orally take 30 to 60 minutes for any clinical effect to be seen. The dose required to produce sedation is unpredictable and absorption of drugs from the gastrointestinal tract is also variable. The effects are therefore variable in depth and duration.

There is the potential for complications should multiple doses be administered outside of a monitored environment. It is the responsibility of the prescriber to ensure that all the rules and regulations relating to sedation are applied and strictly followed.

Diazepam is fairly rapidly absorbed from the gut. As a guide, a dose between 0,1 and 0,25 mg/kg of body weight will produce sedation.

Temazepam may be used, 10 to 20 mg 1 hour before treatment.

Transcutaneous nerve stimulation. This technique is thought to work via the «gate control» theory. Rubbing or massaging a painful area, or the application of a small electrical current to the skin, closes the 'gate' at the spinal cord level and prevents pain fibres from conducting impulses to the brain. Transcutaneous electrical nerve stimulation (TENS) and some types of acupuncture are also thought to promote endogenous opioid release in the brain. In the maxillofacial region this can be effective in postherpetic neuralgia and other forms of deep-seated facial pain.

TENS is contraindicated in patients with pacemakers and should be avoided over the carotid sinus.

Hypnosis. This is thought to produce a state of altered consciousness and relaxation. Hypnosis is generally believed to be an altered state of

consciousness. Sleep is the best-known altered state. The aim of hypnosis is to teach people to cope with the situation to the best of their ability.

It has been suggested that in a hypnotic state, patients do not act against their own consciences and always cooperate voluntarily. Always have a chaperone.

Induction of the hypnotic state can be performed verbally by the surgeon, visually or by the patients themselves. Multiple sessions can prepare patients to autohypnotize or respond to posthypnotic suggestion by using key words or procedures.

Acupuncture. Traditionally acupuncture is a holistic approach to the management of disease as well as maintenance of health. It involves insertion of needles into various parts of the body and should be regarded as a supplement to conventional treatment.

It has value in control of postoperative pain and in the management of myofascial pain dysfunction and facial pain. Its value as a sole analgesic for operative treatment is questionable; however, it may play a role in reducing anxiety preoperatively.

The United Kingdom and German-speaking countries are fairly similar in this area. The United States is a little different.

Analgesia. Dental procedures can be painful and a sound knowledge of good analgesic prescribing is essential. The principles are simple: give appropriate drugs, in sufficient dose, on a regular basis, at sufficient time intervals. Where possible, use of smaller doses of a combination of drugs will have a synergistic effect, while minimizing side effects. When oral analgesics are combined with effective local anaesthetic techniques, the results can be very rewarding.

There are numerous approaches to this end. The simplest is set out in the World Health Organization analgesic ladder on the next page. Devised by the World Health Organization (WHO), it outlines a systematic approach to pain control that will satisfy the needs of the majority of patients.

Simple analgesics. Simple analgesics (e.g. paracetamol) are useful for mild pain. Minimal side effects at therapeutic doses make this an attractive option. Hepatotoxicity is a problem only at toxic doses. Paracetamol has antipyretic and analgesic properties. It is a useful analgesic if nonsteroidal anti-inflammatory drugs (NSAIDs) are contraindicated.

Doses: adult dose – 1 g every 4 to 6 hours. Maximum daily dose – 4 g; Paediatrics – dependent on age, consult recent formulary.

Nonsteroidal anti-inflammatory drugs. NSAIDs (e.g. aspirin, diclofenac, ibuprofen, ketorolac) have both anti-inflammatory and analgesic effects; therefore, they are useful particularly when inflammation is the primary cause of the pain. Following oral surgical procedures involving the teeth and bones (e.g. wisdom teeth removal, apicectomies), NSAIDs can be given orally, i.m. or rectally.

These drugs are contraindicated in patients with peptic ulcer disease, renal impairment and coagulation disorders and in patients who have had a previous hypersensitivity reaction to aspirin or NSAIDs.

A note about asthmatic patients and NSAIDs – These drugs are not absolutely contraindicated in asthma. There is, however, a higher chance of allergy and an increased chance of exacerbation of asthma symptoms.

Side effects include gastrointestinal upset, bleeding, hypersensitivity reactions and wheezing. Use with caution in elderly patients – Long-term use can result in severe gastrointestinal haemorrhage.

Doses. Adult dose – Ibuprofen 400 to 600 mg three times daily. Take with food to reduce chances of gastrointestinal upset. Maximum daily dose – 2.4 g.

Diclofenac 50 mg three times daily. Take with food.

Child dose – dependent on weight, consult recent formulary. Avoid aspirin in children with recent flu-like illness – Potentially lethal Reye's syndrome may result.

Minor opioids. These drugs (e.g. codeine, tramadol, dihydrocodeine) are effective for mild to moderate pain. Given orally or i.m. They can be given in combination with paracetamol. Side effects include nausea, constipation and confusion, especially in elderly patients.

Doses. Codeine – 30 to 60 mg every 4 to 6 hours to a maximum of 240 mg daily.

Tramadol – 50 to 100 mg every 4 to 6 hours; said to be less likely to interfere with pupillary response in head injury.

Compound analgesic (Co-Codamol [codeine and paracetamol])

This drug is used for mild to moderate pain relief or pyrexia.

Presentations: 8/500 – 8 mg codeine phosphate, 500 mg paracetamol. (If Co-Codamol is prescribed with no stated strength, this will be dispensed.) Given orally, constipation and rebound 'analgesic headache' are the main complications.

Adult dose – 1 to 2 tablets every 4 to 6 hours. Maximum daily – 8 tablets.

Child dose – dependent on age.

30/500 – 30 mg codeine phosphate, 500 mg paracetamol.

Dose – 1 to 2 tablets every 4 hours. Maximum daily – 8 tablets. Not recommended for children.

60/1000 – 60 mg codeine phosphate, 1 g paracetamol.

Dose – 1 tablet every 4 hours. Maximum daily – 4 tablets.

Opioids (e.g. morphine, diamorphine). These are the most potent of the analgesics. The opioids are seldom used after office procedures. The role is analgesia in the postoperative period after major surgery.

Routes of administration – options include oral (Oramorph), i.m., subcutaneous and intravenous administration and patient-controlled analgesia (PCA). Because of the side effect profile of the opioids, they should be administered only in an inpatient setting, where respiratory monitoring is available.

Side effects – Nausea and vomiting, constipation, sedation, confusion and respiratory depression. Prescription of naloxone, a specific opioid antagonist and an antiemetic for use alongside the opioid is humane. Consider addition of a laxative, especially in elderly patients or if long-term use is anticipated.

Cryotherapy. This is the therapeutic use of extreme cold, achieved by using N2O or liquid nitrogen to freeze tissues. Cell death and subsequent tissue necrosis result in analgesia.

Intractable or recurrent pain from nerve infiltration (e.g. malignancy or physiological conditions such as trigeminal neuralgia) may be treated by cryotherapy.

The diagnosis must be established beforehand and this is most easily done by a nerve block. In such cases the nerve (e.g. inferior alveolar, infraorbital) can then be exposed and frozen.

Procedure. Informed consent must be gained. In particular, patients must be warned of postoperative oedema and ulceration, which may be quite severe.

A local anaesthetic should be used to anaesthetize the area, followed by selection of appropriate probe tip. A lubricant jelly (such as KY) should be applied to the area to improve contact between probe and tissue. Freeze for 1 minute; thaw for 1 minute is the usual cycle.

During thawing, be careful not to pull the probe from the tissue because this will result in damage to tissue. At least two cycles are used. One may need to overlap ice zones.

Follow up to check symptoms.

The duration of paraesthesia varies, but there is usually an analgesic period after the paraesthesia resolves. If necessary, cryotherapy can be repeated at a later date.

TOPIC: INDICATIONS AND CONTRAINDICATIONS FOR TOOTH EXTRACTION

Extraction of teeth is one of the most common surgical procedures worldwide. It has a psychological impact on the patient, because the patient will be losing a tooth, and the associations the patient will have with such a procedure. The patient will also face another problem in that the loss of a tooth often requires a later replacement of the missing tooth. For this reason patient information and consent is very important. Moreover, extraction of teeth incorporates basic principles from physics, mechanics, and surgery, and the clinician should therefore fully understand and master the techniques of extraction.

Indications for extraction. Although teeth in principle should be treated and maintained in the oral cavity as long as possible, provided they fulfill functional and esthetic criteria, it is sometimes inevitable that teeth have to be removed for various reasons. General indications for extractions, are discussed under their respective headings; however, the decision to extract has to be made individually for each case.

Caries. When the tooth is subjected to severe caries with extensive loss of tooth substance that will not permit restorative procedures, it may sometimes be necessary to extract the tooth.

Periodontal disease. Periodontal disease should be treated as first alternative, but there are situations where severe periodontal disease can be an indication for extraction, especially when the prognosis is poor for periodontal treatment. Severe bone and attachment loss and irreversible tooth hypermobility may be an indication for extraction. Long-standing, progressive periodontitis will result in alveolar bone loss. If implant treatment is going to be performed after extraction it is important not to wait too long before severely periodontally affected teeth are extracted. The severity of periodontal disease, long-term prognosis, and even cost/benefit aspects should be considered before making the decision. Pulp disease when endodontic treatment is not possible or has failed Irreversible pulpitis, pulp necrosis or internal resorption of the root canal where endodontic procedures are not possible or have failed are sometimes other indications for tooth extraction. This could be because of obliterated root canals, canals that are not accessible due to root anatomy, or when a patient chooses not to undergo such treatment. Pathologic lesions in relation to teeth Pathologic lesions associated with teeth, i.e. apical or juxtaradicular periodontitis, can usually be solved by endodontic treatment. If endodontic procedures are not possible, then extraction can be considered. If teeth

compromise the surgical treatment of other pathologic lesions found in the tissues surrounding them, then extraction may be considered, e.g. in the treatment of osteomyelitis, or benign and malignant tumors of the jaw.

Crown and root fractures. Crown, crown-root, and root fractures after trauma can most often be successfully treated and extraction avoided. However, there are other situations where fractures of the crown and root do not allow successful restorative therapy and extraction is the only alternative.

Malposition of teeth. Although malposition of teeth is not an indication for extraction, there are situations where malposition is associated with other conditions such as trauma to soft tissue or blockage of eruption of adjacent teeth. Another situation is when there is elongation of teeth due to the missing antagonist and where prosthetic rehabilitation is considered in the opposing jaw. The elongated tooth may then be considered for extraction.

Impacted teeth. Impacted teeth do not always reach functional occlusion, often because of lack of space. These teeth should be investigated and considered for extraction if they present a potential for the development of pathology in the future. These could include the risk for root resorption of adjacent teeth, loss of bone around adjacent roots or development of other pathologic conditions such as cysts. Impacted third molars are the most common teeth considered for extraction. However, there must always be an indication if third molars are going to be removed and prophylactic removal of impacted third molars without pathology or symptom is not justified today.

Supernumerary teeth. Supernumerary teeth that are potential sources for future pathology should sometimes be removed. However, supernumerary teeth without pathology do not have to be routinely removed. Orthodontic indications Extraction of teeth is sometimes required to create space in order to carry out planned orthodontic treatment. The most common teeth for extraction on orthodontic indications are premolars. The decision on which tooth/teeth are to be extracted is made by the orthodontist.

Before prosthetic procedures. Before prosthetic reconstructions is carried out it is sometimes necessary to extract teeth. Teeth could interfere with the proper placement of a fixed or removable prosthetic appliance and may then be extracted. For example, in the case of rehabilitation of a jaw with implants where there are only one or two incisors remaining that have a dubious prognosis, in some situations it may be better to be radical and extract the remaining teeth and perform a full arch implant-supported reconstruction.

Before other surgical procedures. Sometimes teeth have to be removed prior to other surgical procedures. The most common indication in this regard is the removal of impacted molars prior to LeFort-I and sagittal split osteotomies. This is done if the teeth lie in the line of the planned osteotomiesor increase the risk for other complications such as undesired fractures.

Before radiation therapy. Careful consideration should be given to patients who are to undergo radiation therapy due to tumors in the head and neck region. These extractions should preferably be carried out before radiation treatment is starting. Teeth associated with pathologic conditions such as periapical periodontitis should be considered either for swift endodontic procedures or extraction. A radical approach by extracting rather than choosing doubtful restorative treatment with less chance of successful outcome is recommended to avoid later complications in the irradiated bone. There is a high risk of osteoradionecrosis if extractions have to be carried out after radiation therapy, especially with high doses of radiation (>60 Gray). This risk persists throughout the life of the patient.

Before bisphosphonate therapy. Patients treated with bisphosphonates, especially those treated for malignancies with intravenous administration of bisphosphonates, run a high risk of osteonecrosis if extraction is carried out after bisphosphonate treatment has started. Like in irradiated patients, this risk persists throughout the life of the patient. For this reason dental examination and appropriate treatment shall always be taken into consideration when such bisphosphonate treatment is planned. Extractions should be carried out before bisphosphonate therapy is started. Teeth associated with pathologic conditions such as periapical periodontitis should be considered either for swift endodontic procedures or extraction. A radical approach by extracting rather than choosing doubtful restorative treatment with less chance of successful outcome is recommended to avoid later complications. There is a high risk of osteonecrosis if extractions have to be carried out after intravenous bisphosphonate therapy is started. Patients on oral bisphosphonates, usually osteoporosis patients, are not subjected to the same high risk of osteonecrosis. Teeth in bone fracture lines Sometimes teeth in the line of a jaw fracture should be considered for extraction in order to prevent infection. Tooth luxation can almost always be treated by repositioning and fixation, but where there is severe luxation of teeth associated with complex jaw fractures, where teeth are in the line of the fractures and interfering with the repositioning, these teeth should be extracted.

Other reasons for extraction. There are other situations where extraction may be chosen, even when the extraction may be on doubtful indications. In these situations it is especially important to discuss alternative treatment and inform the patient preoperatively so the surgeon and patient agree on the choice of treatment. Extractions can sometimes be performed due to economic reasons. Patients might choose to extract a tooth rather than incur the costs of, for example, having endodontic treatment or a more expensive restorative procedure. Extractions can sometimes also be performed due to esthetic reasons. For example, the patient could choose to extract an upper malformed lateral incisor and have it replaced with an implant. Furthermore, a patient could choose to extract protrusive teeth in the upper front and have them replaced by an implant-supported prosthesis as an alternative to undergoing orthodontic or orthognathic surgical correction. Malformed or severely discolored teeth could also be considered for extraction due to esthetic reasons where the patients choose extraction and prosthetic reconstruction over other procedures such as veneers and crowns. Teeth could sometimes also be extracted due to difficulty in maintaining adequate oral hygiene. Most commonly, the third molars are extracted due the recurrence of pericoronitis and difficulties in maintaining oral hygiene.

Contraindications for extraction

The surgeon should also consider the contraindications for extracting the tooth, for example with consideration to the patient's general health or local conditions in the region of extraction. Contraindications for extractions are often relative and can be changed after treating or adjusting the underlying reason for the contraindication.

Systemic contraindications. These constitute all general health factors and mental factors which have influence on the patient's ability to withstand the surgical procedure. Severe dental anxiety is a relative contraindication to extraction in local anesthesia and in some cases patients can be treated in general anesthesia. One should pay extra attention to patients on medication such as anticoagulant drugs, cancer medication, glucocorticoids, immunosuppressants and bisphosphonates. Patients with hemophilia or other coagulopathies should first have their disorders controlled before extraction. In general, most uncontrolled metabolic diseases, such as diabetes, constitute a relative contraindication until they are brought under control. Similarly, patients with severe uncontrolled hypertension and cardiac diseases should ideally be treated for these conditions first before extractions are carried out. Ongoing radio- and/or

chemotherapy is also a relative contraindication. In all cases, one should be aware of the medications, especially those drugs that affect the immune system, delay or impair the healing process, or could interact with medication administered to manage an extraction. Some cancer medications, e.g. bisphosphonates, can also cause necrosis of the jaws after extractions.

Local contraindications. The most common local contraindication is an ongoing acute inflammatory or infectious process. The acute infection/inflammation should first be treated before proceeding with the extraction, depending on the location of the acute process. Extraction of a third lower molar during an ongoing acute pericoronitis could lead to a life-threatening postoperative infection. Local treatment of the pericoronitis is preferred and extraction may be carried out later. However, there are also situations where an acute abscess is best drained by extraction of the tooth even in an acute phase. Therefore, an acute infectious and inflammatory process should not be considered as an absolute contraindication for extraction. The surgeon should, however, bear in mind that there could be other problems, such as severe pain, swelling, reduced mouth opening, and anxiety, which could make extractions associated with other acute conditions suboptimal. In such cases extractions should be deferred until the acute symptoms have subsided. One of the most important contraindications to extraction is radiation therapy, past and present, involving the jaws. Delayed healing, dehiscence, and necrosis of the bone are often complications due to extractions performed in irradiated bone. Finally, teeth within the area of a malignant tumor should not be removed before the planning of tumor treatment has been performed.

TOPIC: TOOLS AND METHODS FOR TOOTH EXTRACTION

A tooth or root may be removed with either the closed or the open technique. The closed technique is also known as the simple technique or forceps technique, while the open technique is also known as a surgical extraction or flap technique. The simple technique is that which is used most often in everyday practice. In contrast, the surgical technique is employed only in cases where the tooth or root extraction is not possible with the simple technique. The basic requirements for a successful outcome in simple tooth extraction are as follows:

−   informing and reassuring the patient, so that stress and fear levels are minimized, and so to ensure desirable cooperation during the procedure.

−   knowing tooth anatomy well, which can be variable

−   detailed clinical and radiographic examinations, since these provide important information pertaining to procedure planning and selecting the appropriate technique.

−   preparation of the patient, which includes: rinsing the oral cavity with various antiseptic solutions, and correct positioning of the dental chair.

Patient Position

To ensure adequate visualization and comfort during the various manipulations required for the tooth extraction, the dental chair must always be positioned correctly. For the extraction of a maxillary tooth, the patient's mouth must be at the same height as the dentist's shoulder and the angle between the dental chair and the horizontal (floor) must be approximately 120°. Also, the occlusal surface of the maxillary teeth must be at a 45° angle compared to horizontal when the mouth is open. During mandibular extractions, the chair is positioned lower, so that the angle between the chair and the horizontal is about 110°. Furthermore, the occlusal surface of the mandibular teeth must be parallel to the horizontal when the patient's mouth is open. The position of right-handed dentists during extraction using forceps is in front of and to the right of the patient; left-handed dentists should be in front of and to the left of the patient. For the extraction of anterior mandibular teeth right-handed dentists should be positioned in front of the patient, or behind them and to their right; left-handed dentists should be in front of them or behind them and to their left.

Forceps for tooth extraction

The forceps design:

1. Cheeks.
2. Lock.
3. Handles (jaws)

Characteristic of the angle.

In the forceps to remove the upper teeth:

–   cheeks axis coincides with the axis handles, making a straight line.

–   the angle formed by the axis of the cheeks and the axis handles close to two right angles.

–   axis cheeks and handles axis are parallel or nearly parallel.

In the forceps to remove the lower teeth:

–   cheeks axis and the axis of the handles forms a right angle or approaching straight angle.

Feature curve handles:

–   To remove the front (incisors and canines) upper teeth are straight forceps handles are in the same plane with the cheeks.

–   To remove the top small and large root teeth (premolars and molars) are tongs with an S-shaped cheeks and handles – S-shaped forceps. Due to this bending pliers can freely impose on the tooth side, and thus prevents the lower jaw dislocating movements.

–   To remove the upper third molars – special bayonet forceps having a bayonet bend, which allows you to seamlessly bring them to the third molar.

Feature convergence cheeks:

–   To remove the roots of the teeth on the upper jaw – or bayonet forceps with convergent cheeks (at the closing of the forceps handles, their cheeks converge – is the hallmark of forceps for removing roots of teeth).

–   To remove the roots of the teeth on the lower jaw – coronoid forceps with convergent cheeks.

Feature of direction:

There is only the S-shaped tongs for removing molars in the upper jaw. These pliers have a spike on one of the cheeks, the other cheek – smooth. Spike enters the bifurcation between the two buccal roots. If a spike on the right cheek – is to remove the left molars, and vice versa. To identify correctly the forceps must be placed on the palm of his right hand swell up pens.

All other tongs are designed to operate as a right-hand side of the jaw, and on the left.

Feature width cheeks:
Choosing the right forceps depends on the group membership of a tooth in accordance with the crown width of the tooth. The tongs for removing incisors, canines, and premolars cheeks are narrower than – to remove molars. Narrower cheeks have forceps for removing roots of teeth.

To remove the teeth on the lower jaw are coronoid forceps:
- the cheeks, bent on the edge – smooth, without thorns – to remove the incisors, canines and premolars;
- the cheeks, bent on edge – with a spike on each cheek, which is designed for entry into the bifurcation between the two roots – a front and a distal – to remove molars in the lower jaw;
- cheeks, curved forceps on a plane – with a spike on each cheek. It is intended for removal of lower third molars with limited mouth opening.

Elevators for tooth extraction

Use elevators, failure the roots removal of teeth with forceps,
Mode of elevator's action – the lever of the first kind, consists of:
1. Cheeks, which ends in a slightly concave groove with a thinned end. The concave cheeks face to the deleted root. The convex part of the cheeks rests on the wall of the cavity or a nearby root.
2. Intermediate part, where the second doctor's finger is located while using elevator.
3. Handles, that the doctor grasps his right hand.

Straight elevator: to remove the single-root teeth in the upper jaw, upper jaw teeth, positioned outside the arc. Sometimes straight elevator is used for removal of lower third molar roots and lower molars.

The corner or side elevators: to remove the roots of the teeth on the lower jaw, especially the molars.

Unlike straight elevator: cheek bent on edge and forms with the longitudinal axis of the elevator angle $60\text{-}80^0$.

In some sorts of elevators – also connecting part has a bend.

In the operating position of the elevator cheek facing the concave part or otherwise that depends on the point force application.

T-shaped or bayonet elevator (Lecluse key) to remove the third molar of the lower jaw with the stable first and second molars. Lecluse key comprises cheeks connected by a bayonet coupling link with a massive

handle is perpendicular to the elevator axis. Cheeks, thinned to an end, one side is flat, the other convex.

Separation of tooth from soft tissues
Severing soft tissue attachment

The first step in removing a tooth using the simple technique is to sever or loosen the soft tissue attachment surrounding the tooth. Two instruments are required to sever the soft tissue attachment: the straight and curved desmotomes. The straight desmotome is used for the six maxillary anterior teeth, while the curved desmotome is used for the rest of the maxillary teeth and all the mandibular teeth. The desmotome is held in the dominant hand, with a pen grip and, after being positioned at the bottom of the gingival sulcus, it is used to sever the periodontal ligament. This is accomplished in one continuous motion, beginning at the distal surface of the tooth and moving toward the mesial surface, first buccally and then lingually or palatally. While severing the soft tissue attachment, the index finger and thumb of the nondominant hand are positioned buccally and palatally or the index finger and middle finger are placed buccally and lingually, to protect the soft tissues from injury (tongue, cheeks and palate). More specifically for right-handed dentists, in the right maxilla, from the canine and posterior to the canine teeth (teeth 13–18), the index finger is placed palatally and the thumb buccally, while for the rest of the teeth (anterior teeth and teeth on the left side, teeth 12–28), the index finger is positioned buccally and the thumb palatally. In the mandible, the fingers are positioned differently. The fingers usually used are the index finger and middle finger of the nondominant hand. More specifically, from the left third molar until the right lateral incisor (teeth 38–42), the index finger is placed buccally and the middle finger lingually, while for the rest of the teeth of the right side (teeth 43–48), the index finger is positioned lingually and the middle finger buccally. For left-handed dentists, from the canine and posterior to the canine teeth (teeth 23–28) in the left maxilla, the index finger is placed palatally and the thumb buccally, while for the rest of the teeth (anterior teeth and teeth on the right side, teeth 22–18), the index finger is positioned buccally and the thumb palatally. In the mandible, the fingers are positioned differently. The fingers usually used are the index finger and middle finger of the nondominant hand. More specifically, from the right third molar until the left lateral incisor (teeth 48–32), the index finger is placed buccally and the middle finger lingually, while for the rest of the teeth of the left side (teeth 33–38), the index finger is positioned lingually and the middle finger buccally.

Reflecting soft tissues

Reflecting the gingiva surrounding the tooth is accomplished with two instruments called Chompret elevators. Depending on the shape of the blade, the Chompret elevator is either straight or curved. These elevators are used to push or slightly reflect the gingiva around an intact tooth, to allow the extraction forceps to grasp the tooth beneath the cervical line of the tooth as apically as possible. Some people suggest that reflecting the soft tissues is not necessary since severing them is sufficient, while others consider that reflecting is a more appropriate procedure compared to severing the soft tissue attachment. The fact remains that severing the soft tissue attachment is a less traumatic procedure compared to reflecting. Chompret elevators are also used to expose destroyed teeth that are covered by hyperplastic gingivae, enabling positioning of the appropriate instrument for their removal. Reflecting (positioning of fingers and movements) is done in exactly the same way as severing the soft tissue attachment, with a slightly different motion, which is applied with slight pressure and in an outward direction. Chompret elevators may also be used as dental elevators to remove roots and broken root tips. It is worth noting that in the case of an intact tooth, the Freer periosteal elevator, being a very narrow instrument and easy to handle, is considered more suitable for reflecting the soft tissue attachment compared to the previously mentioned instruments.

Extraction technique using tooth forceps

The extraction technique using tooth forceps is based on certain guidelines to ensure that the tooth is extracted with maximum skill. These guidelines involve the correct way to hold the forceps and the tooth itself, the forces applied to the tooth, and the direction of movement during the extraction. The extraction forceps are held in the dominant hand, while the thumb is simultaneously placed between the handles directly behind the hinge, so that pressure applied to the tooth is controlled.The nondominant hand also plays an important role in the extraction procedure. More specifically:

−   It reflects the soft tissues of the cheeks, lips, and tongue, so that there is adequate visualization of the surgical field.

−   It supports the alveolar process of the maxilla and aids in stabilizing the patient's head. It also controls the expansion of the alveolar bone by way of feel, as well as luxation of the tooth during the various maneuvers.

−   It supports and stabilizes the mandible, counteracting the forces applied by the extraction forceps, which, when very great, may injure the temporomandibular joint.

After reflecting of the gingiva, the beaks of the forceps are positioned at the cervical line of the tooth, parallel to its long axis, without grasping bone or gingivae at the same time. The initial extraction movements applied are very gentle. More specifically, the dentist applies slow steady pressure to move the tooth buccally at first, and then palatally or lingually. Movements must become greater gradually and the buccal pressure is greater than the corresponding palatal or lingual pressure, because the labial or buccal bone is thinner and more elastic compared to that of the palate. If anatomy of the root permits (single, conical roots), rotational force may be applied in addition to buccopalatal or buccolingual pressure. These movements expand the alveolar bone and also sever all the periodontal fibers. Slight traction is also employed at the same time, facilitating the tooth extraction. During the final extraction phase, traction is not permitted, because there is risk of damage due to sudden removal of the tooth and the risk of the forceps knocking the teeth of the opposite arch. To avoid such a possibility, the final extraction movement must be labial or buccal, and in a curved direction that is outwards and upwards for the maxilla, and outwards and downwards for the mandible. Before the tooth is delivered from the socket, the soft tissue between the tooth and the gingiva must be examined for a possible attachment. If this is the case, the gingiva must be completely severed from the tooth, because there is a risk of greatly tearing the tissues.

Procedural steps:

1. Separation – separation of circular ligament from the neck of the tooth and the gums of the alveolar bone.

The basic rule: thoroyghness of the work.

2. Forceps on the tooth.

The basic rule: the axis cheeks forceps should coincide with the axis of the tooth.

3. Promoting cheeks forceps. When removing teeth preserved crown, cheeks forceps to promote the neck of the tooth. When bone resorption around the tooth is permissible to promote extractor deeper in the upper part of the root. When you remove the roots of teeth impose forceps on the edge of the alveoli.

The basic rule: the axis cheeks forceps must coincide with the axis of the tooth.

4. Retention or interlocking of forceps. Forceps and the tooth should be «one». Tooth and forceps at the same time form a common arm.

5. The dislocation of the tooth. There is a gap periodontal fibers, connecting the tooth to the walls of the cavity.

There are two ways of dislocation:

Luxation – oscillating (pendulum) movement in the vestibular-oral direction;

Rotation – rotational motion around the axis of the tooth to 20-28^0 in one direction and then in another direction. Rotation is possible while dislocation 11th, 12th, 13th, 21st, 22nd, 23rd and the severed roots 14th, 24th, 17th, 18th, 26th, 27th, 28th.

Basic rules:

– The first sprained movement should start in the direction of least resistance (where the cavity wall is thinner). Vestibular wall of the alveolar bone is usually thinner than the palate. So the first sprained movement by removing the teeth and roots of teeth of the upper jaw should be done in the vestibular side (outside). The exceptions are 16th and 26th teeth, as at the level of the teeth passes chine alveolar crest, thickening the outer wall. Therefore, if you remove these teeth – the first sprained movement is carried out in the palatal side. When you remove the lower teeth presence of the external oblique line in the area of molars results in that the removal of these teeth need to make the first move in the oral side.

– The first sprained movement makes weak, should gradually increase the amplitude of the oscillation.

6. Removing the tooth from the cavity. Produced when the connection with the tissues of the tooth completely lost. It carried out smoothly, without jerks.

7. Cavity curettage.

The basic rule: curette spoon size should fit well. You should know the presence of the maxillary sinus on upper jaw.

8. Provide full clot formation and convergence cavity edges using gauze.

The basic rule: the clot must be complete, i.e. not extend beyond the cavity (not to be loose, overlapping the edge of the cavity).

Tooth extraction on mandible

The position of the patient in the chair: the operative field is to be at the level of the elbow lowered doctor's hands. The patient's head is in a vertical position, and by removing the left molars and premolars slightly rotated right.

The position of the doctor to the patient:

– The right and in front by removing all groups of teeth in the lower jaw on the left and the right incisors and canines, and molars on the right while removing with forceps, curved in the plane.

−   The right and rear of the patient in removing premolars and molars of the mandible on the right with coronoid shaped forceps, curved along the edge, and elevators.

Using forceps:

−   For the removal of 31st, 32nd, 41st, 42nd teeth use forceps, curved along the edge of a narrow cheeks, thornless.

−   For the removal of 33rd, 34th, 35th, 44th, 45th teeth using coronoid forceps curved along the edge, with widen cheeks, without thorns.

−   For the removal of 36th, 37th, 46th, 47th teeth used coronoid forceps, bent on the edge, with thorns on both cheeks.

−   For the removal of 38th and 48th used the tooth coronoid forceps, bent on the edge, with thorns on both cheeks (normal opening of the mouth).

−   For the removal of 38th and 48th while limiting the opening of the mouth using coronoid forceps curved in the plane.

−   To remove the roots of all the groups of teeth in the lower jaw are used coronoid forceps, bent on the edge, with narrow converging cheeks.

According to indications the elevators are used.

Using elevators:

−   When removing 38th and 48th used straight elevators. Bearing point are located near the 37th and 38th.

−   For the removal of the distal right and left mesial roots of the molars used a corner pull elevator.

−   For the removal of the distal left root and right mesial roots of the molars used a corner push elevator.

Tooth dislocation. First dislocating (luxation) movement while removing all groups of teeth in the lower jaw with the exception of 37th, 38th, 47th and 48th spend in the vestibular side (in the direction of less resistance); 37th, 38th, 47th, 48th – in the oral (lingual) side.

Exclusion of dislocation when the 2nd and 3rd molars of the mandible is due to thickening of the vestibular wall by the external oblique line.

Tooth extraction on maxilla

Extraction of maxillary central incisors

Extraction forceps for six anterior maxillary teeth or maxillary universal forceps. In order to extract maxillary central incisors, righthanded dentists must be positioned in front of and to the right of the patient, and left-handed dentists in front of and to the left of the patient. The index

finger of the nondominant hand is then placed labially, and the thumb palatally, firmly holding the alveolar process next to the tooth to be extracted. The beaks of the forceps are adapted to the tooth, and the beaks must be parallel to the long axis of the tooth. The initial extraction movements are gentle, first in a labial direction, and then palatal. After the initial force is applied to the tooth, motions gradually become greater and the final extraction force is applied labially. Because the root of the central incisor is conical in shape, its removal may also be achieved using rotational forces. More specifically, the tooth is rotated first in one direction and immediately afterwards in the other direction, until the periodontal fibers are completely severed. The tooth is then delivered from the socket using slight traction.

Extraction of maxillary lateral incisors

Extraction forceps for six anterior maxillary teeth or maxillary universal forceps. In order to extract maxillary lateral incisors, righthanded dentists must be positioned in front of and to the right of the patient, and left-handed dentists in front of and to the left of the patient. The fingers of the nondominant hand are placed in exactly the same way as for the central incisors. The extraction movements for removal of the lateral incisor are labial and palatal. Because the lateral incisor has a thin root and there is usually curvature of the root tip distally, rotational force is not allowed. Slight rotational motions may be employed only in the final stage, with simultaneous traction of the tooth from the socket.

Extraction of maxillary canines

Extraction forceps for six anterior maxillary teeth or maxillary universal forceps. Maxillary canines present some degree of difficulty due to their firm anchorage in alveolar bone, and their long roots and frequent curvature of the root tip. Also, the labial surface of the tooth's root is covered by thin alveolar bone, and if due consideration is not given during movements, there is a risk of fracturing the alveolar process. In order to extract maxillary canines, right-handed dentists must be positioned in front of and to the right (left-handed dentists should be in front of and to the left) of the patient, whose head should be turned towards the dentist. For the right-handed dentist, the fingers of the nondominant hand are placed as follows: for the right side, the thumb is placed labially and the index finger palatally, while for the left side, the index finger is placed labially and the thumb palatally. For the left-handed dentist, the fingers of the nondominant hand are placed as follows: for the right side, the thumb is placed palatally and the index finger labially, while for the left side, the index finger is

placed palatally and the thumb labially. The extraction movements are labial and palatal, with gradually increasing intensity. Because the canine has a flattened root and the root tip is usually curved distally, rotational motions are not permitted, or if they are used, they must be done so very gently and with alternating buccopalatal pressure. The final extraction movement is labial.

Extraction of maxillary premolars

Maxillary universal forceps. In order to extract maxillary premolars, the dentist should be positioned in front of and to the right (or to the left for left-handed dentists) of the patient. For right-handed dentists, the fingers of the nondominant hand are placed as follows: for the right side, the index finger is placed palatally and the thumb buccally, while for the left side, the index finger is placed buccally and the thumb palatally. For left-handed dentists, the fingers of the nondominant hand are placed as follows: for the right side, the index finger is placed buccally and the thumb palatally, while for the left side, the index finger is placed palatally and the thumb buccally. As for the first premolar, because it usually has two roots, buccal and palatal pressure should be gentle and slight. If movements are vigorous and abrupt, there is a risk of fracturing the root tips. If one of the root tips does break, it may be removed easily, since they are not very curved and the tooth has already been mobilized during the extraction attempt. Rotational motions are not allowed due to the tooth's anatomy. Extraction of the second premolar is easier, because the tooth has one root. Movements are the same as those for the first premolar. The final movement for both teeth is buccal.

Extraction of maxillary first and second molars

Maxillary right molar forceps, maxillary left molar forceps. In order to extract maxillary molars, the dentist must be positioned in front of and to the right (or to the left, for left-handed dentists) of the patient. The fingers of the nondominant hand are placed in exactly the same way as for maxillary premolars. The appropriate forceps are chosen, depending on the tooth to be extracted. The right and left maxillary molar forceps differ in that their buccal beaks have a pointed end at the center, which adapts to the root bifurcation. The maxillary first molar has three diverging roots: the palatal, which is the largest and most widely divergent toward the palate, and the two buccal roots, which are often curved distally. The tooth is firmly anchored in the alveolar bone and its buccal surface is reinforced by the extension of the zygomatic process. This tooth therefore requires the application of strong force during its extraction, which may cause fracture

of the crown or root tips. To avoid this from happening, initial movements must be gentle, with buccopalatal pressure and an increasing range of motion, especially buccally, where resistance is less. The final extraction movement is a buccal upwards curved motion, following the direction of the palatal root. Because the root tips are close to the maxillary sinus, their removal requires careful consideration, due to the risk of oroantral communication. Extraction of the maxillary second molar may be accomplished in the same way as for the maxillary first molar, because the teeth have similar anatomy. Extracting the second molar, however, is considered to be easier than extracting the first molar, because there is less resistance from the buccal alveolar process and relatively little divergence of the roots. Quite often the roots of this tooth are fused together in a conical shape. In this case, extraction of the tooth is even easier.

Extraction of maxillary third molar

Maxillary third molar forceps. In order to extract maxillary third molars, the dentist must be positioned in front of and to the right (or to the left, for left-handed dentists) of the patient. The fingers of the nondominant hand are placed in exactly the same way as for maxillary premolar extraction. The maxillary third molar is the smallest of all molars and varies greatly in size, number of roots, and root morphology. It has three to eight roots. It most commonly has three roots just like the other maxillary molars, but smaller and converging. They are usually fused together in a conical shape, curved distally. Extraction of the tooth depends on its location, as well as on the number and shape of the roots. If the third molar has erupted completely and its roots are fused (conical shape), its extraction does not usually present any difficulty and it may be removed with only buccal pressure. The risk of fracturing the palatal alveolar process is avoided this way, which would otherwise occur if force were applied palatally (the palatal bone is thinner and lower than the buccal bone). When the tooth has three or more roots, though, its extraction is accomplished by applying buccal pressure and very gentle palatal pressure. The final extraction movement must always be buccal. Root anatomy of the third molar permitting, extraction is easily accomplished using the straight elevator. The elevator is positioned between the second and third molars and the tooth is luxated according to the direction of its roots.

TOPIC: SURGICAL TOOTH EXTRACTION

The management of impacted teeth is probably the most common problem in oral and maxillofacial surgery worldwide. Teeth that fail to erupt are usually the teeth which erupt last in a certain region where there is not enough space or because of crowding of teeth. The most common teeth which are impacted are mandibular and maxillary third molars followed by maxillary canines and mandibular premolars. An impacted tooth is one which is prevented from completely erupting into a normal functional position. This may be due to lack of space, obstruction by another tooth, or an abnormal eruption path. The tooth may be soft tissue impacted or hard tissue impacted and may be unerupted or partially erupted. Impaction per itself is not an indication for removal, it is only a description of the position of the tooth. However, impacted teeth may sometimes give rise to complications if they are left in place, and over several decades there have been recommendations that impacted teeth should be removed, even if they are asymptomatic.

In the last 20 years, however, there has been much discussion and controversy regarding the need for prophylactic treatment of asymptomatic impacted teeth and there is now evidence that asymptomatic impacted teeth do not have to be removed. This discussion of prophylactic third molar surgery has been stimulated by research in medical decisionmaking, public health analysis, cost-effectiveness studies and by incorporating patient preferences in the decision-making process. It is well known in the practice of medicine that there is also a geographical and cultural variation in treatment indications and this variation can also be expected in the management of the third molar problem. Since surgery is sometimes associated with complications, one must always balance the risk of complications caused by leaving the impacted tooth in place against the risk for complications and discomfort associated with surgery. The main complications related to third molar surgery are alveolar osteitis (fibrinolytic alveolitis, dry socket) infection and temporary or permanent nerve injury. Nerve injuries often cause temporary and permanent neuropathic pain or altered sensation in and around the mouth, resulting in significant difficulties for the patient with regard to eating, drinking, speaking, kissing, shaving, applying makeup etc. A nerve injury is one of the main causes of litigation in dentistry. Prevention of these injuries must therefore be taken into consideration before surgical removal of impacted teeth. The patient should always be advised of the risk of inferior alveolar nerve injury. It is probably easier for a patient to accept a permanent complication or disability of an intervention if it was properly based on a

therapeutic indication than if surgery was performed on prevention and prophylaxis. Patient information about risks and complications is very important and the patient should always be part of the decision.

While many impacted third mandibular molars that cause problems are removed, impacted canines and premolars may often be guided to erupt spontaneously or by using orthodontic traction. Some impacted teeth, especially premolars, can be used as autotransplants to another region.

Management of impacted third molars Indications for third molar removal.

There should always be an appropriate indication for third molar removal. Indications can be local or for medical reasons.

Local therapeutic indications
 • Recurrent or severe pericoronitis;
 • Periodontal disease with a pocket depth of 5mm or more distal to the second molar;
• non-restorable caries in the third molar;
• Resorption of the third molar or adjacent tooth;
• Caries in the second molar where the third molar removal would render restoration possible or more simple;
• Apical periodontitis;
• Cysts or tumors associated with the third molar (or adjacent tooth);
• When required prior to orthognatic surgery;
• Removal of third molar in a fracture line;
• When a third molar may be considered for autogenous transplantation. Medical conditions that require a serious consideration of prophylactic third molar removal Prior to:
• radiation therapy for head and neck malignancies;
• organ transplantation;
• chemotherapy;
• bisphosphonate therapy.

Contraindications for third molar removal
There are situations when third molars should not be removed.

Summarizing our current knowledge from the literature, published in reviews and guidelines, it is recommended that:
• third molar buds in young people should not be enucleated;
• asymptomatic pathology free third molars totally covered by bone should not be removed;

• routine removal of pathology free third molars totally or partially covered by soft tissue is not recommended but specific medical and local conditions may prove a prophylactic approach appropriate;

• third molar surgery is contraindicated in patients whose medical history or conditions expose the patient to an unacceptable risk to their health.

Presurgical assessment of third molars

In addition to a thorough history-taking, clinical and radiologic assessment should always be combined before considering removal of a third molar. Clinical assessment Clinical assessment should be carried out with the aim of assessing the status of the patient, the oral and maxillofacial region, the third molars and the adjacent teeth (eruption status, caries, periodontal status, occlusion).

Radiological assessment

Radiological examination is a complement to the clinical examination and is necessary in order to make decisions related to the procedure. A radiological evaluation will give information about anatomy of the impacted tooth, the region and the relation of structures. Usually a pair of periapical radiographs taken in different projections is enough and can be supplemented by a panoramic radiograph when more than one third molar requires assessment. If the initial radiographs suggest a close relationship between the roots of the lower third molar and the inferior alveolar nerve (IAN) canal, cone-beam computer tomography (CBCT) scanning can be used to give more detailed information of the aImportant factors to consider.

The following local factors are important to take into consideration when planning third molar surgery.

Application depth.

The alveolar bone level and tooth position will dictate the application point depth. The depth of application and the point of elevation will dictate the amount of bone removal that is required to gain access to the optimal application point. This factor is the most predictive of difficulty of surgery. Another way to describe depth of impaction is Pell and Gregory classification, which assesses the relationship of the tooth to occlusal plane (classified as A, B, C) and relationship of the tooth to the anterior border of ramus (classified as 1, 2, 3). This classification may be used to describe the depth of impaction of the tooth but has been found to be less reliable in predicting difficulty than assessing the application point depth.

Angulation

The distinction between vertical, mesoangular, horizontal, and disto-angular orientation may affect the surgical approach, in particular with regard to the requirements for bone removal in order to gain access to point of application. The incidence and estimated degree of difficulty for the different angulations are:

• vertical impaction: 40% of all impacted mandibular third molars and usually the least difficult to remove.

• mesoangular impaction: 45% – can be of moderate difficulty;

• horizontal impaction: 10% – are generally of intermediate difficulty;

• distoangular: 5% – the most difficult to extract and frequently underestimated.

The application point and necessary bone removal is not only dictated by the angulation of the tooth but also root morphology and proximity to adjacent structures (adjacent tooth, antrum and nerve). In association with identifying the tooth angulation, the potential space for application points must be identified. Often distoangular lower third molars are in close proximity to the adjacent second molar and have limited space for mesial application point. Several examples of radiographs of third molars illustrating angulation of teeth and a summary of potential application points for bone removal and planned sectioning.

The crown size and condition

The crown width of the third molar can be an important factor in making surgery more difficult. If the tooth is impacted and the crown is wide, sectioning of the crown will be required to minimize bone removal thus reducing potential pain and swelling for the patient. If the third molar is carious or heavily restored, or indeed non-vital, this may render the tooth more brittle on elevation thus impacting on surgical difficulty.

Root number and morphology

More complex root morphology is associated with increased difficulty of surgery. Identification of such hooks is important, as they may fracture during removal of the tooth and a decision is then required as to whether to attempt their removal. Hooked, dancing or bent roots may provide a "challenge" to routine elevation. Even after sectioning of the crown and roots, if the root morphology is complex the roots will often require further sectioning and patience is often required to identify the "sweet spot" with which the resistant root will comply with elevation. Occasionally lower third molar roots can perforate the lingual plate and this

is often not evident until part way through surgery. Every effort must be made to ensure these roots do not get lost through the perforated lingual plate, one of the rare indications to raise a lingual flap for third molar surgery.

Pathology associated with third molars Cystic lesions are the most common pathology associated with mandibular third molars. If the cystic lesion is associated with the crown of the tooth, the first differential diagnosis should be dentigerous cyst followed by odontogenic keratocystic tumor or ameloblastoma. Odontogenic keratocystic tumors are more likely to be associated with missing teeth. Surgical removal of third molars in association with pathology may be facilitated. However, the surgeon must ensure the pathology is correctly diagnosed and treated accordingly.

Removal without using a flap

In some cases, when the molar is erupted, a third molar can be removed using forceps or elevator without raising a flap.

Surgical flaps

Impacted third molars are extracted by first raising buccal triangular or envelope flap to gain access to the tooth. The flap should be a full thickness mucoperiosteal flap and, as pointed out in other another chapter, consideration must always be taken to the anatomy and sensitive structures in the region of the flap.

Bone removal

In the maxilla the overlying bone is thin and the maxillary bone is cancellous and elastic so extraction is usually accomplished by removing additional bone rather than by sectioning the tooth. For maxillary third molars, bone removal is done primarily on the lateral aspect of the tooth down to the cervical line to expose the crown. In the mandible an air-driven or electric hand piece with round or fissure burs is used. A fissure bur is be used to get clean sections for tooth splitting for elevation. For mandibular teeth, bone on the occlusal and buccal aspects of the impacted tooth is removed beyond the cervical line down to the roots of the tooth. It is advisable not to remove bone on the lingual and distal aspects due to the likelihood of damage to the lingual nerve.

Sectioning the tooth

Tooth sectioning is important and saves operative time. When sectioning the crown from the root a fissure bur allows the surgeon to get a narrow clean section into the dental pulp then extend the slot within the confines of the tooth. At no point should the bur breach the mesial, distal or lingual surfaces of the tooth. Thus one achieves a "partial" section of the tooth covering about 40% of the split surface. After this section has been

made the crown can be fractured with the help of an elevator in the slot. Depending on the depth of application point and the angulation, the crown or root will need to be sectioned. When sectioning the roots the surgeon can use the dental pulp chambers to estimate where to split the roots. Again at no point should the drill cut extend through the lingual aspect of the roots. Drilling a small hole large enough to engage the tip of a curved Warwick James elevator is useful in gaining a "purchase point" to elevate roots.

Coronectomy

Coronectomy (also known as partial tooth removal, partial odontectomy or intentional root retention) is a technique of partial root removal which should be considered when radiographic imaging suggests an intimate relationship between the roots of the lower third molar and the IAN and there is a high risk of nerve injury if too much bone has to be removed. In such cases only the crown is removed and the root is retained. In the years after coronectomy subsequent root migration can be seen towards the superior border of the mandible. Later root removal may be required but only in 2–6% of cases. Roots may require removal when they erupt later and become infected but sometimes the roots have then migrated away from the IAN thus minimizing potential injury to the nerve.

TOPIC: COMPLICATIONS ASSOCIATED WITH DENTOALVEOLAR SURGERY

BLEEDING

Etiology and prevalence.

Postoperative bleeding is a side-effect of dentoalveolar procedures. In healthy patients, postoperative bleeding is typically minimal and self-limited by the clotting processes. It is important to distinguish active bleeding from surgical site oozing. Patients will often complain of excessive bleeding because they have noticed blood in their saliva. Oozing should resolve within 36–72 hours postoperatively, should respond to pressure, and is generally a nuisance for the patient. In contrast, patients with an active bleed will often complain of their mouth filling with blood immediately after removing a gauze dressing or other local pressure measure.

Risk factors and prevention

Among the most important steps in the management of excessive postoperative bleeding is recognition of the at-risk patient. During the preoperative assessment, a detailed history should be obtained, including a history of disorders associated with coagulation, e.g. hemophilia, von Willebrand disease, use of medications such as antiplatelet agents like aspirin and clopidogrel (Plavix), vitamin K antagonists like warfarin (Coumadin), or heparin or its derivatives, e.g. enoxaparin (Lovenox) or fondaparinux (Arixtra), an individual or family history of bleeding with surgical procedures, excessive bleeding upon loss of deciduous teeth, and, in females, a history of menorrhagia.

As the average age of oral surgical patients increases due to prolonged life, practitioners will encounter a greater number of anticoagulated patients. Appropriate adjuvant therapy, such as discontinuation of anticoagulant medications, factor infusions, or use of clot-stabilizing medications, should be considered in patients with risk factors for bleeding or known bleeding diatheses. Of note, patients taking clopidogrel, aspirin and other non-steroidal anti-inflammatory medication do not need to stop their medications prior to routine dentoalveolar procedures. Patients on warfarin pose a common and special problem for the dentist. The underlying medical problem, e.g. long-standing atrial fibrillation, deep vein thrombosis, prosthetic heart valve, or myocardial infarction, often prohibits discontinuing the anticoagulant. An acceptable, but uncommon, management strategy is to hospitalize the patient, discontinue the warfarin, and maintain the patient on a heparin bridge until

the INR (international normalized ratio) returns to the normal range. An alternative option is to discontinue the warfarin 3 days preoperatively.

Care should be taken in considering the type of dentoalveolar surgery being performed. Many minor oral surgical procedures (such as single tooth extraction) can be done while the patient is anticoagulated, based on the coagulation profile. In general, for patients on warfarin, an INR <2.5 is generally acceptable if extraction of multiple (more than four) teeth is required. For extraction of one to three teeth, with no posterior teeth or surgical extractions, an INR of <3.0 is acceptable. Keeping this in mind for the patient who may need multiple extractions, staged visits may be most appropriate so discontinuation of the anticoagulants can be avoided.

Newer anticoagulants such as the oral factor Xa inhibitors (rivaroxaban and apixaban) and the oral thrombin inhibitor (dabigatran etexilate) have more rapid onset than warfarin, have fixed dosing, are not affected by food, have fewer interactions, and do not require monitoring. Despite the cost differential, they are therefore rapidly becoming the anticoagulants of choice for patients requiring anticoagulation and generally do not require any adjustment for routine dental extractions.

Treatment

Excessive postoperative bleeding can be prevented intraoperatively by appropriate tissue management and local measures. In general, careful removal of granulated/infected tissue, minimal manipulation of surgical flaps to avoid tearing, use of local anesthetic with vasoconstrictor, primary wound closure, and the application of topical agents, such as absorbable gelatin sponge, oxidized regenerated cellulose fabric, or chitosan bandage, can limit most postoperative bleeding. Direct pressure with gauze in the immediate postoperative setting is an important method of limiting bleeding as the initial clot forms. Patients should be instructed to continue to apply pressure to the wound until bleeding has stopped.

Bleeding that persists after the initial phase of clot formation should be treated first with local measures, starting with direct pressure to the surgical site. Careful examination of the operative site with illumination and magnification and good suction can be invaluable to identify the source of bleeding. It is not uncommon to identify an incompletely formed clot, a "liver clot", that is mobile and continues to aggravate the site. Careful removal of the clot is critical to control the bleeding successfully. Use of local vasoconstricting agents, such as local anesthetics with a vasoconstrictor such as epinephrine, is appropriate once the source of bleeding has been identified. If the vasoconstrictor is applied to the area prior to identification of the bleeding vessel, identification will be complicated. The wound may need to be repacked with a local hemostatic

agent and sutured. Arterial bleeds that cannot be controlled with local measures should be treated with ligation or electrocautery. If bleeding persists, embolization, proximal vessel ligation, or other endovascular procedures may be required.

PAIN

Etiology and prevalence

As with bleeding, postoperative pain is a side-effect of operative intervention. Pain associated with routine dentoalveolar procedures usually begins with the resolution of local anesthesia (6–12 hours) and typically peaks between 24 and 48 hours postoperatively.

Risk factors and prevention

Prevention of pain via intraoperative measures and adequate postoperative pain control measures is essential. Intraoperatively, minimizing tissue trauma and careful tissue manipulation will decrease inflammation and thus decrease pain. There is evidence that the administration of preoperative non-steroidal anti-inflammatory medications (salicylates, cyclooxygenase (COX)-2 inhibitors) can reduce the severity of postoperative pain. Postoperatively, the use of nonsteroidal medications, as well as narcotic preparations with acetaminophen (APAP) (hydrocodone, oxycodone, tramadol) are useful for treatment of moderate to severe postoperative pain. In addition, the use of long-acting local anesthetics, e.g. 0.5% bupivacaine with 1:200 000 epinephrine, can be beneficial in delaying the onset of pain, which may allow the patient to start postoperative analgesics prior to the onset of pain.

SWELLING

Etiology and prevalence

Edema following the surgical removal of teeth and other routine dentoalveolar procedures is an expected finding during the postoperative course. The onset of swelling is typically between 12 and 24 hours following the procedure, with a peak swelling noted 48–72 hours postoperatively. Swelling typically begins to subside at 4 days postoperatively, with most patients experiencing resolution of surgical edema within 1 week postoperatively.

Prevention and treatment

It is important to inform patients of this time course and that swelling is an anticipated postoperative finding. In the early postoperative period, the use of ice may help with the management of swelling. In addition, patients should be told to sleep with the head of their bed elevated and not to sleep on their side, so as to avoid dependent swelling. Finally,

perioperative steroids may be used to prevent swelling in patients undergoing significantly invasive procedures (e.g. third molar extraction). While the use of perioperative steroids may produce moderate decreases in swelling, these medications are typically short in action.

SURGICAL SITE INFECTION

Etiology and prevalence

Because the oral cavity is home to a wide variety of bacterial flora, any intraoral wound will be exposed to a broad spectrum of aerobic, anaerobic, and facultative organisms with pathogenic potential. As such, postoperative infections should be primary among concerns for the practitioner when performing oral surgical procedures. Though the routine use of antibiotics for prevention of postoperative infections is still debated, there are several measures that can be implemented to reduce the likelihood of postoperative wound infection.

Prevention

Prevention of postoperative infection begins with identification of the patient at risk. A number of studies have demonstrated that the incidence of postoperative inflammatory complications increases with age, smoking, pre-existing infection/pathology in the surgical area, oral contraceptive use, and lack of surgical experience. When dealing with impacted teeth, mandibular third molars have been shown to have a higher rate of postoperative infections than maxillary teeth.

As with other common complications, careful tissue management, debridement/curettage of necrotic/ infected tissue, and thorough irrigation of the wound site will help to reduce the bacterial inocula within the wound site and reduce the possibility of infection.

Treatment

Patients presenting with infections will typically complain of persistent pain and swelling that is not improving with time, a foul taste, drainage from the wound, and limitation of jaw motion (trismus). Fever is variable and depends on the magnitude of the infection. Early recognition of an infectious process, typically a cellulitis, requires prompt treatment with an empiric course of antibiotics with broad-spectrum coverage for Gram-positive and anaerobic organisms. If the symptoms have persisted for more than 48–72 hours after the procedure, an abscess, or pus pocket, may have formed, in which case incision and drainage may be indicated, with collection of exudate for culture and sensitivity testing to guide antibiotic therapy. Prompt recognition and treatment are necessary to prevent the spread of infection into the submandibular, sublingual, submental,

retropharyngeal spaces and spaces of the deep neck, which can result in airway compromise and the necessity for emergency airway management.

ALVEOLAR OSTEITIS

Prevalence and etiology

Among the most common complications associated with oral surgical procedures, specifically the removal of impacted teeth, is alveolar osteitis (AO), or "dry socket". The reported incidence is as high as 30% in some studies, though there exists a wide variation in reported incidence due to inconsistent diagnostic criteria. This condition, which was classically thought to be infectious in nature, is now understood to be associated with malformation, disruption, or other loss of a newly formed blood clot from an extraction socket. Patients presenting with AO will usually complain of a severe throbbing, radiating pain, often associated with a malodor from the surgical site. Trismus is an associated sign, related more to pain than swelling. Recognition of AO is based on the presence of new-onset severe pain, typically 3–5 days postoperatively, at which point pain and swelling associated with the operation should be beginning to subside. The lack of constitutional symptoms (fever), significant swelling, or intraoral discharge may help to distinguish AO from a surgical site infection. This distinction is important, since antibiotic treatment will not resolve AO. Physical exam findings may include a crypt-like socket with exposed bone and erythematous soft-tissue margins, food debris, or other detritus in the socket and extreme tenderness to palpation. Radiographic examination should also be obtained to rule out the presence of a retained tooth structure or other surgical site complication, such as alveolar fracture.

Prevention

Preoperatively, there are a number of risk factors that have been identified that should alert the vigilant practitioner of the patient at risk. As with postoperative infections, age, oral contraceptive use, surgical experience, smoking, and mandibular surgery have been associated with AO. In addition, poor oral hygiene and pre-existing infections have been shown to increase the risk for AO. Intraoperatively, thorough lavage of the surgical site is associated with a decreased incidence of AO. The use of topical medicaments and antibiotics, clot stabilizers (Gelfoam®), platelet-rich plasma, and medicated mouthrinses have also been suggested for prevention of AO.

Treatment

As the condition is self-limiting, the treatment is supportive, with pain control being the primary goal. Treatment typically consists of gentle irrigation of the wound area with warm saline and application of medicated

packing to the area, e.g. eugenol dressings, and aggressive use of oral analgesics. The packing should be changed every 24 hours until symptoms subside.

FRACTURES

Prevalence and etiology

While rare, fractures of the dentoalveolar process or mandible should be considered in the differential diagnosis of persistent pain or swelling after dentoalveolar procedures. Fractures are the result of using excessive force during tooth extraction. If unrecognized and untreated, such fractures can lead to malocclusion, malunion, infection, and paresthesia.

Prevention

Preoperatively, there are few risk factors for fracture that have been identified. There is some evidence to suggest that age is a risk factor for fractures, presumably because of the loss of bone density, elasticity, and strength which are common findings in elderly patients. Atrophic mandibles or mandibles with large intrabony lesions are at risk for fracture.

Treatment

Recognition of the fracture is the most important management. Intraoperatively, recognition of an alveolar process or mandibular fracture can result from observing a mobile alveolar or mandibular segment or malocclusion. Postoperatively, any patient complaining of malocclusion, pain and swelling disproportionate to the procedure, tooth displacement or mobility, or persistent numbness should be evaluated for a possible fracture.

Once a fracture is identified, typically with the aid of imaging studies, e.g. periapical or panoramic radiographs or computed tomography (CT), treatment is guided by the nature of the fracture and functional limitation. Treatment ranges from dietary modifications (blenderized diet) and early immobilization to reduction and fixation of the fracture.

ROOT FRACTURE

Prevalence and etiology

Root tip fractures are common after tooth extraction, especially in posterior, multirooted teeth. Fracture of the roots, or root tips, is typically due to excessive forces applied during extraction with inadequate separation of the roots from the extraction socket and is commonly unavoidable due to the root anatomy and bone quality. When such forces are applied, the torque generated will typically cause a fracture at the junction between that portion of the root still attached to the socket and that portion already freed from the alveolar wall.

Prevention

The prevention of root fractures is primarily based on use of proper surgical technique, minimizing excessive forces, and carefully ensuring that teeth are adequately elevated and mobilized prior to luxation. Recognition of teeth at risk for root fracture is also an important preventative measure. Multirooted posterior teeth, roots that are curved, canines or other anterior teeth that have root dilacerations, or teeth with widely spaced thin roots, all have an increased risk for fracture. Inadvertent root fractures can be avoided by operative planning and prudent sectioning of a tooth prior to elevation and removal.

Treatment

The most important step in treating a fractured root or retained root tip is recognition that such an incident has occurred. Once the tooth has been removed, it should be carefully inspected to confirm that the roots were removed completely. Reconstitute the fragments of a sectioned tooth to confirm complete removal.

If a root fracture is noted, the socket should be irrigated thoroughly and an attempt should be made to directly visualize the retained root/root tip. For teeth without preoperative evidence of periapical pathology or infection, small root tips (<3 mm) can be left in place without adverse effects. In fact, for posterior teeth, the risk of causing damage to the maxillary sinus or inferior alveolar nerve may often outweigh the risk of leaving the fragment in place, and sometimes this is carried out deliberately in the technique known as coronectomy.

If there is associated pathology with the tooth preoperatively, the root fragment should be removed. Once the fragment is directly visualized, root tip picks/elevators should be used to carefully separate the fragment from the alveolar socket, with special care taken not to apply apical pressure to the fragment. This gentle manipulation should be done until the root is mobilized, at which point it can be removed.

ROOT OR TOOTH DISPLACEMENT

Prevalence and etiology

Displacement of root tips or tooth fragments is an uncommon but distressing complication nonetheless. Given the proximity of various fascial spaces to maxillary and mandibular third molars, displacement of tooth fragments can occur into the infratemporal fossa and maxillary sinus or submandibular space and inferior alveolar canal, respectively.

Prevention

Displacement of tooth fragments into these fascial spaces can often be prevented by using careful surgical technique. For example, when

elevating an impacted maxillary third molar, the use of a periosteal elevator posterior to the distal aspect of the crown can serve as a barrier to displacement into the infratemporal fossa. In the event of displacement into the infratemporal fossa, a minimal attempt should be made to visualize the fragment and remove it. If this attempt is unsuccessful, the wound should be closed and the patient should be given a course of antibiotics. Future exploration of the region should be anticipated and CT, plain film imaging or both should be obtained to aid in localization and surgical treatment planning.

Careful examination of preoperative radiographs can be useful in evaluating the association between the roots of impacted maxillary third molars and the maxillary sinus. In older patients, or those with significant periodontal disease, pneumatization of the maxillary alveolus can increase the likelihood of an association between the roots of the teeth and the maxillary sinus. In these cases, careful attention must be directed to avoiding excessive apical pressure to the teeth during the process of extracting teeth.

Treatment

In the event that a root fragment or tooth is displaced into the maxillary sinus, the first step in treatment is localization of the fragment and prevention of further displacement. Typically this can be achieved by seating the patient in the upright position and obtaining periapical radiographs of the region of interest. In the event that a root or fragment is visualized, various methods can be used for retrieval. The simplest method is forcing positive pressure through the sinus to displace the root – this can be accomplished by closing the nostrils and having the patient attempt to exhale through the nose. Alternative methods include attempting to remove the fragment using a thin suction tip or packing the socket with iodoform gauze and removing the gauze in a smooth stroke, hoping that the fragment will be caught in the gauze. In the event that such measures prove unsuccessful, the maxillary sinus can be explored to directly visualize and remove the fragment, either endoscopically or with open surgery involving a Caldwell–Luc incision. This can be done as a simultaneous procedure or at a future visit. If done at a future visit, the patient should be placed on sinus precautions, antibiotics and nasal decongestants.

Displacement of mandibular teeth into either the submandibular space or inferior alveolar canal is a rare occurrence. However, given the vital structures in these regions, any suspicion of displacement must be evaluated fully. Visualizing any fragments is best accomplished immediately using periapical and Panorex-type films, with occlusal films in addition for submandibular space invasion. These will be supplemented by

cone-beam CT scans as time allows. Once the fragment is identified, a gentle attempt should be made to remove the fragment from the inferior alveolar nerve (IAN) canal or the submandibular space, but care should be taken not to compromise the spaces and further displace the tooth. In the event that the fragment cannot be easily removed, delayed removal may be indicated and the patient should be placed on antibiotics. For fragments in the IAN canal, if the patient does not demonstrate any signs of infection or paresthesia in the postoperative course, the fragment may be left without concern. For fragments in the submandibular space, exploration of the region with lingual dissection and separation of the mylohyoid muscle from the mandible is indicated approximately 6 weeks after the initial operation. This delay allows for tissue fibrosis to occur around the displaced fragment, thereby stabilizing its position. This procedure can be carried out intra-orally or extra-orally, depending on the position of the retained fragment.

OROANTRAL COMMUNICATION

Prevalence and etiology

Following extraction of maxillary posterior teeth, oroantral (sinus) communications are common, commonly unrecognized, and do not need treatment. Persistent, symptomatic oroantral communications are uncommon with a frequency of <1%. Oroantral communications may result from excessive manipulation of the operative site or poor technique. It should be readily acknowledged that communications typically result from intimate anatomic associations between the roots of the teeth and the floor of the maxillary sinus and may be unavoidable.

Prevention

As with displacement of teeth into the maxillary sinus, prevention of oroantral communications starts with identification of the patient at risk. Evaluation of preoperative radiographs for any evidence of encroachment of the roots upon the floor of the sinus should alert the surgeon to the likelihood of this complication. Upon removal of the tooth, the socket should be curetted gently, avoiding the apical areas. If the tooth is not removed completely, judicious exploration should be undertaken, so as not to: (1) displace the remnant into the sinus; or (2) perforate the sinus floor while attempting to remove the fragment. A self-limiting oroantral communication may be an unavoidable side-effect of tooth removal due to the anatomic relationship between the roots and the sinus. Informing the patient of a likelihood of an oroantral communication prior to tooth removal is preferable to explaining it after tooth removal.

Treatment

Diagnosis of a sinus communication is often made by having the patient force air through the nasal cavity while the nares are closed. If a large communication exists, air bubbles should be visible within the socket. This method may prove ineffective for small communications.

In the event that a communication is discovered, either by tactile sensation or forced air maneuver, the size of the defect and patient complaint guide treatment. As a general principle, any patient with a communication should be placed on sinus precautions, antibiotics, and nasal decongestants.

Most oroantral communications heal spontaneously with little intervention. At the time of the procedure, primary closure of the extraction socket is not indicated. The patient should be placed on broadspectrum antibiotics, e.g. amoxycillin or clindamycin, and sinus precautions. Monitor the patient closely over the postoperative period to confirm closure of the oroantral communication. If an oroantral fistula develops, standard procedures to produce a layered closure of the wound and management of the sinus are indicated. Clinicians should remember that the size of the visible fistula is much smaller than the actual bony defect.

THIRD MOLAR SURGERY COMPLICATIONS

Injury to adjacent teeth/wrong tooth extraction

The most common injury to an adjacent tooth is loosening or fracture of a large restoration. Other injuries can include tooth loosening due to inappropriate use of elevators, crown fracture due to caries, and inadvertent extraction of an adjacent tooth. The incidence of injury to an adjacent second molar when performing third molar surgery is between 0.3% and 0.4%. Limited data exist regarding inadvertent extraction of an adjacent tooth specifically during third molar surgery; however, the overall incidence of wrong tooth extraction ranges from 0.026% to 0.047%.

Adjacent teeth with large restorations, caries, or recurrent decay pose a risk for inadvertent injury. Evaluation of adjacent teeth both clinically and radiographically should be completed prior to beginning a procedure, and patients should be made aware of the possibility of injury. If an adjacent tooth poses a high risk for injury, attempts should be made to avoid luxation with elevators adjacent to the tooth or consideration should be given to not using an elevator at all. To avoid injury to the opposing dentition during extraction, excessive traction forces should be avoided. If a tooth suddenly releases, this can result in instrument damage to opposing cusps. Also, placing a finger or suction tip in between the forceps and

opposing dentition can prevent contact with the instrument or absorb some of the blow. Wrong tooth removal should never occur if adequate attention is given to planning and appropriate time out. The tooth to be extracted should be marked on the radiograph and confirmed with both the patient and the assistant in terms the patient can understand. Referrals should be contacted if confusion exists as to the correct procedure.

If an injury occurs, it should be promptly treated and all parties involved notified. A fractured tooth or restoration can be temporized and the referring practitioner notified. Loosened or avulsed crowns can be recemented if no recurrent decay exists or temporarily cemented if caries are noted. If an adjacent tooth is loosened it should be repositioned and stabilized. Often, this requires only minimal repositioning, and the tooth can be left alone. If significant loosening has occurred, stabilization for 10–14 days with the least rigid method of stabilization should be used to avoid risk of ankylosis or root resorption. Extraction of the wrong tooth, if immediately noted, can be treated as an avulsion. The tooth should be implanted back into the extraction site and stabilized. If the tooth is being extracted for orthodontic reasons, the remaining teeth should not be extracted and a call should be placed to the referring orthodontist. Occasionally, modification of the treatment plan can be done to utilize the tooth that should have been removed and treatment can proceed with the new plan. If the original tooth planned for extraction needs to be removed, the health and stability of the accidentally extracted tooth should be confirmed prior to proceeding with further extractions. When the error goes unnoticed at the time of extraction, the tooth can obviously no longer be replanted. It is important to document thoroughly any case of wrong tooth extraction and inform all parties involved. According to data from the Oral and Maxillofacial Surgery National Insurance Company (OMSNIC), 46% of all wrong-site tooth extraction claims are settled with an indemnity payment. Thus, documentation and communication with both the patient and referring dentist are important to avoid litigation.

Injury to adjacent osseous structures

During the process of third molar extraction, and more specifically maxillary third molar extraction, the surrounding bone is at risk for inadvertent fracture. The most likely places for bone to fracture during removal of maxillary third molars are the buccal cortical plate and maxillary tuberosity. The incidence of maxillary tuberosity fracture in association with third molar extraction is approximately 0.6% and is most often caused by excessive force with forceps or elevators. The combination

of Type IV bone, no distal support, and often significant space involvement by maxillary sinus contribute to the potential for tuberosity fracture.

Maxillary tuberosity fracture or buccal cortical plate fracture can compromise future prosthetic rehabilitation as the maxillary tuberosity is an important anatomical retention point for complete dentures. Buccal plate fracture can lead to soft tissue tearing and irregular remaining alveolar bone. To avoid these complications the surgeon should ensure appropriate force application and remove bone in a controlled fashion when excessive force is necessary for extraction. In addition, placement of a periosteal elevator distal to the third molar to elevate the tooth and separate it from the periodontal ligament and tuberosity can assist the surgeon in avoiding a tuberosity fracture.

When a fracture of the buccal cortical plate occurs, the surgeon should asses the stability, size, and soft tissue attachment of the fractured segment. If the surgeon has been supporting the alveolus with finger pressure during extraction, early cortical plate fracture can be assessed. At this point, the cortical plate should be dissected free from the tooth with an elevator or other sharp instrument while the tooth is stabilized with forceps. Once the bone and soft tissue are dissected free, the tooth is extracted and the tissues approximated and secured with sutures. If a soft tissue flap is reflected from bone, the blood supply to the segment has been compromised, and that segment will become necrotic if not removed. Maxillary tuberosity fractures should be treated in a similar manner. Once recognized, the fractured segment should be dissected free from the tooth. Using a handpiece, the bone segment can be separated from the tooth and the roots sectioned to allow for atraumatic extraction. If adequate soft tissue attachment remains, the tuberosity is stabilized through good soft tissue closure with sutures. In the event that the tuberosity cannot be dissected free from the tooth, the reason for extraction should be revisited. If asymptomatic, the tooth and attached tuberosity segment can be fixated for 6–8 weeks via an arch bar or orthodontic fixation followed by surgical extraction with controlled bone removal and tooth sectioning on a later date. If symptomatic, the tooth must be extracted and in doing so, the tuberosity will be removed. The remaining bone should be smoothened and soft tissues approximated with sutures. The overall goal of treatment in a tuberosity fracture is to maintain the bone in place unless its removal is absolutely necessary.

TMJ injury

The occurrence of temporomandibular joint (TMJ) injury as a result of third molar surgery is not supported in the literature. In a study by

Threlfall, patients with diagnosed anterior disk displacement were no more likely than the control group to have had prior third molar surgery. Also, only 9.5% of patients with anterior disk displacement reported third molar extractions within the past 5 years. Complaints of limited opening are most often due to trauma from injections, inflammation of the muscles of mastication, and/or the body's own protective mechanism to limit function and further trauma.

Injury may occur if excessive force is used, a bite block is not in place when extracting lower third molars, or the patient's mouth is opened excessively. This transient injury often resolves with soft diet, moist heat, jaw rest, and NSAID use. An acutely "stuck disc" can be treated effectively with arthrocentesis when observed.

It is important to evaluate all patients undergoing third molar surgery for preoperative joint disease or myofacial pain and thoroughly document all such history. Clicks, pops, crepitus, opening and excursive movements, and any tenderness of the muscles of mastication should be noted. If prior TMJ dysfunction is present, contemplation for surgical extraction of teeth to avoid trauma to the joint should be made.

Aspiration/ingestion

The incidence of foreign body aspiration or ingestion is likely underreported in the literature. Approximately 92.5% of objects are ingested while the remaining 7.5% are aspirated. Patients who undergo the surgical removal of third molars are often sedated, which results in their gag and cough reflexes being obtunded. A pharyngeal curtain should be utilized in all patients to prevent aspiration or ingestion during surgery. If the patient is not coughing or in any respiratory distress, it is likely the tooth has been ingested and prompt referral to an emergency room for abdominal and chest radiographs to confirm the location of the object should be made. Coughing that continues or leads to respiratory distress should alert the surgeon to probable aspiration. An attempt to suction the object from the oral pharynx should be made and ACLS protocols activated. The Heimlich maneuver should be used to attempt to dislodge the object. If a patient becomes cyanotic or unconscious, an attempt at retrieval under direct laryngoscopy can be made. If this fails, cricothyrotomy may be necessary to secure the airway. An object that passes through the vocal chords will most likely end up in the right main stem bronchus or right lung, and the patient should be transported to the emergency room and arrangement for bronchoscopy and object retrieval should be made.

Neurologic complications

The incidence of neurologic complications as a result of third molar surgery ranges from 0.4% to 11%. Injury to the inferior alveolar nerve (IAN) is associated with spontaneous recovery in 96% of cases and spontaneous recovery of lingual nerve injury is approximately 87%. Sensory deficits that last longer than 1 year are likely to be permanent; recovery of sensation should begin within the first 8 weeks following surgery. According to the AAOMS white paper on third molars, the incidence of IAN injury 1 to 7 days postoperatively is 1–5% and persistent alteration in sensation after 6 months ranges from 0.0% to 0.9%. Lingual nerve injury 1 day after surgery was reported in 0.4–1.5% of patients, with persistent sensory alteration at 6 months in 0.0–0.5% of patients. The use of lingual retraction increased the incidence of temporary paresthesia; however, the incidence of persistent findings remained the same. In a study by Tay et al., 192 inferior alveolar nerves in 170 patients were exposed during third molar surgery. Twenty percent reported paresthesia at the 1 week follow-up, and 6% had persistent paresthesia at 1 year.

An increased risk of IAN injury is associated with increased age, complete bony impaction, horizontal angulation, sectioning of the tooth multiple times, bone removal, surgeon's experience, and duration of surgery. Additionally, Rood et al. has described several radiographic predictors of potential nerve injury. These include diversion of the IAN canal, darkening of the root, and interruption of the white line. One in three patients with canal diversion, and one in four patients with darkening of the root or interruption of the white line, exhibited impairment of sensation. These signs are highly sensitive but not highly specific for risk of injury, and the absence of all signs has a strong negative predictive value. Therefore, patients without any significant indicators of injury are unlikely to have injury, patients with an injury are likely to have at least one of the predictors, and patients without injury commonly have predictors of injury radiographically. Other reported radiographic indicators such as deflected roots, narrowing of the root, dark bifid roots, and narrowing of the canal were statistically unrelated to nerve injury.

Lingual nerve injury is associated with distoangular inclination, lingual orientation, and perforation of the lingual cortex. Often, flap reflection, tooth sectioning with extension into the lingual plate, or lingual plate fracture are the cause of injury. Due to the nerve's variable position, care must be taken when incisions are made and flaps reflected. Miloro et al. reported 10% of lingual nerves positioned superior to the lingual crest and 25% in direct contact with the bone. The mean vertical distance from

the crest is 2.75 mm and the mean horizontal distance from the lingual plate is 2.53 mm.

Injury to the lingual or inferior alveolar nerve due to local anesthetic injection occurs in approximately 1 in 785,000 cases with 79% affecting the lingual nerve and 21% the IAN. The highest incidence is associated with prilocaine or articaine injection. The majority of cases (85%) resolve within 8 weeks and of the remaining 15%, one-third will eventually resolve. Unfortunately, patients with persistent paresthesia are not candidates for microneurosurgical repair.

All patients who report paresthesia should be followed closely for resolution and appropriate objective testing should be performed. The clinical neurosensory test should be performed to determine the degree of impairment and whether microneurosurgical intervention is necessary. Mechanoceptive testing begins with Level A testing. It comprises brush stroke directional discrimination and two-point discrimination. It is important to test both normal and abnormal areas, map out the area of impaired sensation by marking directly on the patient's skin, and photograph the markings for future reference. Two-point discrimination can be tested using a Boley gauge or the noncotton end of a cotton tip. Testing should be completed in 2-mm increments until the patient can no longer discern two separate points. Normally, the IAN tests to 4 mm and the lingual nerve to 3 mm. Level B testing involves contact detection and Level C pin-prick and thermal discrimination. The indications for repair are complete anesthesia beyond 1–2 months, profound hypoesthesia with no improvement after 3 months, early dysesthesia, and a clinically observed Sunderland V transection. Referral to a surgeon proficient in microneurosurgery should be made if any of the above criteria are met or if unfamiliar with nerve testing and possible treatment protocols.

Bony sequestra and lingual plate exposure are potential complications of low significance but require thorough and prompt attention. Small bony sequestra will spontaneously extrude through the soft tissues and usually cause only temporary discomfort. Reassuring the patient or parent that there is no remaining tooth in the area, the usual concern at presentation, and removing the loose bone is all that is required. The injury to the soft tissues is resolved within few days, and the patient is instructed to avoid trauma from chewing in the area until this occurs. Exposure of the lingual plate or a portion of the mylohoid ridge is not uncommon since the overlying mucosa in this area is excitingly thin. The common complaints will be pain upon swallowing and sharp bone detected in the area. Application of topical anesthetic to allow for a bone file or fine rongeurs to gently smooth or remove any sharp bone is all that is required. The patient

is instructed to avoid further injury to the area with certain foods such as popcorn or potato chips and is reassured that the area will spontaneously heal. Oral hygiene and rinses with chlorhexidine will facilitate coverage of the area.

Osteomyelitis

The incidence of osteomyelitis as a result of third molar extraction is not reported in the literature however it is a known complication of infection, fracture, and/or extraction in medically compromised patients. Osteomyelitis is an inflammation of the bone marrow and is most common in the mandible due to its dependence on blood supply from the inferior alveolar artery and poorly vascularized thick cortical bone. Because the maxilla has a rich vascular supply from multiple vessels it is less likely to develop osteomyelitis. The presence of bacteria within the marrow space leads to inflammation and edema with subsequent compression of blood vessels and a decrease in blood supply. This decrease in blood flow results in ischemia, bone necrosis, and proliferation of bacteria. Purulence and bacteria can spread within the marrow via Haversian and Volkmann's canals and extend into cortical bone. Once the cortical bone and periosteum are involved, the blood supply is further compromised and perforation of soft tissues can occur resulting in fistula formation. Predisposing factors in the development of osteomyelitis involve suppression of host defenses in some form. Diabetes, alcoholism, autoimmune disease, radiation therapy, chemotherapy, steroid use, osteopetrosis, myeloproliferative diseases, and malnutrition can contribute to the development of osteomyelitis.

The classification of osteomyelitis offered by Hudson is commonly cited in the literature and essentially breaks down into acute and chronic forms based on disease presence greater than 1 month.

Patients with osteomyelitis will often present with complaints of a dull and deep pain, swelling and erythema of overlying tissues, paresthesia of the inferior alveolar nerve, trismus, adenopathy, fistula, fever, and malaise. In patients with chronic osteomyelitis, signs of acute infection such as fever are often not present; however, fistulas, both intra- and extraorally, are more common. Radiographs typically demonstrate a "moth-eaten" appearance of bony sequestrum. CT scanning can assist in the demarcation of lesion extent although it should be noted that 30–50% demineralization of bone is necessary before radiographic changes. In chronic osteomyelitis there may be radiopacity due to an osteitis-type reaction and proliferation of bone. A laboratory workup will demonstrate leukocytosis in acute forms, elevated erythrocyte sedimentation rate (ESR) and C-reactive protein (CPR). Further laboratory evaluation of ESR and

CRP levels during treatment can assist in assessment of healing. Culture specimens will often reveal bacteria traditionally responsible for odontogenic infections such as Bacteroides, Peptostreptococci, Fusobacterium, and Streptococci. Occasionally, less common odontogenic bacteria are present. These include Lactobacillus, Eubacterium, Klebsiella, Acinetobacter, and Pseudomonas aeruginosa. Osteomyelitis of the jaws is different from osteomyelitis of other bones in that Staphylococci are not the predominant bacteria.

The treatment of osteomyelitis is combination of surgical and medical management. Treatment of systemic diseases must be considered along with medical consultation when appropriate. Empiric antibiotics should be administered while awaiting final culture results. Penicillin/metronidazole or clindamycin are excellent first-line antibiotics. In chronic cases, sequestrectomy, decortication, and saucerization are necessary and extend to vital, bleeding bone. Removal of the cortex with placement of periosteum directly on the marrow space assists with blood flow. After aggressive debridement, that may lead to further weakening of the mandible, fixation may need to be employed to prevent fracture or for stabilization of a known fracture. External fixation, rigid internal fixation, or intermaxillary fixation may be used with the fixation type dependent on the surgeon's preference and degree of success of surgical debridement. Other methods of treatment have been proposed such as local antibiotic administration with both resorbable and nonresorbable carriers and hyperbaric oxygen. Polymethylmethacrylate beads impregnated with gentamycin have been discussed in the orthopedic literature; however, results can be disappointing due to inadequate local release and subinhibitory antibiotic levels. Also, a second surgery is necessary to remove the beads. Hyperbaric oxygen (HBO) has not been demonstrated to have a significant effect on outcome based on the limited available literature. Esterhai et al. studied the use of HBO on 28 patients with chronic refractory osteomyelitis and this controlled trial concluded that HBO had no effect on length of hospitalization, rate of wound repair, or recurrence of infection.

TOPIC: FEATURES OF LOCAL ANESTHESIA, TOOTH EXTRACTION AND MEDICALLY COMPLEX PATIENTS

The first step in managing the patient with medical problems is acquiring a thorough health history; the second step is for the clinician to fully understand the significance of the disease that may be endorsed by the patient. Each identified condition can affect dental care in a unique manner. For example, medication prescribed for a medical condition might produce a problem during the administration of a local anesthetic, or it could interact with pain medication prescribed post intervention. The dental clinician needs to understand the potential complications that can occur as a consequence of dental treatment of a medically compromised patient and when pretreatment or post-treatment medication or emergency care is indicated.

Certain medically compromised patients should only be treated in a hospital setting where emergency issues, should they arise, can be immediately addressed and promptly attended to in a controlled manner. For example, the patient with a significant bleeding problem or thrombocytopenia arising as a primary condition or secondary to medication, radiation, or leukemia is best managed in an in-patient environment where replacement of platelets can be provided before the procedure or afterwards if spontaneous bleeding occurs.

Dental management of the medically compromised patient requires acquisition of a complete health history of the patient. This should include documentation via questionnaire as well as a verbal history. A comprehensive health history questionnaire should include questions about the patients cardiovascular, hematologic, neural and sensory, gastrointestinal, respiratory, dermal, mucocutaneous, and musculoskeletal, endocrine, and urinary systems as well as questions related to sexually transmitted diseases, drug use (eg, alcohol, tobacco), allergies, x-ray exposure or treatment, medications, and hospitalizations. Preferably an oral history should also be obtained as a review of systems (ROS). This oral ROS often elucidates information that is only touched on by a questionnaire.

The dental history should also include questions related to current oral conditions such as periodontal disease or oral ulceration and past dental treatment and potential complications from prior intervention including treatment failure and the delivery of anesthesia or post-treatment medication.

Cardiovascular diseases

Local anesthetic agents themselves can affect the cardiovascular system, especially at higher doses. Cardiovascular manifestations are usually depressant and are characterized by bradycardia, hypotension, and cardiovascular collapse, potentially leading to cardiac arrest. The initial signs and symptoms of depressed cardiovascular function commonly result from vasovagal reactions (dizziness and fainting), particularly if the patient is in an upright position. Cardiovascular diseases constituting contraindications to the use of local anesthetics in general, and to the use of vasoconstrictors in local anesthetics in particular, are often discussed in terms of absolute as opposed to relative contraindications. Absolute contraindications for the use of local anesthetics with or without vasoconstrictors in patients with cardiovascular diseases exist only if the patients condition is determined, by the dentists review of the health history, to be medically unstable to the degree of posing undue risk to the patients safety. Dental care should be deferred in these patients until their medical conditions have been stabilized under the care of their physicians. For patients with stabilized cardiovascular diseases, dental treatment may usually be delivered in near routine fashion, although, as the following sections will emphasize, the amount of vasoconstrictor-containing local anesthetic used may need to be limited and the patient carefully monitored.

Hypertension

It is estimated that more than 50 million people in the United States have high blood pressure or are taking antihypertensive medications. Because lack of compliance is a major problem in medical treatment of hypertensive patients, the dental practitioner is wise to measure blood pressure and evaluate the patients status at every visit. The decision regarding whether or not a local anesthetic agent containing vasoconstrictor should be administered to a patient with hypertension or other cardiovascular disease is a common concern amongst dental practitioners. A rational approach to this question is to recall the effects and mechanism of action of the vasoconstrictors. One of the primary effects, and advantages, of vasoconstrictors in dental local anesthetics is to delay the absorption of the anesthetic into the systemic circulation. This increases the depth and the duration of anesthesia while decreasing the risk of toxic reaction. Additionally, the vasoconstrictor provides local hemostasis. Epinephrine and levonordefrin (neocobefrin) are the two vasoconstrictor agents commonly used in dental local anesthetic formulations. Although they do have slightly differing cardiac effects, they carry the same precautions for their use. There are no absolute contraindications to the use of vasoconstrictors in dental local anesthetics, since epinephrine is an

endogenously produced neurotransmitter. In 1964, the American Heart Association and the American Dental Association concluded a joint conference by stating that "the typical concentrations of vasoconstrictors contained in local anesthetics are not contraindicated with cardiovascular disease so long as preliminary aspiration is practiced, the agent is injected slowly, and the smallest effective dose is administered. It has long been recommended that the total dosage of epinephrine be limited to 0.04 mg in cardiac risk patients. This equates to approximately two cartridges of 1:100,000 epinephrine-containing local anesthetic. Levonordefrin is considered to be roughly one-fifth as effective a vasoconstrictor as epinephrine and is therefore used in a 1:20,000 concentration. In this concentration, levonordefrin is considered to carry the same clinical risks as 1:100,000 epinephrine. The results of a number of studies[11-17] indicate that the use of one to two 1.8 ml cartridges of local anesthetic containing a vasoconstrictor is of little clinical significance for most patients with hypertension or other cardiovascular diseases, and that the benefits of maintaining adequate anesthesia for the duration of the procedure far outweighs the risks. However, the use of more than two cartridges of local anesthetic with a vasoconstrictor should be considered a relative rather than an absolute contraindication. If, after administering one to two cartridges of vasoconstrictor-containing local anesthetic with careful preliminary aspiration and slow injection, the patient exhibits no signs or symptoms of cardiac alteration, additional vasoconstrictorcontaining local anesthetic may be used, if necessary, or local anesthetic without epinephrine can be used. Some practitioners prefer to achieve initial anesthesia with a nonvasoconstrictor-containing anesthetic agent such as 3 percent mepivacaine or 4 percent prilocaine plain and then use a small amount of local anesthetic with vasoconstrictor to supplement cases of inadequate anesthesia. While this is a viable protocol, a safer choice is to use a minimal amount of vasoconstrictor-containing local anesthetic first and then supplement as necessary with nonvasoconstrictor-containing agents. The advantage of using the epinephrine-containing anesthetic first is that it will minimize blood flow in the injection site, thereby holding the local anesthetic in place, optimizing the anesthetic effect while minimizing the rate of plasma uptake and potential toxicity. Since nonvasoconstrictor-containing local anesthetics produce localized vasodilation, addition of a vasoconstrictor-containing agent after first injecting with a nonvasoconstrictor-containing local anesthetic can be expected to produce increased cardiovascular alterations. The goal should always be to minimize the dosage of local anesthetic with or without vasoconstrictor; but if additional vasoconstrictor will provide improved pain control for the

dental procedure, it is not contraindicated. If a patient has severe uncontrolled hypertension, elective dental treatment should be delayed until his or her physician can get the blood pressure under control. But if emergency dental treatment is needed, the clinician may elect to sedate the patient with valium and use one to two cartridges of local anesthetic with a vasoconstrictor. This dose will have minimal physiologic effect and will provide prolonged anesthesia. The greater risk in such a scenario is that without the epinephrine the anesthesia will wear off too soon and the endogenous epinephrine produced by the patient, because of pain from the dental procedure, will be much greater and more detrimental than the small amount of epinephrine in the dental anesthetic cartridge. Another concern for the dental practitioner is the possibility of an adverse interaction between the local anesthetic agent and a patients antihypertensive medication, particularly the adrenergic blocking agents. The nonselective beta-adrenergic drugs, such as propranolol (Inderal), pose the greatest risk of adverse interaction. In these patients, an injection of vasoconstrictor-containing local anesthetic may produce a marked peripheral vasoconstriction, which could potentially result in a dangerous increase in blood pressure due to the pre-existing medication-induced inhibition of the compensatory skeletal muscle vasodilation. This compensatory skeletal muscle vasodilation normally acts to balance the peripheral vasoconstriction effects in nonmedicated patients. The cardioselective beta blockers (Lopressor, Tenormin) carry less risk of adverse reactions. Both classes of beta blockers may increase serum levels of anesthetic solutions due to competitive reduction of hepatic clearance. Though these considerations are theoretically important, there is still little risk of a problem if the total dose of anesthetic, with 1:100,000 epinephrine or its equivalent, is limited to one to two 1.8 ml cartridges. Other antihypertensive medications, such as the central sympatholytic drugs, for example Clonidine and Methyldopa (Aldomet), and the peripheral adrenergic antagonists such as Reserpine as well as the direct vasodilators, may potentiate adrenergic receptor sensitivity to sympathomimetics, resulting in a magnified systemic response to vasoconstrictor-containing anesthetics. However, once again, these medications pose no significant risk as long as the vasoconstrictor-containing anesthetic is limited to one to two 1.8 ml cartridges. An additional reminder to inject vasoconstrictor-containing local anesthetics slowly is appropriate due to the increased risk of injection site ischemia resulting from the potentiated localized vasoconstrictor effect.

Angina pectoris and post-myocardial infarction

Patients with stable angina without a history of infarction generally have a significantly lower risk of adverse reactions to dental anesthetics than do patients with unstable angina or a history of recent (less than six months prior) myocardial infarction. Stress and anxiety reduction play a crucial role in management of these patients, and excellent pain control throughout the dental procedure is essential. The use of local anesthetics containing a vasoconstrictor is recommended as part of the stress reduction protocol for these patients. The dosage of the vasoconstrictor should be limited to that contained in one to two 1.8 ml cartridges of vasoconstrictor-containing anesthetic. For patients with unstable angina, recent myocardial infarction (less than six months), or recent coronary artery bypass graft surgery (less than three months), elective dental treatment should be postponed. If emergency treatment is required, stress-reduction protocols with antianxiety agents are appropriate, and the above limitation of one to two cartridges of vasoconstrictor-containing anesthetic must be strictly observed.

Cardiac dysrhythmia

Proper identification of patients with an existing cardiac dysrhythmia, commonly called arrhythmias, or those patients who may be prone to developing dysrhythmia, is essential and requires a physician consult to determine the current status. Patients with coronary atherosclerotic heart disease, ischemic heart disease, or congestive heart failure are susceptible to stress-induced cardiac dysrhythmias. Stressand anxiety-reduction protocols are again of paramount importance. Local anesthetic agents containing vasoconstrictors are appropriate for maintenance of adequate pain control during dental procedures. Elective dentistry should be avoided in patients with severe or refractory dysrhythmias until their physician can get the problem under control. Once again, it is reasonable and safe to limit the total dose of local anesthetic to no more than two 1.8 ml cartridges per appointment. The use of periodontal ligament or intraosseous injections using a vasoconstrictor-containing local anesthetic is not recommended in these patients. Congestive Heart Failure Patients who are under physician care and well-controlled with no complications can be treated relatively routinely. Limitation of vasoconstrictor dosage to two 1.8 ml cartridges of vasoconstrictorcontaining anesthetic is advised. Patients taking digitalis glycosides, such as digoxin, should be carefully monitored if vasoconstrictors are used since interaction of the two drugs may precipitate dysrhythmias.

Cerebrovascular accident

Atherosclerosis, hypertensive vascular disease, and cardiac pathoses such as myocardial infarction and atrial fibrillation are commonly associated with the occurrence of strokes. A patient who has suffered a stroke is at greater risk for having another one than is a patient who has never had one. It is recommended that dental treatment be deferred for six months following a stroke because of the increased risk of recurrent strokes during this period. After six months, dental procedures may be provided with the use of vasoconstrictor-containing local anesthetics where required for adequate pain control. If the stroke patient has associated cardiovascular problems, the dosage of local anesthetic with vasoconstrictor should be minimized in accordance with the guidelines for their specific cardiovascular disease

Pulmonary disease

The most common pulmonary diseases encountered in the dental office are asthma, tuberculosis, and chronic obstructive pulmonary disease, which includes chronic bronchitis and emphysema. While the status of tuberculosis infection in a patient is of the utmost concern to dental practitioners, and the patients infection must be under control before elective dentistry is done, it poses no implications with regard to the use of dental local anesthetics.

Asthma

Dental management of asthmatic patients is primarily aimed at prevention of an acute asthma attack. Knowing that stress may be a precipitating factor in asthma attacks, adherence to stress-reduction protocols is again essential and implies the judicious use of local anesthetics containing vasoconstrictors when the planned procedure requires extended depth and duration of anesthesia. However, caution has been recommended based upon Food and Drug Administration warnings that drugs containing sulfites can be a cause of allergic reactions in susceptible individuals. Studies suggest that sodium metabisulfite, which is used as an antioxidant agent in dental local anesthetic solutions containing vasoconstrictors to prevent the breakdown of the vasoconstrictor, may induce allergic, or extrinsic, asthma attacks. Data on the incidence of this problem occurring is limited, and suspicion is that it is probably not a common reaction even in sulfite-sensitive patients since the amount of metabisulfite in dental anesthetics is quite small. Indications are that more than 96 percent of asthmatics are not sensitive to sulfites at all; and those who are sensitive are usually severe, steroiddependent asthmatics. As Perusse and colleagues conclude, we believe local anesthetic with

vasoconstrictor can be used safely for nonsteroid-dependent asthma patients. However, until we know more about the sulfite sensitivity threshold, we recommend avoiding local anesthetic with vasoconstrictors in corticosteroid-dependent asthma patients on account of a higher risk of sulfite allergy and the possibility that an accidental intravascular injection might cause a severe and immediate asthmatic reaction in the sensitive patient.

Chronic obstructive pulmonary disease

The two most common forms of chronic obstructive pulmonary disease, characterized by chronic irreversible obstruction of ventilation of the lungs, are chronic bronchitis and emphysema. Patients with chronic obstructive pulmonary disease already have decreased respiratory function, making it mandatory that the dental practitioner take every precaution to avoid further respiratory depression. There are no containdications to the use of therapeutic doses of local anesthetics in these patients. However, any patient with chronic obstructive pulmonary disease who also suffers from coronary heart disease and/or hypertension must be managed in accordance with the guidelines provided for those diseases.

Renal disease

In general, drugs excreted by the kidney, such as dental local anesthetics, may not be metabolized and cleared from the blood stream as quickly as normal in the presence of renal disease. Total anesthetic dosage may need to be reduced and the interval of time between subsequent injections may need to be extended. Though this is a consideration, it is not a factor in most dental procedures provided the total local anesthetic dosage is kept to a safe minimum.

Hepatic disease

For patients with known liver function impairment, drugs metabolized by the liver should be avoided if possible, or the dosage at least decreased. Since all of the amide local anesthetics are primarily metabolized in the liver, the presence of liver disease and the status of liver function are important to the dentist. A history of hepatitis infection is not uncommon in most dental office patient pools. In completely recovered patients, local anesthetics may be administered routinely. However, patients with chronic active hepatitis or with carrier status of the hepatitis antigen must be medically evaluated for impaired liver function. Local anesthetics may be used in these patients, but it is recommended that the dose be kept to a minimum. In patients with more advanced cirrhotic disease, metabolism of local anesthetics may be significantly slowed,

leading to increased plasma levels and greater risk of toxicity reactions. Total anesthetic dosage may need to be reduced and the interval of time between subsequent injections may need to be extended. In these cases, initial injection with rapid-onset anesthetics such as lidocaine or mepivacaine followed by injection with a long-acting anesthetic like etidocaine or bupivacaine may be the best protocol for limiting total anesthetic dosage while achieving adequate pain control duration. Cimetidine (Tagamet) has been shown to significantly reduce the metabolic clearance of amide local anesthetics through the liver. However, the probability of cimetidine and therapeutic doses of local anesthetic interacting to produce a toxic level of local anesthetic in the blood stream is unlikely and unreported. Other histamine H2 -receptor antagonist drugs such as ranitidine (Zantac) or famotidine (Pepcid) do not share cimetidines metabolic inhibition of liver enzymes.

Pancreatic disease
Diabetes

Patients with either Type I insulin-dependent diabetes mellitus or Type II non-insulin-dependent diabetes mellitus, can generally receive local anesthetics without special precautions if control of their disease is well-managed. Consultation with a patients physician, as well as frank discussion with the patient, can determine the current status and what, if any, precautions are needed. Stress-reduction protocols, including excellent pain control, are of paramount importance and use of local anesthetics with vasoconstrictors is recommended when appropriate as long as the dosage is kept to the minimum needed. Special caution should be used for patients with Type I diabetes who are being treated with large doses of insulin. Some of these patients, so-called brittle diabetics, experience dramatic swings between hyperglycemia and hypoglycemia ;and the use of vasoconstrictors should be minimized due to the potential for vasoconstrictor-enhanced hypoglycemia.

Adrenal disease
Adrenal insufficiency

No alteration of local anesthetic use is required for patients with adrenal insufficiency. Of greatest concern for treatment of these patients is the maintenance of good anesthesia during the dental procedure and good postoperative pain control to reduce stress.

Pheochromocytoma

The cardinal symptom of this tumor of the adrenal medulla or of the sympathetic paravertebral ganglia is hypertension due to the increased secretion of endogenous epinephrine from these tissues. These patients are also prone to cardiac dysrhythmias. Due to the risk of potentiating cardiovascular problems, the use of vasoconstrictor-containing local anesthetics is contraindicated in these patients. No elective dental treatment should be rendered until the disease is medically corrected.

Thyroid disease

Hyperthyroidism

The use of epinephrine or other vasoconstrictors in local anesthetics should be avoided, or at least minimized to one to two cartridges, in the untreated or poorly controlled hyperthyroid patient. Hypertension and cardiac abnormalities, especially dysrhythmias, are common in the presence of excessive thyroid hormones. However, the well-managed or euthyroid patient presents no problem and may be given normal concentrations of vasoconstrictors.

Hypothyroidism

In general, the patient with mild symptoms of untreated hypothyroidism is not in danger when receiving dental treatment. However, patients with mild to severe hypothyroidism may have exaggerated responses to local anesthetics due to the central nervous system depressant effects. Dosage should be kept to a minimum in mild hypothyroid patients, and dental treatment is best deferred in severe hypothyroidism until the patients condition can be corrected by his or her physician.

Musculoskeletal diseases

Malignant hyperthermia

This rare, but potentially fatal, muscle disease was at one time believed to be induced by administration of amide local anesthetics. However, leading authorities, including the Malignant Hyperthermia Association of the United States, do not advise any special precautions for the use of amide anesthetics in patients susceptible to malignant hyperthermia.

Blood dyscrasias

Sickle cell anemia

Profound anesthesia as part of a proper stress reduction protocol is essential in management of these patients. The use of vasoconstrictor-

containing local anesthetics is considered safe as long as the dosage is limited to one to two cartridges.

Methemoglobinemia

Methemoglobin is hemoglobin that has been oxidized and can no longer bind and transport oxygen. While present in everyone, it normally makes up less than 1 percent of the circulating red blood cells. Increases in methemoglobin levels can be induced by administration of local anesthetic solutions, particularly prilocaine (Citanest), usually when in combination with other medications that also increase the methemoglobin level. Examples of common medications that may produce this interaction are Cipro, Bactrim, Septra, Dapsone, Macrodantin, Macrobid, Isordil, Nardil, and nitroglycerin.[32] Patients with methemoglobinemia or taking medications associated with this disease may be safely treated with local anesthetic injections, with or without vasoconstrictors; however, the dosage should be minimized and the use of prilocaine should be avoided.

Drug interactions

Antipsychotic drugs (Phenothiazines)

There are no contraindications for use of any local anesthetics, with or without vasoconstrictors, in patients taking lithium for bipolar disease. For bipolar patients taking a phenothiazine type of drug such as chlorpromazine (Thorazine) or risperidone (Risperdal), fluctuations in blood pressure are common. Local anesthetics with vasoconstrictors used in normal amounts usually will produce no adverse effects.[33] However, consultation with the patients physician is recommended before dental treatment, and the patient should be carefully monitored for possible hypotensive episodes during the appointment.

Cocaine

The main concern in patients abusing cocaine is the significant danger of myocardial ischemia, cardiac dysrhythmias, and hypertension. Patients high on cocaine should not be treated in the dental office for a minimum of six hours following the last administration of cocaine,[34] although the longer the time since the last use of the drug the better, with some researchers recommending deferral of dental treatment for 24 to 72 hours.

Tricyclic antidepressants

Although use of tricyclic antidepressant drugs such as imipramine (Tofranil) and amitriptyline (Elavil) is decreasing, they are still prescribed to significant numbers of patients. One to two cartridges of epinephrine-containing local anesthetic can be safely used in patients taking these drugs, however, these patients should be carefully observed at all times for

signs of hypertension due to enhanced sympathomimetic effects. Levonordefrin-containing local anesthetics are not recommended due to a greater tendency toward hypertension producing receptor potentiation than is seen with epinephrine.

Monoamine oxidase inhibitors

Dentists have long been cautioned about potential interactions of drugs of this class, for example the antidepressant phenelzine (Nardil), the Parkinsons disease drug selegiline (Eldapryl), and the antimicrobial furazolidone (Furoxone), relative to vasoconstrictor-containing local anesthetics. These cautions were based upon a fear of induction of severe hypertension due to interaction of vasoconstrictor-containing anesthetics with the MAO inhibitors. However, both animal and human studies have failed to yield evidence of such an interaction. Vasoconstrictor-containing local anesthetics may be used without special precautions in patients taking MAO inhibitor drugs.

Antianxiety drugs

Diazepam (Valium), one of the most widely prescribed drugs in the United States, is a potent central nervous system depressant. Dosage of all local anesthetic agents should be kept to the minimum necessary for good pain control in patients taking benzodiazepine antianxiety drugs due to their additive depressive effects.

Thus, local anesthetics, with or without vasoconstrictors, may be safely used in most medically complex patients. Observance of simple safety guidelines should be universal for administration of local anesthetics to all patients: Aspirate carefully before injecting to reduce the risk of unintentional intravascular injection; Inject slowly, a maximum rate of one minute per carpule is widely recommended, and monitor the patient both during and after the injection for unusual reactions; Select the anesthetic agent and whether to use it with or without a vasoconstrictor based upon the duration of anesthesia appropriate for the planned procedure; and Use the minimum amount of anesthetic solution that is needed to achieve an adequate level of anesthesia to keep the patient comfortable throughout the dental procedure. Adherence to these simple guidelines will reduce the risk of adverse reactions to the local anesthetic agents themselves or to the vasoconstrictors contained in local anesthetics. A further safety guideline useful for the majority of medically complex patients is to reduce the amount of local anesthetic containing a vasoconstrictor to no more than two 1,8 ml cartridges. If additional anesthetic volume is need to maintain adequate pain control for the procedure, nonvasoconstrictor anesthetics can be used for subsequent injections.

TOPIC: COMPLICATIONS ASSOCIATED WITH TOOTH EXTRACTION. EMERGENCY MEDICAL CARE

Syncope.

Syncope, one of the most common anesthetic complications, typically occurs in the preoperative setting, but may be observed occasionally postoperatively as well. Syncope is defined as transient loss of consciousness with spontaneous return to consciousness. It is usually related to patient's anxiety in the preoperative setting and is most frequently observed upon venipuncture for placement of an intravenous line. Syncope responds well to placing the patient in the Trendelenberg position, as this places the patient's head lower than the thoracic cavity and speeds blood return to the brain. Supplemental oxygen is beneficial and should always be given; it is also useful in cases of near-syncope. Ammonia smelling salts may also be helpful and are usually applied in situations where Trendelenberg positioning and supplemental oxygen does not result in a rapid return to consciousness. In the postoperative period, patients may experience syncope due to vasovagal response or transient orthostatic hypotension when rising too quickly from a seated or supine position. This complication may be prevented by assisting all patients when they stand or begin walking, since syncope under these circumstances carries the additional risk of injury from falling. Management consists of patient positioning, supplemental oxygen and ammonia salts if needed. Any period of unexpected patient unconsciousness that lasts for several minutes is not considered true syncope. If a loss of consciousness episode lasts more than a few minutes, other causes should be investigated without delay, including the possibility of hypoglycemia, hypotension, dehydration, partial seizure, oversedation, or cerebrovascular accident.

Vasovagal syncope.

Before you faint due to vasovagal syncope, you may experience some of the following:
- Pale skin
- Lightheadedness
- Tunnel vision — your field of vision narrows so that you see only what's in front of you
- Nausea
- Feeling warm
- A cold, clammy sweat
- Yawning
- Blurred vision

During a vasovagal syncope episode, bystanders may notice:
- Jerky, abnormal movements
- A slow, weak pulse
- Dilated pupils

Recovery after a vasovagal episode generally begins in less than a minute. However, if you stand up too soon after fainting – within about 15 to 30 minutes – you're at risk of fainting again.

Fainting can be a sign of a more serious condition, such as a heart or brain disorder. You may want to consult your doctor after a fainting spell, especially if you never had one before.

Causes

Vasovagal syncope occurs when the part of your nervous system that regulates heart rate and blood pressure malfunctions in response to a trigger, such as the sight of blood.

Your heart rate slows, and the blood vessels in your legs widen (dilate.) This allows blood to pool in your legs, which lowers your blood pressure. Combined, the drop in blood pressure and slowed heart rate quickly reduce blood flow to your brain, and you faint.

Sometimes there is no classical vasovagal syncope trigger, but common triggers include:
- Standing for long periods of time
- Heat exposure
- Seeing blood
- Having blood drawn
- Fear of bodily injury
- Straining, such as to have a bowel movement

Diagnosing vasovagal syncope often involves ruling out other possible causes of your fainting – particularly heart-related problems. These tests may include:
- Electrocardiogram. This test records the electrical signals your heart produces. It can detect irregular heart rhythms and other cardiac problems. You may need to wear a portable monitor for at least a day or as long as a month.
- Echocardiogram. This test uses ultrasound imaging to view the heart and look for conditions, such as valve problems, that can cause fainting.
- Exercise stress test. This test studies heart rhythms during exercise. It's usually conducted while you walk or jog on a treadmill.
- Blood tests. Your doctor may look for conditions, such as anemia, that can cause or contribute to fainting spells.

Tilt table test

If no heart problems appear to cause your fainting, your doctor may suggest you undergo a tilt table test.

For a tilt table test:

- You lie flat on your back on a table.
- The table changes position, tilting you upward at various angles.
- A technician monitors your heart rhythms and blood pressure to see if the postural changes affect them.

In most cases of vasovagal syncope, treatment is unnecessary. Your doctor may help you identify your fainting triggers and discuss ways you might avoid them.

However, if you experience vasovagal syncope often enough to interfere with your quality of life, your doctor may suggest trying one or more of the following remedies.

Medications

A drug called fludrocortisone acetate that is normally used to treat low blood pressure may be helpful in preventing vasovagal syncope. Selective serotonin inhibitors may also be used.

Therapies

Your doctor may recommend ways to decrease the pooling of blood in your legs. These may include foot exercises, wearing compression stockings or tensing your leg muscles when standing.

You may need to increase salt in your diet if you don't usually have high blood pressure. Avoid prolonged standing – especially in hot, crowded places – and drink plenty of fluids.

Surgery

Very rarely, inserting an electrical pacemaker to regulate the heartbeat may help some people with vasovagal syncope who haven't been helped by other treatments.

Oversedation

Oversedation is a relatively common event observed during ambulatory anesthesia that can rapidly develop in a potential complication of variable severity. It initially manifests as lack of adequate patient response to appropriate stimuli. For example, a patient who previously responded to loud verbal or forceful physical stimuli may suddenly fail to respond. In cases of profound oversedation, a patient may fail to respond to increasingly painful stimuli, and when the plane of general anesthesia is reached, the patient will have lost protective airway responses. If allowed to progress without intervention, oversedation can rapidly advance to

airway obstruction, hypopnea, or apnea leading to hypoxemia. In severe cases, respiratory depression can lead to respiratory arrest and depression of cardiac output will be observed. Oversedation in ambulatory anesthesia takes two forms: unintended deep sedation or general anesthesia during the procedure, or prolonged or delayed awakening in the postoperative period. Intraoperatively, oversedation is produced by too high a dose of an anesthetic drug or a dose of anesthetic that is administered too quickly. Patient factors often figure prominently in cases of oversedation, as patients who are very sensitive to the effects of an anesthetic or who have greatly decreased elimination kinetics will have a narrowed therapeutic range compared to an "average" patient. It can be quite difficult to titrate anesthetic drugs in such a patient, with the result that oversedation is more likely to occur. Age is an important factor in a patient's response to anesthesia. Sensitivity to anesthetic drugs and alterations in the dosages are required to achieve specified levels of sedation with extremes of age. While this may seem self-evident in the elderly, research shows that the reduction in required anesthetic dose begins as early as age 40 to 45. For each decade past the age of 40, there is an observed 10% reduction in the dose of fentanyl required while for propofol, the dose reduction is about 8%. The pediatric population in particular has a markedly idiopathic response to anesthetic drugs, and titration of sedation can be more challenging in this age group. Ironically, patients with very high anxiety levels may be prone to oversedation because they typically require a high initial dose of anesthetic to achieve sedation, but often markedly less medication to maintain a given level of anesthesia. Failure to reduce the dosage of anesthesia adequately after the initial induction bolus in these patients can result in oversedation. Oversedation may be caused when boluses of a drug are given too quickly or too close together. This typically occurs during an anesthetic procedure when a patient begins to awaken or become agitated and additional medications are administered to rapidly deepen the anesthesia. Since all anesthetic drugs take some period of time to exert their effect, failure to wait for the drug to take effect can result in the observation that the dose was insufficient and the administration of an additional bolus. Subsequently, when the additional boluses have had time to take effect, the patient may be in a deeper plane of anesthesia than was intended. This can be partially prevented by the spacing of additional drug boluses and knowing the time to effective onset of the anesthetic drugs utilized. Not all pharmacologic agents demonstrate first order kinetics however, and rate of drug onset can be increased or decreased depending on the patient's plasma drug level. Oversedation can sometimes result when the level of surgical stimulation is rapidly or dramatically decreased. Since surgical stimulation

tends to counteract the sedative effects of anesthetic drugs, a higher dose of anesthesia is typically required for more stimulating surgical procedures. A patient who is at an appropriate level of anesthesia may quickly become over-sedated if stimulation is decreased or discontinued. In situations where changes in the level of surgical stimulation can be predicted, allowing time for the anesthetic drug to wear off or decreasing the rate of infusion can effectively prevent most oversedation in these cases. Oversedation is a relatively common complication of ambulatory anesthesia which can rapidly develop in severity. It initially manifests as lack of adequate patient response to appropriate stimuli. For example, a patient who previously responded to loud verbal or forceful physical stimuli may suddenly fail to respond. In cases of profound oversedation, a patient may fail to respond to increasingly painful stimuli, and when the plane of general anesthesia is reached the patient will have lost protective airway responses. If allowed to progress without intervention, oversedation can rapidly progress to airway obstruction, hypopnea, or apnea leading to hypoxemia. In severe cases, respiratory depression can lead to respiratory arrest and depression of cardiac output will be observed. Management of mild oversedation may consist of briefly interrupting the administration of anesthetic drugs and observing the patient for a return to the desired level of anesthesia. If any degree of respiratory obstruction or depression is noted, maneuvers aimed at opening the airway such as a chin lift or jaw thrust should be performed as well. Given the rapid redistribution and short duration of effects of many anesthetic drugs, mild oversedation is self-correcting with supportive measures within a matter of a few minutes. Although not a mainstay of treatment, administration of reversal agents may be considered as an adjunctive therapy for oversedation. Few drugs used in ambulatory anesthesia have a reversal agent, but naloxone is able to reverse the effects of opioid agonist drugs and flumazenil is an effective antagonist of the benzodiazepine class of drugs. These reversal agents can be effective in reversing the effects of oversedation due to drug overdosage, but they reverse all actions of a drug including desirable effects such as analgesia, hypnosis, and anxiolysis. They may be considered for the treatment of oversedation and prolonged awakening in the postoperative period and are generally well tolerated. Research has not supported the routine use of reversal agents to speed recovery from ambulatory anesthesia procedures.

Seizures.

Seizure activity, both partial type and tonic–clonic seizures, represents abnormal CNS excitation. Because anesthetic drugs act by causing depression of the CNS, seizure activity during an anesthetic procedure is unlikely to occur. In patients with seizure disorders, however, seizures may occur in the preoperative and postoperative periods. Management of seizures involves positioning the patient to avoid injury and loosening tight or restrictive clothing as much as possible. Most seizures will terminate after a few minutes and require no other treatment, though benzodiazepines such as midazolam, lorazepam, or diazepam may be given intravenously or intramuscularly to terminate seizure activity. Since patients will typically become hypoxic during the clonic phase of a tonic–clonic seizure, supplemental oxygen may be beneficial in the immediate postictal period.

Cardiopulmonary complications.
Respiratory depression and respiratory arrest.

The effects of anesthetic drugs are the most common cause of respiratory depression in ambulatory anesthesia. An overdose of anesthesia will produce respiratory depression in virtually all cases, and this may progress to full respiratory arrest if not promptly corrected. Even typical doses of anesthetic drugs will cause some degree of respiratory depression in a proportion of patients. Primary respiratory depression, caused by the provision of anesthesia itself, refers to a deficit in ventilation or oxygenation or both. Respiratory depression may take the form of mechanical obstruction, caused by collapse of the oropharyngeal soft tissues or occlusion of the airway by the tongue or secretions. Central respiratory depression, characterized by hypopnea or apnea can also occur either separately or concurrently. Typically, mechanical obstruction occurs more frequently and at lower anesthetic doses than central apnea does, and it occurs to some extent in susceptible persons. Obese patients, those with short thick necks, mandibular retrognathia, and patients with obstructive sleep apnea are among the most susceptible groups. In severe cases, this may render these patients unsuitable for ambulatory anesthetic procedures. In most other cases, patient positioning can play a role in airway obstruction. Respiratory obstruction due to mechanical airway obstruction can be managed by careful suctioning, repositioning of the tongue in a forward position, and either a chin lift or jaw thrust maneuver. If necessary, the level of anesthesia may be lessened, as increasing levels of sedation contribute to the degree of airway impediment. Rarely, an oral or nasal airway may be needed to overcome the obstruction in the posterior pharynx

and stent the airway open. Supplemental oxygen can be helpful to decrease any oxygen desaturation associated with mild to moderate obstruction, although oxygen by itself does not alleviate the mechanics of obstruction. Respiratory depression may also be "central," characterized by a decreased respiratory rate or periods of apnea. Narcotic drugs are most often implicated because of their effects on the medullary respiratory center of the brainstem that results in decrease respiratory drive and response to hypercapnia. At moderate levels of narcotic effect, the decreased respiratory rate is accompanied by a compensatory increase in tidal volume that prevents oxygen desaturation. At higher levels of narcotic sedation, respiratory depression can progress to apnea and respiratory arrest. A brief period of respiratory support in the form of supplemental oxygen via a face mask with cessation of anesthetic drug administration may be all that is necessary in terms of management—particularly with short-acting drugs in a patient with good respiratory reserve. Whenever there is desaturation in a setting of frank apnea, however, the patient's ventilation should be assisted by a positive pressure face mask until spontaneous respiration resumes. Occasionally, mask ventilation with or without the placement of an oral or nasal airway will not be sufficient to overcome airway obstruction and provide oxygenation. In these cases, other means of establishingan airway and achieving effective ventilation should be employed. These include laryngeal mask airway (LMA) insertion or endotracheal intubation for administration of positive pressure ventilation with high oxygen flow. Because endotracheal intubation is a technically complex procedure and requires specialized equipment, it is subject to high rates of failure, especially in emergency situations. Intubation should only be considered in a patient who is hypoxemic and cannot be effectively mask ventilated. An LMA can be successfully used for the support of ventilation as an alternative to endotracheal intubation and has several advantages over the traditional endotracheal tube (ET). LMAs are quickly and easily inserted without the need for specialized equipment. Use of an LMA poses no risk of inadvertent intubation of the esophagus or mainstem bronchus or injury to the vocal cords. Airway stimulation is minimal and removal of the LMA can be easily accomplished once spontaneous respirations return. Regardless of the method used for airway establishment early recognition, preparedness, familiarity with the available equipment, and skill maintenance for their effective use are critical. In addition to respiratory depression or arrest caused by anesthetic drugs, other causes of respiratory complications include stroke or myocardial infarction. The signs and symptoms of stroke or acute coronary syndrome can be significantly masked in a patient undergoing ambulatory anesthesia, and respiratory

depression or arrest may initially be diagnosed as a case of oversedation. Any respiratory complication that does not respond to moderate interventions or progresses to a need for airway establishment and support of ventilation should be investigated for additional contributing factors or underlying conditions.

Laryngospasm, Bronchospasm, and Acute Asthma.

A second group of respiratory complications that may arise in the course of outpatient anesthesia includes reactive airway conditions such as laryngospasm, bronchospasm, and acute asthma. One analysis of complications in ambulatory anesthesia identified laryngospasm, stridor, and obstruction as the most frequently observed adverse events, accounting for 40% of complications. Acute asthma attacks are more frequent preoperatively and may be associated with patient anxiety. Laryngospasm and bronchospasm typically result from the combination of airway irritation and anesthetic sedation. Acute asthma and bronchospasm are manifested clinically by audible wheezing (more prominent during expiration), tachypnea, shortness of breath, and are usually accompanied by decreasing oxygen saturation. They represent a hyperreactive process of the large airways that results in bronchoconstriction and obstruction to airflow. A number of factors may precipitate an asthma attack or bronchospasm, but in an oral surgical setting anything that causes airway irritation may be the predominant etiologic factor. Some examples include the production of aerosols during a procedure or decreased clearance of secretions that can irritate the airway and stimulate coughing. Laryngospasm, by contrast, is an acute upper airway obstruction that presents with stridor (incomplete laryngospasm) or failure of ventilation (complete laryngospasm with total closure of the glottis). Obstruction of the upper airway due to foreign body aspiration may also present with acute stridor and should be ruled out clinically. Laryngospasm results in reflexive closure of the glottis upon irritation and is a protective airway reflex. It does not occur in awake patients or in patients during general anesthesia, but can occur in a mild or moderate stage of sedation. Acute asthma attacks may be managed with inhaled beta-2-agonist bronchodilator medications such as albuterol. These drugs are typically administered via a metered-dose inhaler (MDI) either with or without an additional spacer device. Patients who are awake and alert may be allowed to self-administer the inhaled medication, while patients who are sedated may need assistance. In sedated patients, the use of a spacer may be particularly useful to assist delivery of the drug to the lungs and to prevent excess drug deposition in the oropharynx where it is has no therapeutic effect. Inhaled bronchodilators are also the first choice

treatment for bronchospasm and are administered similarly. In intubated patients these inhaled medications may be administered via ET tube or LMA, though the dosage must be greatly increased (up to 10 to 20 puffs) to account for the large amount of drug that coats the airway tube and does not reach the lungs. Both acute asthma and bronchospasm benefit from supplemental oxygen. In severe cases that do not respond to inhaled beta-agonists, intravenous or subcutaneous epinephrine may be considered as a rescue therapy. The adverse effects of epinephrine-particularly tachycardia and increased blood pressure-limit its use for reactive airway disease. It should be used with extreme caution, if at all, in patients with underlying cardiac disease.

The treatment of laryngospasm differs from that of asthma or bronchospasm. Because it occurs in patients who are at "lighter" levels of anesthesia, deepening the level of anesthesia will help to abolish the protective airway reflex and relax the vocal cords to allow the passage of air. Positive pressure ventilation, especially when instituted early in the course of the laryngospasm, is frequently successful at "breaking" the spasm. If it appears that secretions or bleeding in the oropharynx may be contributing factors, a brief period of suctioning with a tonsillar (Yankauer) suction may be helpful. Care should be taken that this does not delay positive pressure ventilation, however, and that the suction itself does not serve to further provoke the laryngospasm reflex. If neither deepening the anesthesia nor positive pressure ventilation proves successful, the treatment of choice for laryngospasm is the administration of the neuromuscular blocking agent succinylcholine. Succinylcholine for the treatment of laryngospasm is typically given at a dose of 20–40mg initially, with an additional 20–30mg given a minute or two later if the first dose proves insufficient. This dose is less than the "standard intubating dose" of succinylcholine, but whenever a paralytic agent is given, it is safest to assume that complete paralysis may occur and the practitioner should be prepared to assist the patient's ventilation until the drug has adequately worn off and the patient is ventilating well without assistance.

Aspiration.

Aspiration refers to the entry of substances such as blood, saliva, gastric contents, or foreign bodies into the lungs via inadvertent inhalation. Aspiration occurs due to decreased or absent protective airway reflexes and is exacerbated by decreased gastroesophageal tone. Patients with neuromuscular degeneration or history of stroke are at increased risk as are those undergoing sedation and general anesthesia. Additional risk factors include gastroesophageal pathology such as GERD (gastroesophageal

reflux disease), hiatal hernia, or achalasia, as well as a history of esophageal surgery or gastric bypass. The greatest risk from aspiration occurs with gastric contents that are due to complications from pneumonia (a chemical pneumonia causing damage to the lungs from the low pH of gastric fluids and the presence of peptic enzymes) or acute respiratory distress syndrome (ARDS). Either passive regurgitation of stomach contents or active vomiting during anesthesia can lead to aspiration. Any patient who begins to retch or vomit during an anesthetic procedure should be placed with their head lowered to prevent aspiration into the lungs, and any vomitus should be suctioned carefully from the mouth and oropharynx. Patients known or suspected to have aspirated vomitus should have their respiratory status carefully monitored as they may require elective intubation with lavage and suctioning of the bronchial tree. The role of steroids and antibiotic therapy in these patients has been questioned and they are not routinely administered. In the absence of signs indicating respiratory compromise, management of aspiration is expectant. In the case of aspiration of a foreign body, the surgeon may make a careful attempt to visualize and retrieve the object if possible. A laryngoscope and MacGill forceps may be helpful in this situation. If the object cannot be visualized for removal, the patient's respiration should be monitored and supported as needed and the patient transferred to a hospital.

Acute Vascular Events.

Acute vascular events are among the most serious perioperative complications and include myocardial ischemia, myocardial infarction, and cerebrovascular accident (stroke). Due to the high prevalence of cardiovascular and atherosclerotic diseases in adults, complications of this nature should be anticipated in any office emergency plan. Myocardial ischemia and myocardial infarction are most common in the postoperative period and can be related to the surgical procedure, the anesthesia, or both. In a very anxious patient with a history of ischemic heart disease, the preoperative period presents a risk of acute angina. Risk factors for acute vascular events include history of heart disease or cerebrovascular disease, increasing length and invasiveness of surgery, and significant changes in heart rate, respiration, or blood pressure due to anesthetic drugs or surgical manipulation. Though profound fluctuations in heart rate, blood pressure, or respiration should be avoided in any patient, this is critical for individuals with underlying risk factors for acute coronary or cerebrovascular complications. In these patients, vital signs should be maintained close to baseline to avoid hemodynamic decompensation. Acute angina is characterized by a sensation of pain, tightness, or crushing in the

substernal region of the chest and may be accompanied by shortness of breath, anxiety, and diaphoresis. It can be difficult to differentiate acute angina from a panic attack or GERD/acute gastritis unless the patient has a history of angina episodes. Acute angina should be treated by discontinuing any stimulating procedure, administering a dose of sublingual nitroglycerin, applying supplemental oxygen via face mask or nasal cannula, and continuous monitoring of vital signs. If the pain does not subside completely within 10 minutes, a second dose of nitroglycerin may be given. Up to three doses of nitroglycerin have been recommended to alleviate symptoms of angina, but the surgeon should take into account the patient's medical history and level of distress in deciding when to call EMS (emergency medical services). It is recommended that EMS be notified immediately and that emergency medical drugs and supplies be readily available [advanced cardiac life support (ACLS) protocol] in cases of moderate to severe chest pain lasting 30 minutes or more, when the pain appears to be getting worse, if two to three doses of nitroglycerin are not sufficient to provide relief, and in any patient who is hemodynamically unstable. In situations where a myocardial infarction (MI) is suspected, the patient should be given 325mg of aspirin (chewed or crushed is preferable as it speeds absorption of the drug), sublingual nitroglycerin, and supplemental oxygen. If morphine is available, this should be given as well, both for pain relief and because it causes peripheral vasodilation, which enhances cardiac output. The patient's vital signs should be monitored continuously until EMS arrives, particularly the ECG (arrhythmias may accompany myocardial ischemia and can signal imminent cardiac arrest) and blood pressure. If the patient deteriorates to a situation of cardiac arrest, the ACLS protocol should commence without delay. (NB: Adequate and uninterrupted chest compressions are now recognized as a key to successful resuscitation efforts. If the patient is in a dental chair without a hard, flat back or which does not recline completely, it is preferable to place the patient on the floor so that adequately forceful chest compressions can be delivered against a firm supporting surface.) The management of a patient where stroke/cerebrovascular accident is suspected includes notification of EMS and supportive measures. Supplemental oxygen should be given and the patient's vital signs monitored. A brief neurological examination may distinguish true cerebrovascular complications from confusion or disorientation that may result from anesthetic drugs. Aspirin should not be given to a patient suspected of suffering a stroke because intracerebral hemorrhage may be present. Patients who develop signs of neurocognitive deficit in the setting of severe hypertension (systolic >200, diastolic >110mmHg) should be

treated with medication to decrease blood pressure. Of the intravenous agents, labetalol (a combination alpha- and beta-blocking agent) is frequently preferred for the management of acute severe hypertension (see the section on hypotension and hypertension).

Cardiac Arrhythmias.

Cardiac arrhythmias may arise spontaneously or they may be associated with myocardial ischemia, respiratory depression, metabolic disorders, or other physiological derangements. Some anesthetic agents can cause or contribute to arrhythmias, particularly in susceptible individuals. Arrhythmias may be divided based on rate into tachyarrhythmias and bradyarrhythmias, or based on location of supraventricular ectopic rhythm generation versus ventricular arrhythmias. Some cardiac rhythm abnormalities such as premature ventricular contractions (PVC) and premature atrial contractions (PAC) occur spontaneously in an otherwise normal population and require no intervention. Likewise, certain instances of tachycardia (mild, associated with anxiety) and bradycardia (due to chronic treatment with beta-blockers, or in a competitive athlete) may be within acceptable limits. Any arrhythmia that is symptomatic, that carries a risk of conversion to a more dangerous cardiac rhythm, or that is accompanied by hemodynamic instability should be promptly addressed, however. If the arrhythmia is attributable to an underlying physiologic disturbance, efforts should be made to treat the underlying condition. Otherwise, the management strategies for cardiac arrhythmias include pharmacologic interventions or cardioversion/ defibrillation.

Tachycardia due to stress, anxiety, or pain usually responds to a deepening of anesthesia and additional analgesia. The administration of a beta-adrenergic blocking medication can be considered for refractory cases. Selective beta-1 medications are preferred so as to avoid undesirable bronchoconstriction. Esmolol is a beta blocker with a fast onset and short-acting duration. Metoprolol is another beta-1-selective medication with a longer acting-duration. Both are available for intravenous use and may be titrated to effect. In general, beta blockers are best avoided in patients with low cardiac output states such as acute MI or acute exacerbation of congestive heart failure due to negative inotropic effects. When tachycardia is secondary to hypotension, hypovolemia, or fever, it is preferable to treat the underlying physiological derangement.

For cases of paroxysmal supraventricular tachycardia, the drug adenosine is typically recommended. Supraventricular tachycardias that do not respond to drug therapy or wide-complex tachycardia (ventricular tachycardia) should be treated with synchronized/unsynchronized

cardioversion (electric shock). Cardioversion is also preferred for tachycardia associated with hemodynamic instability. Cardiac rhythms associated with cardiac arrest, i.e., ventricular fibrillation or pulseless electrical activity, should be treated according to the ACLS protocols.

Hypertension and Hypotension.

During the course of an anesthetic, both hypertension and hypotension may be encountered. Hypertension is typically associated with patient anxiety, painful stimulus, or anesthesia that is too light. Hypertension may also be seen in the hypertensive patient who neglects to take their regular antihypertensive medications the day of the surgical procedure. Hypertension may be treated by deepening the anesthesia or by judicious use of an antihypertensive medication. Labetalol, a combined alpha-adrenergic and beta-adrenergic blocker is often preferred, but selective beta-blocking agents such as metoprolol or vasodilating agents such as hydralazine may also be used. In patients whose baseline blood pressure is elevated (above 120/80), it is important not to decrease blood pressure too rapidly or profoundly to avoid inducing a decrease in cardiac output. Hypotension may also be encountered in the course of an anesthetic. Several commonly used medications such as propofol can induce a transient decrease in blood pressure, particularly when given as a bolus. In a young patient without underlying cardiac disease, small to moderate decreases in blood pressure are usually well tolerated. However, because hypotension may also be a sign of low volume status or of impending cardiovascular collapse, it should be closely monitored and treated aggressively when indicated. In pediatric patients particularly, hypotension typically precedes cardiac arrest and is an important warning sign. Decreasing the anesthetic depth, increasing the rate of IV fluid infusion, or giving a bolus of IV fluids are all appropriate first steps in the management of hypotension. If these steps are not corrective, a vasopressor medication such as ephedrine or phenylephrine may be given while also investigating for any causative factors such as an underlying medical condition, anaphylaxis/allergic reaction, or increased vagal stimulation.

Nausea and Vomiting.

Postoperative nausea and vomiting (PONV) is frequently cited as the most common complication of anesthesia, and it is one that patients frequently complain about. Many drugs used in ambulatory anesthesia are potentially capable of causing nausea and vomiting, particularly the halogenated gases (isoflurane, halothane, sevoflurane) and anticholinesterases. Narcotic medications such as morphine and fentanyl

may also cause nausea and vomiting, as do barbiturates. Benzodiazepine medications have not been cited as a cause of PONV, and propofol is known to have antiemetic properties. In addition to the effects of the anesthetic drugs, there are several patient factors that are known to increase the risk of PONV. Female gender, obesity, gastroparesis, past history of PONV, and a history of motion sickness may all predispose toward nausea and vomiting post anesthesia. Dehydration may also be a factor. Prevention is an important consideration given that PONV is a frequent cause of delayed discharge to home after ambulatory anesthesia procedures. Treatment of nausea and vomiting once it occurs is more difficult and less successful than efforts at prophylaxis. Avoiding dehydration and hypoglycemia by maintaining a reasonable preoperative fasting period and giving IV fluids during surgery will benefit most patients. In addition, screening prospective patients to identify those at risk of PONV will allow the surgeon to consider pharmacological methods of nausea and vomiting prophylaxis. Several effective medications are available that can be given by mouth or intravenously prior to the procedure in order to prevent and treat nausea and vomiting.

Adrenal Crisis.

Adrenal crisis is a rare but serious complication of suppressed adrenal release of cortisol and can rapidly cause hemodynamic collapse if the cortisol deficiency is not promptly diagnosed and rectified. Risk factors for acute adrenal crisis include both patient and procedure factors. Surgical procedures that are invasive and cause high levels of physiologic stress carry the highest risk. Patients most at risk for adrenal crisis are typically those with a lengthy history of moderate- to high-dose exogenous corticosteroid supplementation, though adrenal crisis has been classically associated with Addison's disease (primary adrenocortical insufficiency). Since most procedures that will be performed in an out, patient setting will be minimally invasive and of short duration, the risk of adrenal crisis is low. Patients should be screened for a history of Addison's disease or corticosteroid use, and preoperative adjunctive corticosteroid supplementation should be considered for any patient deemed to be at risk. Acutely, the management of adrenal crisis involves intravenous cortisol administration and supportive measures.

Immunologic complications.

Hypersensitivity Reactions Hypersensitivity, or allergic, reactions are common in the general population and may be produced in the ambulatory anesthesia setting by a variety of common substances. Patients

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with a history of allergic asthma, atopy, or autoimmune disease may be most at risk. Mild reactions include urticaria, flushing, and pruritis, while more severe reactions can be characterized by angioedema, wheezing, nausea and vomiting, or anaphylaxis. The most common complication is a localized skin reaction, frequently to an adhesive tape used to secure an IV line, for example. Some of the medications used in ambulatory anesthesia (propofol or succinylcholine) have been implicated in allergic reactions, but this is generally rare. Likewise, a true allergy to local anesthetic agents is very infrequent. Most hypersensitivity reactions will be mild and can be managed symptomatically. More serious reactions involving angioedema or a skin rash covering the full body require more aggressive management such as the use of an antihistamine drug (e.g., diphenhydramine) and possibly corticosteroids. Angioedema or other acute allergic facial swelling should be carefully monitored for the development of airway compromise – an unlikely but possible sequela.

Anaphylactic Reaction.

Anaphylactic and anaphylactoid reactions result from systemic release of mediators from mast cells and basophils. Again, anaphylactoid reactions are chemically and clinically indistinguishable from anaphylactic reactions except that they are not IgE mediated. These mediators consist of preformed substances stored in the granules of mast cells and basophils (e.g., histamine, tryptase, heparin, chymase, and cytokines), as well as newly synthesized molecules that are principally derived from the metabolism of arachadonic acid (e.g., prostaglandins and leukotrienes).

Anaphylaxis occurs in an individual after reexposure to an antigen to which that person has produced a specific IgE antibody. The antigen to which one produces an IgE antibody response that leads to an allergic reaction is called an allergen. The IgE antibodies produced may recognize various epitopes of the allergen. These IgE antibodies then bind to the high-affinity IgE receptor (FcεRI) on the surface of mast cells and basophils. Upon reexposure to the sensitized allergen, the allergen may cross-link the mast cell or basophil surface-bound allergen-specific IgE resulting in cellular degranulation as well as de novo synthesis of mediators. Histamine is thought to be the primary mediator of anaphylactic shock. Many of the signs and symptoms of anaphylaxis are attributable to binding of histamine to its receptors; binding to H1 receptors mediates pruritis, rhinorrhea, tachycardia, and bronchospasm. On the other hand, both H1 and H2 receptors participate in producing headache, flushing, and hypotension.

In addition to histamine release, other important mediators and pathways play a role in the pathophysiology of anaphylaxis. Metabolites of

arachadonic acid, including prostaglandins, principally prostaglandin D2 (PGD2) and leukotrienes, principally leukotriene C4 (LTC4), are elaborated by mast cells and to a lesser extent basophils during anaphylaxis and, in addition to histamine, are also thought to be pathophysiologically important. PGD2 mediates bronchospasm and vascular dilatation, principle manifestations of anaphylaxis. LTC4 is converted into LTD4 and LTE4, mediators of hypotension, bronchospasm, and mucous secretion during anaphylaxis in addition to acting as chemotactic signals for eosinophils and neutrophils. Other pathways active during anaphylaxis are the complement system, the kallikrein-kinin system, the clotting cascade, and the fibrinolytic system.

Specific lymphocyte subtypes (CD4+ Th2 T-cells) are central in the induction of the IgE response. CD4+ T-cells are segregated into either T-helper 1 (Th1) or Th2 types, defined by the cytokine profile produced by the individual T cell. Th1 cells are important in cellular immunity and make interferon gamma. Th2 responses are important in humoral immunity and critical for the allergic response. Cytokines produced be Th2 cells include interleukin (IL)-4, IL-5, IL-9, and IL-13. Of great importance, IL-4 is the isotype switch factor for B cells to begin producing IgE. The IgE response is thought to be an overly robust immune response in certain predisposed (atopic) individuals. Multiple factors influence whether one produces a Th2 versus a Th1 response including genetic variables, environmental factors, and triggers. The hygiene hypothesis suggests that exposure to microbes in infancy leads to "immune deviation" from a Th2 response, which predominates in utero, to a predominantly Th1 response. Lack of this "immune deviation" leads to further perpetuation of the Th2 response to allergens. Stimuli (microbes) that lead to a Th1 response cause IL-12 to be produced by antigen-presenting cells. IL-12 not only perpetuates the Th1 response but inhibits IgE production. Furthermore, cytokines such as interferon gamma (produced by Th1 cells) and IL-18 (produced by macrophages) suppress production of IgE. Thus the Th1 response is considered to be inhibitory to allergy.

Signs and Symptoms.

The signs and symptoms are highly variable. These are rapidly occurring and progressive. There are four major clinical syndromes recognised.

1. Skin reactions.

2. Smooth muscles spasm (Gastrointestinal tract, genitourinary tract and respiratory tract).

3. Respiratory distress.

4. Cardiovascular collapse; and loss of consciousness

The clinical signs of allergy: such as urticaria, erythema, pruritis or wheezing occur before patient collapses.

Management Initial Therapy.

An anaphylactic reaction should be treated immediately with an injection of epinephrine (adrenaline). Doses, available by prescription, come in an auto-injector that should be kept with you at all times. Two injections may be necessary to control symptoms. Here are some tips for reducing the risk of anaphylaxis:

Know your trigger. If you have had anaphylaxis, it is very important to know what triggered the reaction. An allergist can review your medical history and, if necessary, conduct diagnostic tests. The most common triggers are:

Food: including peanuts, tree nuts such as walnuts and pecans, fish, shellfish, cow's milk and eggs.

Latex: found in disposable gloves, intravenous tubes, syringes, adhesive tapes and catheters. Health care workers, children with spina bifida and genitourinary abnormalities and people who work with natural latex are at higher-risk for latex-induced anaphylaxis.

Medication: including penicillin, aspirin and non-steroidal anti-inflammatory drugs such as ibuprofen, and anesthesia.

Insect sting: with bees, wasps, hornets, yellow jackets and fire ants being the most likely to trigger anaphylaxis.

Avoid your trigger. Avoidance is the most effective way to prevent anaphylaxis. An allergist can work with you to develop specific avoidance measures tailored specifically for your age, activities, occupation, hobbies, home environment and access to medical care. Here are some general avoidance techniques for common triggers:

Food allergies. Be a label detective and make sure you review all food ingredient labels carefully to uncover potential allergens. When eating out, ask the restaurant how food is prepared and what ingredients are used. If you have a child with a history of anaphylaxis, it's imperative to make sure that school personnel are informed of the child's condition and a treatment plan is provided, including the administration of epinephrine.

Medications. Make sure all of your doctors are aware of any reactions you have had to medications so that they can prescribe safe alternatives and alert you to other medications you may need to avoid. If there are no alternative medications, you may be a candidate for desensitization, a treatment that introduces a small dose of the medication you are allergic to. As your body becomes more tolerant to the medication, the dosage can be increased over time. While the treatment is effective, it is

only temporary and must be repeated if the medication is needed again in the future.

Insect stings. To help prevent stinging insects, avoid walking barefoot in grass, drinking from open soft drink cans, wearing bright colored clothing with flowery patterns, sweet smelling perfumes, hairsprays and lotion during active insect season in late summer and early fall. An allergist can also provide a preventative treatment called venom immunotherapy (or venom allergy shots) for insect sting allergy. The treatment works by introducing gradually increasing doses of purified insect venom, and has been shown to be 90 to 98 percent effective in preventing future allergic reactions to insect stings.

Be prepared. Prompt recognition of the signs and symptoms of anaphylaxis is critical. If you unexpectedly come into contact with your trigger, you should immediately follow the emergency plan outlined by your doctor including the self-administration of epinephrine. If there is any doubt about the reaction, it is generally better to administer the epinephrine. Teachers and other caregivers should be informed of children who are at risk for anaphylaxis and know what to do in an allergic emergency.

Seek treatment. If a severe reaction does occur and epinephrine is administered, you should be transported to the nearest emergency facility by ambulance for additional monitoring.
Tell family and friends. Family and friends should be aware of your condition, your triggers and know how to recognize anaphylactic symptoms. If you carry epinephrine, alert them to where you keep it and how to use it.

Wear identification. Wear and/or carry identification or jewelry (bracelet or necklace) noting condition and offending allergens.
See a specialist. Allergists have the training and expertise to review your allergy history, conduct diagnostic tests, review treatment options and teach avoidance steps.

The following steps should be taken rapidly:
1. Stop the triggering agent/drug.
2. Administer O2 (100%).
 3. Position the patient supine with legs slightly elevated.
4. Give Basic Life Support (BLS) (ABC of Resuscitation).
5. Call for medical assistance.
6. Administer epinephrine IM-IV (0.3-0.5 mg of 1:1000 for adults) immediately, or subcutaneous (SC) or intravenous (IV). Epinephrine is the mainstay of the initial pharmacotherapy.
7. Monitor vital signs.

Secondary Therapy

1. Administration of antihistaminic. If the patient shows signs of allergy, give antihistaminics such as IV/IM diphenhydramine 1 mg/kg (maximum 50 mg).

2. If the patient continues to deteriorate, administer glucocorticoids, such as: IV hydrocortisone sodium succinate 100 mg, or b. IV dexamethasone 8 mg.

3. CPR, if necessary.

4. Transfer the patient to a nearby hospital with ICU facilities in an ambulance, as soon as possible.

Complications of anaphylactic shock

Anaphylactic shock is extremely serious. It can block your airways and prevent you from breathing. It can also stop your heart. This is due to the decrease in blood pressure that prevents the heart from receiving enough oxygen.

This can contribute to potential complications such as:
- brain damage
- kidney failure
- cardiogenic shock, a condition that causes your heart to not pump enough blood for your body
- arrhythmias, a heartbeat that is either too fast or too slow
- heart attacks
- death

In some cases, you will experience a worsening of pre-existing medical conditions.

This is especially true for conditions of the respiratory system. For example, if you have COPD, you may experience a lack of oxygen that can quickly do irreversible damage to the lungs.

Anaphylactic shock can also permanently worsen symptoms in people with multiple sclerosis.

The sooner you get treatment for anaphylactic shock, the fewer complications you are likely to experience.

TESTS AND TASKS

TOPIC: TYPES OF LOCAL ANESTHESIA, LOCAL ANESTHETIC IN DENTISTRY
Tests

1. Which of the following are anesthetics of the amide group?
1) articaine
2) novocain
3) dicain

2. What anesthetic refers to a group of ester?
1) articaine
2) dicain
3) trimekain

3. What vasoconstrictor drugs are used?
1) adrenaline
2) ksilonor
3) felypressin
4) vasopressin

4. Which of anesthetics are used without vasoconstrictor?
1) novocain
2) lidocaine
3) mepivacaine
4) benzocaine

5. What is the maximum single dose for 2% novocaine solution?
1) 20-25 ml.
2) 30-40 ml.
3) 30-35 ml.
4) 25-30 ml.
5) 10-20 ml.

6. What enzymes are hydrolyzed by novocaine?
1) phosphatase
2) esterase
3) hydrolase
4) all true

7. What are the main types of carpool syringes?
1) to the side and front-loading
2) with vertical load
3) with a front-loading, horizontal

8. Which factor affects the onset of anesthetic action?
1) protein binding
2) lipid solubility

3) vasoactivity

4) non nervous tissue diffusability

5) pKa

9. The components of the carpool syringe are:

1) body

2) stock

3) plunger

4) holder

5) all of the above

10. Bevel of the carpool needle can be:

1) simple, complex, super-cut

2) direct, blunt, sharp

3) oblique, longitudinal, transverse

4) short, medium, long, multi bevel

Answers: 1-1; 2-2; 3-1,3,4; 4-3; 5-1; 6-2; 7-3; 8-4,5; 9-5; 10-1.

Tasks

Task №1. The child is 3 years old and 12 kg weight.

What rules for choice the anesthetic and its dose for local anesthesia do you know?

Task №2. Doctor used the amide anesthetic from thiophene group. Anesthesia occurs within 0,5-3 min, quickly removed from the body. It is used for infiltration and block anesthesia. Rarely cause allergic reactions. It does not cross the blood-placenta barrier.

What kind of anesthetic from amide group in the question?

Task №3. The patient came to the dentist and warned that one month ago he had a heart attack. What is the tactics of the dentist? What is the anesthetic of choice?

Task №4. Lidocaine infiltration anesthesia in the mandible was conducted to the patient. His somatic diseases are hypothyroidism and tachycardia. The concentration of adrenaline in the cartridge with anesthetic is 1:50 000.

What mistakes were made for the anesthesia?

Task №5. Pregnant woman turned to oral surgeon for mandibular nerve block anesthesia.

What anesthetic should be used for anesthesia?

What complications may occur in the foetus after using lidocaine as local anesthetic?

TOPPIC: INFILTRATION ANESTHESIA IN MAXILLOFACIAL REGION
Tests

1. Analgesic agents for application anesthesia are used in the form of:
1) solution;
2) powder;
3) gel;
4) suspension.

2. Contraindications to the use of dicain ™ are:
1) children under 5 years;
2) children under 10 years;
3) severe general status;
4) all of the above mentioned is not true.

3. Types of non-injection (topical) anesthesia:
1) chemical;
2) physical;
3) heat;
4) physicochemical.

4. What are the target for intraosseous spongy anesthesia:
1) area of projection of apex of tooth
2) interdental septum
3) no right answer

5. The duration of intrapulpal anesthesia is:
1) 1-2 min;
2) 2-5 min;
3) 5-7 min;
4) 7-10 min.

6. The topical anesthesia is used for manipulation on:
1) mucosa;
2) skin;
3) hard tissues of the tooth;
4) pulp.

7. What are the requirements for topical anesthetic?
1) deep penetration into the tissue;
2) lack of irritation;
3) stability in solutions;
4) no right answer

8. Contraindications for intraligamentary anesthesia are:
1) subgingival calculus;
2) periodontal inflammation;
3) cervical caries;

4) enamel hypoplasia.

9. The advantages of infiltration analgesia:

1) absence of large nerve and vessels in injection area;

2) large area of anesthesia;

3) small amount of solution;

4) rapid pain relief.

10. The benefits of intraligamentary anesthesia are:

1) it is painless;

2) the possibility of dental treatment in 4eh quadrants during one visit;

3)longer analgesia compared with conduction anesthesia;

4) all of the above is true.

11. What amount of anesthetic we can use for intraligamentary anesthesia:

1) 0,1-0,2 ml;

2) 0,4-0,5 ml;

3) 0,5-0,7 ml.

Answers:1-1,2,3,4; 2-1; 3-1,2,4; 4-1; 5-1; 6-1,2; 7-1,2,3; 8-1,2; 9-1,4; 10-1,2; 11-1.

Tasks

Task №1. Topic anesthesia was used for 16th tooth extraction. Decayed tooth had no mobility. Patient fell acute pain during extraction. Was anesthesia chosen correctly? When you can use topic anesthesia?

Task №2. Apical anesthesia with Ultracain™ was used for 13th tooth extraction. Patient felt pain at the injection site the next day after extraction. What was the reason of the pain? How to avoid it?

Task №3. Minimum duration of 11th, 25th and 44th teeth endodontic treatment is necessary for the patient. What type of anesthesia is most suitable in this case and why?

Task №4. Intrapulpal injection anesthesia was used for 12th tooth endodontic. The patient felt pain during the pulp extirpation. Why this anesthesia was not effective enough?

Task №5. Soft tissue infiltration anesthesia was used for the patient with submental abscess. But pain did go away. What is the doctor's mistake?

TOPIC: MANDIBLE NERVE BLOCK ANESTHESIA
Tests

1. The area of innervations of Inferior alveolar nerve
1) pulps of all mandibular teeth from the last molar up to the central incisor in the midline
2) body of the mandible
3) inferior portion of the ramus of the mandible
4) buccal mucoperiosteum, in the region of mandibular anteriors, anterior to mandibular second premolar or anterior to the mental foramen
5) skin of the chin, skin of lower lip, and mucosa of lower lip.

2. The area of innervations of Long buccal nerve
1) buccal mucoperiosteum in the region of mandibular molars or buccal mucoperiosteum posterior to mental foramen
2) adjacent part of vestibular mucosa
3) adjacent part of buccal mucosa
4) mucosa of retromolar fossa.
5) skin of the chin

3. Advantages of mental nerve block:
1) high success rate.
2) technically easy.
3) usually entirely atraumatic.
4) produces pulpal anesthesia, as well as soft and hard tissue anesthesia without lingual anesthesia. It is useful instead of bilateral inferior alveolar nerve blocks.
5) it does not produce lingual anesthesia

4. Indications for Gow-Gates' mandibular nerve block
1) surgical procedures on mandibular body and the ramus.
2) when buccal soft tissue anesthesia from the third molar up to the midline is required.
3) surgical procedures in the tongue and the floor of the mouth.
4) presence of infection or acute inflammation in the area of injection.
5) patients who might bite either their lip or the tongue, such as young children and mentally challenged adults.

5. Areas anesthetised at Akinosi mandibular nerve block
1) all mandibular teeth on the side of injection up to the midline.
2) body of the mandible
3) posterior portion of the ramus.
4) buccal mucoperiosteum
5) lingual soft tissues and periosteum.

6. Advantages of Akinosi mandibular nerve block
1) relatively atraumatic.

2) patient need not be able to open his mouth.
3) difficult to visualise the path of the needle and the depth of insertion.
4) no bony contact, so the depth of penetration is somewhat arbitrary.
5) potentially painful if the needle is too close to periosteum.

7. The average depth of soft tissue penetration during Gow-Gates' mandibular nerve block is
1) 10 mm
2) 15 mm
3) 25 mm
4) 35 mm
5) 40mm

Answers: 1 – 1,2,3,4,5; 2 – 1,2,3,4; 3 – 1,2,3,4; 4 – 1,2,3; 5 – 1,2,4,5; 6 – 1,2; 7 – 3

Tasks

Task №1. When performing regional anesthesia in the mandible the patients has no feeling in right cheek, half of the lower lip, skin of the chin, gums with vestibular side. What type of anesthesia was used?

Task №2. The patient has difficulty opening the mouth – inflammatory contracture. What kind of anesthesia he needs?

Task №3. In the case of mandibular nerve block anesthesia has not come. What mistakes were made during anesthesia?

Task №4. To remove the 41tooth doctor used pterygomandibular nerve block. Complete pain relief is not due. What is the reason?

Task №5. Infiltration anesthesia in the mandible proved to be inefficient. What will you do?

Tests

1. What nerve is not a part of the maxillary nerve?
1) zygomatic
2) inferior alveolar
3) pterygopalatine
4) infraorbital

2. What block do you administer to anesthetize the palatal gingiva of the maxillary posterior teeth?
1) Greater Palatine Block
2) Buccal Block
3) Inferior Alveolar Block
4) Nasopalatine Block
5) Anterior Superior Alveolar Block
6) Infraorbital Block

3. What block do you administer to anesthetize the palatal gingiva of the maxillary anterior teeth?
1) Infraorbital Block
2) Inferior Alveolar Block
3) Nasopalatine Block.
4) Buccal Block
5) Anterior Superior Alveolar Block

4. What block do you administer to anesthetize the labial gingiva of the maxillary anterior teeth?
1) Anterior Superior Alveolar Block
2) Inferior Alveolar Block
3) Nasopalatine Block.
4) Buccal Block
5) Infraorbital Block

5. What block do you administer to anesthetize the pulpal tissue of the maxillary molars?
1) Anterior Superior Alveolar Block
2) Inferior Alveolar Block
3) Nasopalatine Block.
4) Posterior Superior Alveolar Block (except for the MB root of the 1st molar which would be anesthetized by the Middle Superior Alveolar Block).
5) Infraorbital Block

6. What block do you administer to anesthetize the pulpal tissue of the maxillary premolars?
1) Middle Superior Alveolar Block

2) the Infraorbital Block
3) Nasopalatine Block.
4) Buccal Block
5) the Anterior Middle Superior Alveolar Block.

7. What block do you administer to anesthetize the pulpal tissue of the maxillary anterior teeth?
1) Anterior Superior Alveolar Block
2) the Infraorbital Block
3) the Anterior Middle Superior Alveolar Block.
4) Buccal Block
5) the Anterior Middle Superior Alveolar Block.

Answers: 1 – 2; 2 – 1; 3 – 3; 4 – 1,3,5; 5 – 4; 6 – 1,2,5; 7 – 1,2,3,5

Tasks

Task №1. I innervate the lingual gingiva of the mandibular teeth from the midline all the way posteriorly. Who am I?

Task №2. I am the maxillary first molar. I was not cared for properly, and now I am destroyed and need to be taken out. How can you put me to sleep so I don't feel any pain while I am being taken out? Please don't forget that I have 3 legs.

Task №4. We are the maxillary anterior teeth. We have deep pockets on our lingual gingiva that need to be cleaned. How can you help us to go through the process without pain?

Task №5. We are number 1, 2, and 3. We need periodontal treatment on our buccal gingiva. Which nerve will you anesthetize to block the pain? And where do you think you should inject your needle to reach that nerve?

Task №6. I'm the beautiful right maxillary central incisor. I need a cosmetic filling on my lingual face. The doctor tried to put me to sleep but I still have some pain. What do you think he forgot to do?

Task №7. I innervate the pulp tissues of the maxillary incisors and canine. Who am I?

TOPIC: LOCAL COMPLICATIONS OF INJECTING ANESTHESIA IN MAXILLOFACIAL SURGERY
Tests

1. What is the most commonly injured muscle during a maxillary posterior injection?
1) External Lateral pterygoid muscle
2) Medial Pterygoid muscle
3) Medium Pterygoid muscle
4) m. masseter
5) m. mylohyoideus

2. What reasons could be for failed anaesthesia?
1) inaccurate anatomical placement
2) too little solution
3) needs more time
4) inflammation or infection
5) expired or improperly stored LA

3. Where could pain from injection come from?
1) needle puncture (use topical and a steady hand)
2) pressure of solution (work slower)
3) temperature of solution (room temp = less pain)
4) pH of solution

4. Which technique of local anesthesia produced the greatest number of needle breakage?
1) Greater Palatine Block
2) Nasopalatine Block
3) Anterior Superior Alveolar Block
4) Infraorbital Block
5) Inferior Alveolar Nerve Block

5. A prolonged, tetanic spasm of the jaw muscles by which the normal opening of the mouth is restricted is:
1) edema
2) trismus
3) infiltration
4) tumor
5) cancer

6. What is the cause of facial nerve paralysis?
1) needle puncture (use topical and a stead hand)
2) pressure of solution (work slower)
3) injection into the parotid gland (too far posterior)
4) Temperature of solution (room temp = less pain)
5) too little solution

7. In what size needle does most breakage occur?
1) 30-gauge short
2) 60-gauge short
3) 40-gauge long
4)70 -gauge short
5) 48-gauge long

Answers: 1 – 1; 2 – 1-5; 3 – 1, 2, 3, 4; 4 – 5; 5 – 2; 6 – 3; 7 – 1

Tasks

Task №1. How can you avoid broken needles during anesthesia?

Task №2. What happened if you see blanching patient face after anesthesia?

Task №3. What are some bizzare neurologic symptoms after local anesthetic use and why do they occur?

Task №4. What are the main problems that can occur due to local anesthetic cartridge problems?

Task №5. Which of local anesthesia may lead to large hematoma most frequently?

TOPIC: GENERAL ANESTHESIA IN MAXILLOFACIAL SURGERY
Tests

1. Barbiturates: Properties:
1) sedative
2) hypnotic (truth serum)
3) anticonvulsant
4) euthanasia agent
5) general anesthetic: induction and maintenance

2. Propofol: Disadvantages
1) no preservative
2) hypotension
3) potent respiratory depressant
4) pain on injection
5) myoclonic twitching

3. Inhalant Anesthetics
1) isoflurane
2) sevoflurane
3) desflurane
4) ether
5) halothane
6) methoxyflurane

4. General Anesthesia is
1) state of controlled and reversible unconsciousness
2) lack of pain sensation
3) lack of memory

5. General anesthesia is characterized by
1) lack of pain sensation (analgesia)
2) lack of memory (amnesia)
3) relatively depressed reflex responses

6. General anesthesia procedure 4 parts
1) preanesthesia
2) induction
3) maintenance
4) recovery

7. What is endotracheal intubation:
1) place a breathing tube in patient's airway
2) place a wire in patient's airway

8. Advantages of endotracheal intubation?
1) allows efficient delivery of gas to animal
2) improves efficiency of respiration by decreasing dead space

3) can deliver O_2 and provide positive pressure ventilation if need to assist respiration
4) reduce risk of aspiration

      9. Sedation is:
1) a medication given to reduce a client's anxiety and ease induction of general anesthesia
2) relatively depressed reflex responses
3) state of controlled and reversible unconsciousness

    Answers: 1 – 1-5; 2 – 1-5; 3 – 1-6; 4 – 1; 5 – 1-3; 6 – 1-4; 7 – 1; 8 – 1-4; 9 – 1.

Tasks

    Task №1. Patient N. is admitted to dental department of hospital. Diagnosis is phlegmon of the mouth floor. Swallowing, breathing, speech are difficult. It is required to make primary surgical debridement of suppurative focus. What method of anesthesia should you choose?

    Task №2. The patient is indicated to extract tooth 46 because of extensive caries. The doctor has chosen phlebonarcosis. Has he made the right decision?

    Task №3. During the ectomy of mandible for osteoblastoclastoma multicomponent combined anesthesia with fentanyl, tubocurarine, droperidol was used. The patient came suddenly stop breathing in 10 hours after the operation. What was the reason?

    Task №4. Patient M. is scheduled for extraction of impacted 38 tooth. What method of anesthesia should you choose?

    Task №5. Within 3 minutes after the use of inhaled ether anesthesia the patient lost algesthesia however, the patient stayed conscious. What stage of anesthesia was it?

TOPIC: INDICATIONS AND CONTRAINDICATIONS FOR TOOTH EXTRACTION
Tests

1. Indications for tooth extraction:
1) preparation for orthodontic treatment
2) teeth in the fracture line
3) teeth which cannot be restored endodontically
4) fractured teeth
5) supernumerary, supplementary or malformed teeth

2. When can you extract the tooth after patient heart attack (infarction)?
1) 1 year later;
2) 1 month;
3) after 3-6 months;
4) 2 months later.

3. What is an absolute indication for tooth extraction?
1) impacted teeth;
2) odontitis of three 3 molars;
3) spread of periodontal inflammation;
4) incorrect setting of tooth in the dental arch ;
5) traumatic oral mucosal lesions from teeth

4. What trimesters of pregnancy are common relative contraindication for tooth extraction?
1) 1 and 2 trimesters;
2) 1 and 3 trimesters;
3) 2 and 3 trimesters

5. What are the local relative contraindications for surgery tooth extraction?
1) acute infectious diseases of the mouth and throat mucous membrane;
2) tooth localization in the area of cancer;
3) deciduous teeth in the area of absence of permanent teeth;
4) premature removal of deciduous teeth.

6. What local absolute contraindications for tooth extraction do you know?
1) premature removal of deciduous teeth;
2) area of the jaw hemangioma;
3) the tooth location in the area of cancer;
4) acute infectious diseases of the mouth and throat mucous membrane.

7. In which clinical cases the tooth extraction can be done if the pulp is preserved?
1) carious lesions;
2) carious lesion does not support odontogenic inflammation in the maxillary sinus;

3) later stages of the marginal periodontitis;
4) fracture of the tooth crown.
      8. In which clinical cases the wisdom tooth extraction is indicated?
1) carious lesion of wisdom tooth;
2) wisdom teeth take the wrong position in the jaw;
3) wrong position lead to inflammatory processes in the surrounding tissues;
4) in any cases.

Answers: 1 – 1,2,3,4,5; 2 – 3; 3 – 3; 4 – 2 ; 5 – 1,3,4; 6 – 2,3; 7 – 4; 8 – 3.

Tasks

Task №1. 64 years old patient X. suffered from myocardial infarction 2 weeks ago and needs of oral cavity sanitation. What is the doctor's tactics?

Task №2. 21 years old patient X. appealed for help to the dentist for removal and further prosthesis of 12th, 11th, 21th, 22th teeth. Complaints are aesthetic defects (abnormal dentition, disfiguring smile). After examination of the oral cavity doctor revealed acute gingivitis. What will be the patient's treatment plan?

Task №3. A woman at 34th week of pregnancy ask the doctor to extract destroyed 26th tooth, acute periodontal inflammation is absent. What decision the doctor will be right?

Task №4. 56 years old patient complains of pain in 47th tooth when biting down on food, the tooth is after endodontic treatment. On X-ray: big granuloma is in the apex of medial root, instrument's fragment is in the channel. What is your tactic?

Task №5. The patient ask to remove the destroyed 26th tooth. The mucous membrane of the alveolar bone in the area of 23th, 24th, 25th, 26th ulcerated. The patient noted an increasing the ulcer during the last month. What is your tactic?

TOPIC: TOOLS AND METHODS FOR TOOTH EXTRACTION
Tools and methods for tooth extraction in the mandible
Tests

1. Features describing forceps for tooth extraction in the lower jaw:
1) indication of the angle;
2) indication of bending handles;
3) indication of the parties;
4) cheeks width;
5) handle width.

2. What tooth you can extract by using the forceps curved in a plane?
1) mandibular incisors
2) mandibular molars
3) molars of the upper jaw

3. The level of patient's head for maxillary extraction is:
1) at the operator's elbow level;
2) at the operator's shoulder level;
3) at the operator's eye level.

4. Tooth extraction stages are:
1) stripping;
2) forceps;
3) promotion;
4) closing;
5) dislocation;
6) tooth extraction.

5. What is the purpose of the surgical squeezes the cavity after tooth extraction?
1) to promote the formation of a blood clot;
2) to bring together the edges of the hole and give them initial position;
3) after this action small fragments of bone tooth roots come out.

6. When the alveolar socket is covered with epithelium after tooth extraction?
1) after 1 month;
2) after 7th day;
3) after 14th day.

7. What is the level of the alveolar socket resorption occurs after the removal?
1) ⅓ of the root length;
2) ½ of the root length;
3) it is not occur.

8. What forceps is need for the 38th, 48th teeth extraction by orthodontic indications?
1) universal bayonet forceps;
2) coronoid forceps with diverging cheeks;

3) straight elevator;
4) forceps, curved in the plane.

9. What is the aim of circular ligament separation during tooth extraction?
1) to avoid the alveolar mucous membrane injury;
2) to avoid the tongue injury;
3) to avoid maxillary fracture;
4) to avoid mandibular fracture.

10. The tooth was removed with forceps diverging cheeks, bent in a plane, with spikes:
1) upper molar;
2) lower incisor;
3) roots of lower molar;
4) third lower molars with limited mouth opening.

Answer: 1 – 1,2,3,4; 2 – 3; 3 – 1; 4 – 1,2,3,4,5,6; 5 – 2; 6 – 3; 7 – 1; 8 – 4; 9 – 1; 10 – 4.

Tasks

Task № 1. 35 years old patient complains of pain in the right lower jaw and difficulty in opening the mouth for two weeks. The 48th is completely destroyed, takes buccal position, right cheek mucosa is hyperemic and edematous. There is 1 cm traumatic ulcer. What is tactics of the doctor?

Task № 2. It was necessary to extract the 43th tooth. The doctor decided to use coronoid forceps with spikes on both cheeks. Is it right decision?

Task № 3. It was necessary to extract the 37th tooth. The doctor used coronoid forceps curved in the plane, without spines; doctor was on the left side of the patient and in front of the patient during operation. Is it true tactics of the doctor?

Task № 4. It is necessary to extract the 32th tooth root. Doctor is going to use beaked forceps with narrow open cheeks without thorns? Is it right decision?

Task № 5. 35th tooth was extracted because of acute purulent abscess of the mandible. What advice should be given to the patient?

Tools and methods for tooth extraction in the maxilla
Tests

1. For the extraction of maxillary tooth the patient's mouth should be:
1) at the same height as the dentist's elbow;
2) at the same height as the dentist's shoulder;
3) at the same height as the dentist's eyes.

2. For the extraction of anterior mandibulary teeth right-handed dentists should be positioned:

1) in front of the patient;
2) behind the patient and on the left side of the patient;
3) behind the patient and on the right side of the patient.

3. For the extraction of mandibulary tooth the patient's mouth should be:
1) at the same height as the dentist's elbow;
2) at the same height as the dentist's eyes;
3) at the same height as the dentist's shoulder.

4. What is the first step of a tooth extraction by using the simple technique?
1) tooth luxating;
2) forceps positioning;
3) separation of round ligament.

5. The first luxation movement of 16, 26 extraction must be done:
1) buccaly;
2) palatally;
3) it doesn't matter;
4) lingually.

6. What kind of dislocation movement do you choose to extract 2.5 tooth?
1) lifting;
2) luxating;
3) rotational;
4) it doesn't matter.

7. Which forceps should the doctor choose to extract the maxillary second molar?
1) straight forceps;
2) Bayonet forceps;
3) S-shaped forceps;
4) Beak-shaped forceps.

8. What kind of dislocation movement do you choose to extract central incisors?
1) lowering;
2) rotational;
3) it doesn't matter;
4) luxating.

9. What instruments should the doctor choose to sever the soft tissues attachment?
1) dental probe;
2) plier;
3) straight desmotome;

4) scalpel;
5) curved desmotome.

10. What kind of local anesthesia should be done to remove the upper molars?
1) Inferior Alveolar block;
2) Posterior Superior Alveolar block;
3) Nasopalatine block;
4) Greater Palatine block.

Answers: 1 – 2; 2 – 1, 3; 3 – 1; 4 – 3; 5 – 2; 6 – 3; 7 – 3; 8 – 2; 9 – 3, 5; 10 – 2, 4.

Tasks

Task 1. The crown of 1.7 tooth was broken off at the gum line during the tooth extraction. What is the possible cause of the complication?

Task 2. Patient complains of pain and 2.7 tooth mobility. Objectively: tooth mobility is the second degree, tooth roots exposed to 1/3 of its length. Diagnosis: exacerbation of chronic marginal periodontitis of tooth 27. The tooth needs to be extracted. Which instruments should you choose?

Task 3. It is necessary to extract the 16 tooth. Dentist's position is right in front of patient, the patient's head is at the same height as the dentist's elbow. What is the dentist's mistake?

Task 4. It is necessary to extract the 23 tooth because of extensive caries. The doctor use the beak-shaped forceps, with spikes on both cheeks. Is it a right decision?

Task 5. Patient A. 35 y.o. complains of pain in the left part of the lower jaw, pain and difficulty while opening the mouth during a 2-week period. Objectively – the mouth opens for 2 cm, 38 is full erupted, the cheek mucous on the left side is hyperaemic, hydropic, with a traumatic ulcer up to 1 cm. What is the doctor's tactics? Which instruments should be used?

Task 6. A 30-year-old patient needs to have his 26 tooth extracted because of exacerbation of chronic periodontitis. Objectively: the crown of the 26 tooth is decayed by 1/3. What forceps can be used for this tooth extraction?

TOPIC: SURGICAL TOOTH EXTRACTION
Tests

1. In which cases doctor should fill the tooth socket by gauze?

1) after a difficult tooth extraction to the prevention of infection.

2) there is the perforation of sinus maxillaris

2. What tools should be used when the roots of the tooth are disconnecting?

1) corner elevator

2) straight elevator

3) flat chisel

3. What is a surgical tooth extraction?

1) tooth extraction by using elevator ore tooth has to be cut out of the bone with a shearing muco-periosteal flap.

2) tooth extraction using forceps

3) apexectomy

4. What is the purpose of suturing extraction socket?

1) avoid getting food stuck in the extraction socket

2) with a view to the correct positioning torn mucosa and (or) hold the blood clot.

3) for accelerating bone formation.

5. Straight elevator is used to remove teeth of:

1) upper jaw

2) mandible

6. Which elevator is used to remove the 3.7 medial root if the distal root is absent?

1) left side

2) right side

7. What type of anesthesia can be used to removing R2.3?

1) intraligamentary

2) infiltration

3) mandibular nerve block anesthesia

8. Which instrument is used for peeling off muco-periosteal flap for the tooth surgical extraction?

1) elevator

2) raspator

3) spatula

4) nipper Luer

9. Intravenous sedation is rarely used with the tooth surgical extraction because it:

1) does not provide complete pain relief

2) causes swallowing disorders

3) causes possible ingress of blood in the respiratory tract
4) is very expensive

10. The elevator can be used:

1) only for roots extraction
2) only for wisdom teeth extraction
3) for roots and teeth extraction

Answers: 1 – 1,2; 2 – 1,2,3; 3 – 1; 4 – 1,2,3; 5 – 1,2; 6 – 1; 7 –1,2; 8 – 2,3; 9 – 2; 10 – 3.

Tasks

Task №1. The tooth 4.8 needs to be extracted because of chronic granulomatous periodontitis. The top of the crown and root of 1/3 has broken off during tooth extraction. What is the tactic of the doctor? What tools should you use?

Task №2. During 2.6 tooth extraction root fracture at the middle third occurred. What is the tactic of the doctor?

Task №3. During 1.1 tooth extraction root fracture at the apical third occurred. What are the actions of the doctor? What tools and methods will be used in this case?

Task №4. A 24-year-old woman consulted a dentist about pain in the 26 tooth. After a physical examination of the patient the exacerbation of chronic periodontitis of the 26 tooth was diagnosed. During the tooth extraction the coronal part of the tooth was accidentally broken. Further manipulations with bayonet forceps failed to extract the tooth roots. What actions can be taken for the successful root extraction?

Task №5. The 3.6 tooth crown was fractured During the tooth extraction. What tool will be used to extract tooth roots?

TOPIC: COMPLICATIONS ASSOCIATED WITH DENTOALVEOLAR SURGERY
Local complications during the tooth extraction
Tests

1. What types of physical treatment of alveolitis do you know?
1) microwave therapy
2) Ultra-violet radiation
3) helium-neon laser

2. When is alveolitis occurrence after tooth extraction**?**
1) 10-12 days
2) 1-2 days
3) 3-4 days
4) week later

3. What are the reasons of a mandibular fracture during a tooth extraction?
1) rough surgical technique
2) pathological process in the area of the tooth
3) rough bringing together of the edges of the tooth alveoli
4) alveolar process atrophy

4. What are the reasons of primary bleeding from tooth socket during tooth extraction:
1) injury of vessels mucosa
2) injury of alveoli walls
3) injury of alveolar artery branches
4) all answers are correct

5. The signs of the maxillary sinus perforation are:
1) profuse bleeding from the tooth socket;
2) severe pain;
3) asymptomatic;
4) profuse bleeding from the tooth socket, the passage of air from the nose to the oral cavity, nose bleeding;

6. What is the main reason of the late secondary bleeding?
1) purulent fusion of blood clot
2) mucosal lesion
3) vessel lesion

7. What blood tests that need to be done before using of common methods to stop bleeding?

1) Complete Blood Count
2) Blood Clotting Test
3) Iron Test
4) Blood Chemistry Screen

8. What drug can be used for increasing blood fibrinolytic activity?
1) E-aminocapronic acid (2-3 g 3-5 times a day or 100 ml of 5% solution intravenously)
2) epinephrine solution
3) tetracycline

9. What local complications can occur after tooth extraction?
1) bleeding from tooth extraction socket;
2) alveolitis;
3) local osteomyelitis of the tooth socket;
4) the root fracture

10. In case of a fracture in the apical third of a root during extraction the dentist should:
1) stop further manipulation to reduce the trauma to surrounding tissues;
2) remove the tooth in a few days;
3) to complete the tooth extraction.

The answers: 1 – 1; 2 – 3; 3 – 1,2; 4 – 1; 5 – 4; 6 – 1; 7 – 1,2; 8 – 1; 9 – 1,2,3; 10 – 3.

Tasks

Task №1. There was a fracture of the tooth root in the apex region when removing the tooth 26 on the dislocation stage. What are the reasons of this complication, treatment and prevention.

Task №2. During extraction part of the tooth broke off and inhaled. What is the tactic of the doctor?

Task №3. The patient complains for acute pain in front of the tragus of the ear during the 4.8 tooth surgical extraction. After extraction the patient could not close his mouth. On palpation of the TMJ the mandibular condyles is palpated anterior to the articular eminence. What complication occurs? What is the tactic of the doctor.

Task №4. During the 2.3 tooth extraction profuse bleeding from the socket begin. What is the possible cause of bleeding? What is the doctor's tactic?

Task №5. During the 1.7 tooth extraction the doctor noticed air bubbles in the blood from the tooth socket. Tooth extraction was unremarkable. There was hemorrhagic drainage from the socket. What complication developed? What is the doctor's tactic?

Local complications after tooth extraction
Tests

1. What are the post operative complications?
1) pain/swelling/bruising
2) trismus
3) haemorrhage
4) prolonged effects of nerve damage
5) dry socket
6) sequestrum
7) infected socket
8) chronic oaf/root in antrum
9) osteomyelitis
10) osteoradionecrosis
11) bisphosphonate induced osteonecrosis
12) actinomycosis
13) bacteraemia/infective endocarditis

2. What can cause limited mouth opening?
1) surgery - edema, muscle spasm
2) bleeding into tissue
3) damage to TMJ
4) maxillary sinus perforation

3. What is often the cause of secondary bleeding?
1) infection
2) maxillary sinus perforation
3) tooth fracture
4) crown fracture
5) asthma

4. How can post operative bleeding be managed??
1) pressure
2) local anaesthetic with vasoconstrictor
3) haemostatic AIDS e.g. surgicel, bone wax
4) suture socket
5) ligation of vessels/diathermy

5. Name some haemostatic agents?
1) adrenaline containing local anesthetic
2) oxidised cellulose
3) gelatin sponge
4) thrombin liquid and powder
5) fibrin foam

6. Name some systemic haemostatic aids:
1) vit K

2) anti-fibrinolytics e.g. tranexamic acid
3) missing blood clotting factors
4) plasma or whole blood

7. What are the other names for dry socket?
1) alveolar osteitis
2) localised osteitis
3) alveolitis
4) smooth socket

8. What are the signs of an Oro-antral fistula?
1) history of upper molar extraction
2) non-healing socket
3) dull throbbing pain
4) pressure feeling up to eye/sinusitis
5) runny or blocked nose

9. What are the symptoms for dry socket?
1) dull aching pain moderate to severe
2) usually throbs
3) radiates to ear
4) keep awake at night
5) bad odour
6) bad taste

10. What are the major predisposing factors to osteomyelitis?
1) odontogenic infections
2) fracture of the mandible
3) hypertension

The answers: 1 – 1-13; 2 – 1-3; 3 – 1; 4 – 1-4; 5 – 1-5; 6 – 1-4; 7 – 1-3; 8 – 1-5; 9 – 1-6; 10 – 1,2.

Tasks

Task №1. If you think you have displaced tooth into sinus what should you do to see if its right in sinus?

Task №2. If patient returns with post op haemorrhage, what is your management? If large vessel and can't stop, what is difference?

Task №3. Dental prosthetist examined the patient before treatment. 24, 25, 26 teeth extraction was performed in the patient 2 months ago. Now there is a significant deformation of the alveolar crest bone of the upper jaw creating bad conditions for the prosthesis fixation and stabilization. What mistakes of teeth extraction surgeon did?

Task №4. The patient was hospitalized with residual cyst of the mandible on the right. From history we found out that 4.6 tooth was extracted 2 months ago from the cyst location area. What was the cause of the complications?

Task №5. The patient underwent surgery gouging dystopic, impacted tooth 48. After 3 days post op the patient complains of numbness, tingling in the right lower lip. What is the possible reason?

TOPIC: FEATURES OF LOCAL ANESTHESIA, TOOTH EXTRACTION IN MEDICALLY COMPLEX PATIENTS
Tests

1. What are the main skin allergy tests for detection specific sensibilization ?
1) intradermal test
2) open patch test
3) application anesthesia
4) benzidine test
5) aspiration test

2. What are the main symptoms of anaphylactic shock ?
1) tachycardia
2) cyanosis
3) dyspnea
4) stridor
5) bronchial spasm
6) cardiac arrest
7) all answers correct

3. What is the correct definition of anaphylaxis?
1) is a serious allergic reaction that is rapid in onset and may cause death
2) is a method for medical diagnosis of allergies that attempts to provoke a small, controlled, allergic response
3) is a sudden and often unannounced loss of postural tone (going weak), often but not necessarily accompanied by loss of consciousness.
4) is a condition characterized by an abnormal focus of activity in the brain that produces severe motor responses or changes in consciousness

4. Which organ is the target of a mediators direct effect in the development of anaphylaxis?
1) heart
2) liver
3) kidney
4) brain
5) stomach

5. List the diseases in which collapse may be one of the symptoms:
1) cardiac accident
2) sepsis
3) blood loss
4) anaphylaxis
5) dehydration

6. Which solutions have antishock characteristic?
1) Plasmalyte

2) Volulyte

3) Tetraspan

4) Venofundin

5) Voluven

6) all answers correct

7. List your actions before emergency surgical treatment of patient with a high blood pressure:

1) no actions provided

2) intravenous injection of 1% adrenalin

3) 5-10 ml 2,4% euphyllin solution and10 ml 25% magnesium sulfate solution intramuscularly.

Answers: 1 – 1,2; 2 – 7; 3 – 1; 4 – 4; 5 –1,3,4; 6 – 6; 7 – 3.

Tasks

Task № 1. A 45-years-old patient has complaints for the pain in the left cheek. The doctor provided exzamination of patient: 38 have uncorrect position, in the soft tissues near the 38 the patient has ulcus size 1,5 cm. Patient had <u>infarction</u> 1 month ago. What are indications for tooth extraction? Your actions?

Task № 2. The bronchial allergy patient has complaints for the pain in the area of destroyed 27 tooth. 27 destroyed for the gum level, vertical percussion is painful, palpation the gum of the apix level is also painful. What is the most likely diagnosis? Your actions? What kind of anesthetic you must to prepare in this clinical case?

Task №3. A 55-years-old patient has complaints for the pain in the mandible left site. The doctor detected indications for 44 root extracrion. The patient suffers hepatic cirrhosis. What kind of anesthetic you must to prepare in this clinical case?

Task №4. The patient has orthodontic indications for extraction of 24 and 14 teeth. The patient suffers hemophilia A. Your actions?

Task №5. A 35-years-old patient, 26 – apical chronic periodontitis in acute stage. The patient is asocial, has the high degree of anxiety. Your actions?

TOPIC: COMPLICATIONS ASSOCIATED WITH TOOTH EXTRACTION. PROVIDING EMERGENCY MEDICAL CARE
Tests

1. The patient had an epileptic seizures during a tooth extraction under a local anesthetic. What measures should the doctor take?
1) to take measures to prevent tongue biting
2) to continue working
3) to call in an emergency aid team
4) to measure blood pressure

2. What is a severe allergic reaction to foreign material?
1) bronchial asthma attack
2) anaphylactic shock
3) hypertensic crisis
4) asphyxia
5) collapse

3. What are characterized by severe and uncontrolled muscle spams or muscle rigidity?
1) convulsions
2) anaphylactic shock
3) collapse
4) hypoglycemic coma
5) bronchial asthma

4. What is a condition characterized by an abnormal focus of activity in the brain that produces severe motor responses or changes in consciousness?
1) Anaphylactic shock
2) Syncope
3) Epilepsy
4) Cardiac infarction

5. What is cardiogenic shock?
1) heart is damaged and is unable to deliver sufficient amount of blood to the heart and body
2) convulsions
3) anaphylactic shock

6. How do you calculate the dose of prednisolone for patient with anaphylactic shock?
1) 10 mg/kg
2) 0.1 mg/kg
3) 1-5 mg/kg weight

7. Compression to ventilation ratio for adult, one person Cardiopulmonary Resuscitation?

1) 30:2
2) 30:5
3) 15:2
4) 10:1

8. Compression to ventilation ratio for child, two person Cardiopulmonary Resuscitation:

1) 30:2
2) 30:5
3) 15:2
4) 10:1

9. What is myocardial infarction?

1) Necrosis (death) of the myocardium caused by an obstruction in a coronary artery;
2) commonly known as heart attack
3) allergic reaction

10. Signs of Shock:

1) restlessness or irritability,
2) nausea or vomiting,
3) rapid breathing or pulse,
4) pale skin, thirst

Answers: 1 – 1,3; 2 – 2; 3 – 1; 4 – 3; 5 – 1; 6 – 1; 7 – 1; 8 – 3; 9 – 1,2; 10 – 1-4.

Tasks

Task № 1. A 45-year-old patient undergoes teeth preparation. 15 minutes after anesthetization with 4% solution of Ubistesin forte the patient developed hyperemia of skin, increased heart rate, headache, syncope. Previously the patient had not exhibited such reaction to this anesthetic. What complication occurred?

Task № 2. During the surgical removal of a retention cyst of the lower lip a 14-year-old boy complained of sudden weakness, dizziness, nausea. Objectively: the skin is covered with cold sweat. Respiration is frequent, pulse is weak, AP is decreased (90/60 mm Hg), the hands are cold. What is the most likely diagnosis?

Task №3. During the 14 tooth extraction patient lost consciousness, clonic convulsions appears, foam is at the mouth, skin is pale. What complication occurs? Your actions?

Task №4. During the anesthesia the patient complains of acute pains in the stomach, dizziness, weakness, nausea, burning and itching of the face. Objectively: consciousness is inhibited, the skin of the face and hands

is bloodshot, blood pressure is 90/60 mm Hg. What complication occurs? Your actions?

Task №5. During the tooth extraction the patient with diabetes complains for trembling, cramps in the limbs, cold, clammy sweat, consciousness is inhibited. The patient has not taken any food because of tooth pain for 5 hours. What complication occurs? Your actions?

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