

UDK: 616.31-089
Original scientific paper
Received: 27 August 2012
Accepted: 26 September 2012

THE FATE OF TEETH IN MANDIBULAR FRACTURE LINE

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Summary

The mandibular fracture line with involved teeth, because of the presence of periodontal ligament, is always in communication with the oral cavity and therefore may allow the spread of infection. Moreover, such a tooth may lose blood supply due to damage of apical blood vessels and in the case of pulp necrosis the tooth is a source of infection. Methods of sensitivity testing of teeth are based on pain and it is difficult to distinguish the pulp vitality (a function of vascularisation) and the pulp sensitivity (a function of innervation). If the injury causes an interruption of the pulp vascularisation it will lead to the death of pulp tissue including the nerve, and if only the injury of the nerve occurs, the vitality of the pulp is not endangered.

The aim of this investigation was to evaluate the sensitivity of teeth involved in jaw fracture line as well as to determine the number of denervated teeth and the time period in which reinnervation or revitalisation will occur. 50 patients with mandibular fractures were prospectively analyzed, 39 out of 50 patients had a tooth involved in the fracture line. There were 63 fractures in 39 patients, with 84 teeth involved in fracture line; 48 out of 84 teeth involved in the mandibular fracture line were initially seemingly avital and their reinnervation was followed up. Six weeks after the injury 31% of teeth involved in the jaw fracture were reinnervated, and a year after the injury 81% of teeth were reinnervated. No reinnervation occurred later than one year following injury. One year after the injury 84% of incisors, 75% of canines, 83% of premolars, and 80% of molars were reinnervated. During the second and the third year after the injury no reinnervation occurred but the devitalisation of initially denervated teeth is possible. The pulp is vitally stable one year after injury.

Denervated teeth should not be considered as avital and should not be treated if neither clinical nor radiological signs of devitalisation are present. If sensitivity testing is the only criterion for tooth treatment and/or extraction, i.e., if we do not take into consideration the clinical and radiological criteria of devitalisation, 95% of false avital, i.e. only denervated teeth would be considered devitalised and unnecessary treated or extracted.

Key words: mandibular fracture; fracture line; tooth; vitality; sensitivity.

INTRODUCTION

The fracture line with involved teeth communicates through periodontal space with oral cavity which may allow the spread of infection. Another possibility is that the blood supply of these teeth may be disturbed by trauma, and in that case causing necrosis of the pulp with subsequent infection. The pulp will necrotise because of either disturbed vascularisation or bacterial penetration from the fracture into the dental pulp. Marginal bone resorption and development of periodontal pockets usually appears in canine region because of inadequate reduction of bone fragments and disturbed relationships between gums, teeth and supporting structures.

In the literature there are different attitudes and procedures of various authors regarding the tooth in mandibular fracture line. Čupar [1] in 1935, in the pre-antibiotic era, believed that the extraction was absolutely indicated if it was a very carious tooth or retained root. However, if it was a vital tooth, it should not a priori be removed, but he highlighted the possibility that this tooth became devitalized and secondarily infected and in such case the extraction was indicated. Ditchfield [2] in 1960 agreed that disrupted periodontal ligament around tooth might represent the entrance of infection, but he considered that the empty tooth socket after extraction of such teeth is even wider communication fulfilled only with blood clot. Rowe and Killey [3] in 1968 believed that the tooth in the fracture line should be removed only if there was suspicion that it was not vital. Later, in the literature we could find the discussion that even such a devitalized tooth should be kept if needed for fixation. In our region, Aljinović [4] in 1985 didn't find more complications while keeping the teeth in the fracture line. Among patients with complications, it is almost an equal number of those with tooth extracted intraoperatively and those in whom the tooth was left in fracture line. It means that the tooth in the fracture line carries a higher risk of complications, even if extracted "on time", so it is better to remove the tooth only if devitalisation occurred.

Today most authors emphasize that the attitude has changed from the use of antibiotics and there is no longer the rule that every tooth in the fracture line should be removed. They advocate a selective attitude and individual approach considering that endodontic treatment of tooth in fracture line does not interfere with the healing of fractures [5]. Tooth should be kept in fracture line if its role in stabilising of bone fragments exceeds the possibility of development of inflammatory complications. Criteria for the decision should be: the mobility of the teeth in the fracture line, associated fracture of the tooth root, periapical lesions and the role of the teeth in mandibular fracture line in the stabilization and fixation of bone fragments.

Teeth sensitivity testing methods are based on pain, so that the possibility to differentiate vitality (a function of the pulp vascularisation) and sensitivity (a func-

tion of innervation) is impossible. If the injury causes an interruption in the pulp vascularisation, the result will be the pulp tissue death including the nerve, and if only the injury of the nerve occurs the vitality of the pulp is not impaired [6]. It is obvious that some injuries damage the nerve without influencing the survival of the pulp and that terminal and electrical stimuli prove only the sensitivity of the pulp and they are not indicative for the vitality evaluation. A tooth that does not change colour and which pulp does not necrotize is vascularised, and the innervation is of secondary importance. It is known from the clinical experience that teeth involved in the fracture line can have disturbed sensitivity; their reinnervation has not been discussed in literature.

The aim of this investigation was to evaluate the sensitivity of teeth involved in jaw fracture line as well as to determine the number of denervated teeth and the time period in which reinnervation or devitalisation will occur.

MATERIAL AND METHODS

This investigation included patients with: initially seemingly avital teeth in fracture line, actually they were not, but they seem to be avital; complete documentation; complete follow-up (clinical finding, sensitivity tests by electrical stimuli, radiologic follow-up) up to reinnervation or to three-year period in patients in whom reinnervation of all teeth did not occur.

A total of 50 patients with mandibular fractures treated at the Department of Oral and Maxillofacial Surgery in Zagreb were prospectively analyzed. 39 out of 50 patients had a tooth involved in the fracture line.

There were 39 patients with 63 fractures which makes an average of 1.6 mandibular fractures per patient, and 84 teeth in the fracture line out of which 20% was removed intraoperatively, 20% was initially "vital" and 60% (48/84) was initially "avital".

Immediately after the mandibular fracture was diagnosed, sensitivity of teeth involved in the fracture line was tested. Excluded from the investigation were deep carious teeth, teeth with fillings, prosthetic provided teeth and previously devitalized teeth.

Patients with initially seemingly avital teeth in the jaw fracture line were examined 1.5, 3, 4, 6 and 12 months after the injury. Those patients having seemingly avital teeth a year after the injury were examined two years later – three years after the injury.

At every sensitivity test the lowest intensity of electrical stimuli that provoked reaction was noticed. Teeth not reacting to the strongest stimuli were considered

denervated. A tooth was considered vital if it did not change colour, if it was not sensible to percussion or if it was not pathologically mobile (Figure 1).

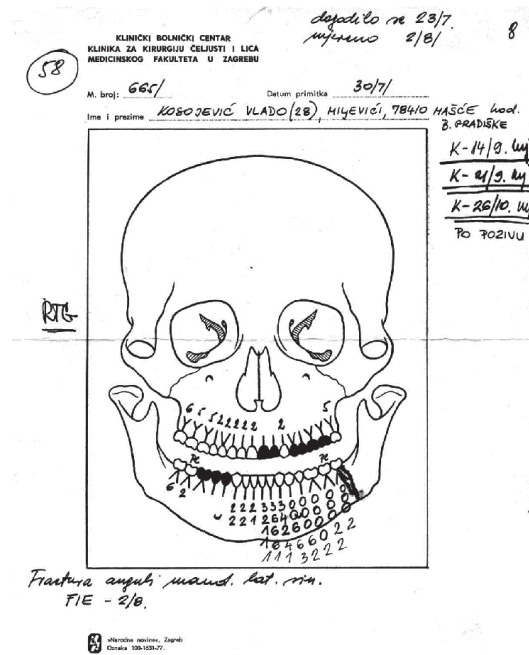


Figure 1. Follow-up scheme

RESULTS

A total of 39 patients had 63 fracture lines with 84 teeth involved in fracture lines which made an average of 1.3 teeth in fracture line i.e. 2.2 teeth in fracture line per patient.

In our patients an average time between the injury to bone reduction was 5.7 days. In 8 patients which 36 months after injury have denervated or devitalised teeth, from injury to reduction passed 4.3 days.

There were 19 out of 84 teeth in the fracture line that were extracted immediately. 17 out of 84 teeth were initially vital and 48 out of 84 teeth were initially seemingly avital and their reinnervation was followed up.

Number of reinnervated teeth increased with the passage of time. Six weeks after the injury 31,2% of teeth involved in the jaw fracture line were reinnervated, and a year after the injury 81,2% of teeth were reinnervated. No reinnervation occurred later than one year following injury (Figure 2).

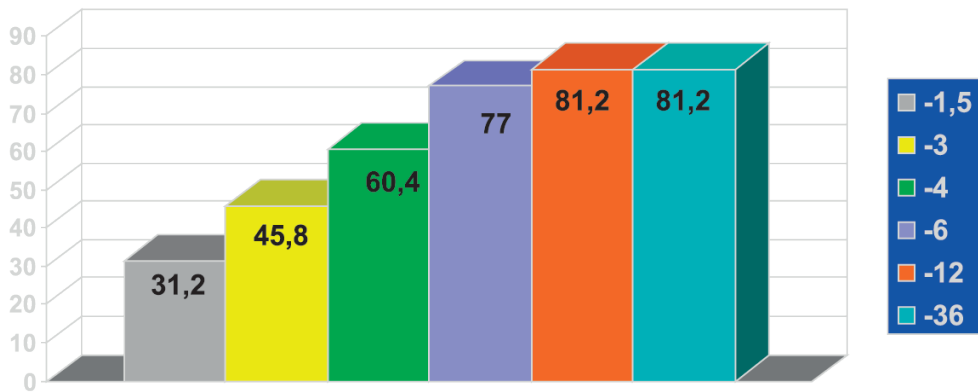


Figure 2. Number of reinnervated teeth with the passage of time

Analyzing the reinnervation of a particular tooth in a determined time period, we have noticed that most of the teeth are reinnervated during the first six weeks after the injury. Least of the teeth are reinnervated in the period from the seventh to the twelfth month after the injury, while in the one to three-year period none of the teeth is reinnervated.

Because of a rather small number of some particular teeth, results are analyzed for particular groups of teeth. Reinnervation of canines, premolars and molars was practically completed in the first six months period after the injury when 75% of canines, 83% of premolars and 80% of molars involved in fracture line were reinnervated. Reinnervation of incisors lasted up to one year after the injury and 84% of them were reinnervated.

Three years after the injury 10 out of 48 (21%) teeth involved in jaw fracture line remain seemingly avital - they did not respond to electrical stimuli. 7 out of 48, it is 14.6% of teeth involved in jaw fracture line remain denervated. 3 out of 48 teeth involved in the fracture line (6.2%) remain devitalized, it is 3 out of 10 seemingly avital teeth involved in jaw fracture line - that did not respond to electrical stimuli three years after the injury.

Incisors and canines are numerically the most denervated teeth, but considering the percentage, molars are the most denervated teeth.

2 out of 10 denervated teeth devitalized in the second and the third year after the injury and they were extracted. The third devitalized tooth was endodontically treated.

Three years after the injury there were eight patients with seemingly avital teeth, only one had malocclusion, but five of them had permanent paresthesias.

Five out of 27 patients who had dislocated fracture had seemingly avital teeth, as well as 3 out of 12 of those having fracture without dislocation. Six out of 24 patients (25%) having intraoral communication of fracture line had denervated teeth 36 months after the injury, as well as 2 out of 15 patients (13%) who did not have intraoral communication of fracture line remain with denervated teeth.

DISCUSSION

Pulp necrosis will occur because of disturbed vascularisation and invasion of bacteria from the fracture line in the tooth pulp. Marginal bone resorption (mostly in the canine region) and the creation of bone pockets usually occur when the reduction of fragments is inadequate which disturb the relation of the gingiva, teeth and supporting tissue.

Today, most authors consider that tooth in mandibular fracture line can cause complications [7], but whenever possible, they recommend maintaining of the tooth in fracture line and point to a surprisingly large number of teeth with a negative response to sensitivity testing, but without clinical and radiological signs of devitalisation. They find that the conservative endodontic treatment of teeth in the fracture line does not interfere with healing of the bone. Tooth in the mandibular fracture line should be retained if its help to stabilize the bone fragments exceeds the ability of such tooth to cause inflammatory complications [8,9]. With literature providing no clear guidance, cliniciand must use their best judgement in weighing the benefits and risks of removing a third molar in the line of an angle fracture against the benefits and risks of leaving it [10].

There are still controversial attitudes in the literature about following:

- the role of earlier reduction of bone fragments on reinnervation of teeth
- the role of the dislocation of fragments on reinnervation of teeth
- prognosis of the tooth if the fracture line involves its apex
- prognosis of impacted wisdom teeth in the fracture line
- the role of fracture treatment on tooth in fracture line
- prognosis of tooth bud in fracture line in children
- what to do firstly – alveotomy or osteosynthesis?

Earlier reduction of bone fragments

It is recommended reduction of bone fragments as soon as possible with the use of antibiotics. Early reduction and correction of anatomic relationships do not guarantee fewer complications, i.e. reinnervation of teeth. In our study earlier reduction did not improve reinnervation of teeth. In our patients an average time period form

the injury to reduction was 5.7 days. In 8 patients with denervated or devitalised teeth 36 months after injury, passed an average of 4.3 days from injury to bone reduction.

Dislocation of bone fragments

Disturbed sensitivity depends on dislocation of the fragments; it is more common in dislocations *cum contractione* than in dislocations *cum distractione*. Denervation of tooth in fracture line can occur regardless of the dislocation, but it is twice as frequent if there is communication of fracture with the mouth. In our study the revised anatomical relationships did not guarantee the reinnervation of teeth in fracture line.

The course of the fracture line in relation to the tooth apex

Necrosis of the pulp and bone pockets usually occur if the fracture line involves apex of the tooth and / or periodontal gap because in such case periodontal vascularisation is compromised (Figure 3).

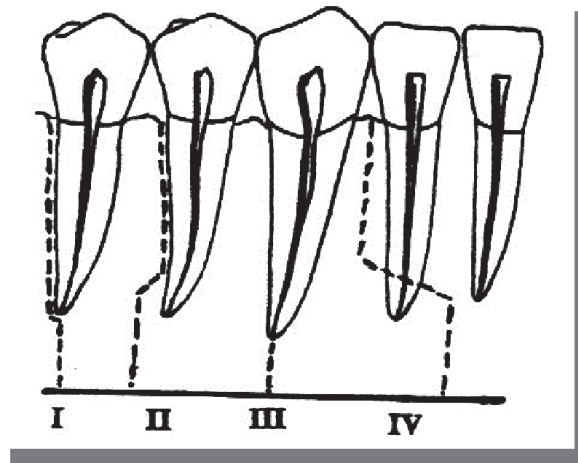


Figure 3. Possible courses of the fracture line in relation to the tooth apex and periodontal gap.

Impacted third molar in the fracture line

Conservative therapy of mandibular fracture (intermaxillary fixation) is recommended. The tooth should be kept in the fracture line under following conditions:

- there is no pericoronar infection
- the tooth is not fractured
- there is no tooth dislocation
- the tooth does not compromise the reduction of bone fragments
- bone healing is uneventful and there are less complications using conservative therapy because after osteosynthesis it is allowed and possible to open a mouth
- tooth in fracture line should be kept with antibiotic coverage and alveotomy should be done together with removal of osteosynthetic plate at least three months after the osteosynthesis

Method of treatment of mandibular fracture

The purpose of every fracture treatment is to restore the occlusion as it was before the injury. We should use the least invasive method that will accomplish the purpose of treatment. The tooth that compromises the reduction of bone fragments should be removed [11].

Tooth bud in fracture line

Tooth buds, i.e. mixed dentition in children very often restrict the surgical treatment. In one third of mandibular fractures in children tooth buds are in fracture line, mostly canines. Approximately 67% of mandibular fractures in children are treated conservatively. Approximately 80% of involved tooth buds later normally erupt. Follicular disruption rarely occurs indicating that follicle is more elastic than the surrounding tissue, thus protecting the tooth bud. Surgical treatment is doubtful due to the position of the bud near the lower border of the mandible.

It is recommended closed reduction of bone fragments and intermaxillary fixation or lingual plate fixation whenever possible. If this treatment is impossible to perform it is recommended the wire osteosynthesis on the lower border of mandible with intermaxillary fixation or lingual plate. The tooth bud should not be removed unless there is an avulsion of tooth bud or follicular disruption [12,13].

Order of procedure - what to do firstly – alveotomy or osteosynthesis?

If the tooth in fracture line is essential for maintaining the level (height) of occlusion while performing osteosynthesis it should be kept even if it is fractured. If there is incomplete dentition and tooth in fracture line is distally it is important to maintain the level (height) of occlusion while performing osteosynthesis

Intermaxillary fixation should involve such a tooth and thus determine the level of occlusion and after that osteosynthesis should be performed. Earlier (before osteosynthesis) tooth extraction or alveotomy of tooth from fracture line usually cause further destabilisation and dislocation of fracture

The arch bar should be removed from tooth in fracture line after osteosynthesis and extraction or alveotomy of tooth from fracture line should be performed

CONCLUSION

More than one half of teeth involved in the mandibular fracture line were only denervated. Cumulatively one third of the teeth were reinnervated within 6 weeks after the injury and a year after the injury 81% of teeth were reinnervated. Reinnervation of canines, premolars and molars was completed 6 months after the injury, but reinnervation of incisors lasted up to one year after the injury. Three years after the injury 19% of teeth involved in fracture line remain seemingly avital i.e. denervated. During the second and the third year after the injury reinnervation should not be expected, but the devitalisation of denervated teeth is possible. During the one to three years period following injury three teeth were devitalized which is 6,2% of the initially "avital" teeth or 33,3% of denervated teeth after one year. There was no correlation between avital teeth and the occlusion, the earlier bone reduction, age and sex of patients, but the correlation between avital teeth and intraoral communication is present. The pulp is vitally stable one year after the injury.

After trauma, denervated teeth involved in jaw fracture should not be considered devitalised so they should not be treated or extracted if neither clinical nor radiologic signs of devitalisation are present. If sensitivity testing is the only criterion for tooth treatment and/or extraction, i.e., if we do not take into consideration the clinical and radiological criteria of devitalisation, 95% of false avital, i.e. only denervated teeth would be considered devitalised and unnecessary treated or extracted.

References

- [1] Čupar I. Patologija i terapija fraktura čeljusti. Liječ Vjesn. 1935;10:1-6.
- [2] Ditchfield A. Interosseous wiring of mandibular fractures: a follow-up of fifty cases. Brit J Plast Surg. 1960;13:146-51.
- [3] Rowe NL, Killey HC. Fractures of the facial skeleton. 2nd Ed. Edinburgh: ES Livingstone, 1968; p5.
- [4] Aljinović N. Kritički osvrt na komplikacije pojedinih metoda liječenja prijeloma donje čeljusti. Chir Maxillofac Plast. 1985;15:31-9.

- [5] *Ridell A, Astrand P.* Conservative treatment of teeth involved by mandibular fractures. *Swed Dent J.* 1971;64:623-32.
- [6] *Brajdić D, Virag M, Uglešić V, Aljinović-Ratković N, Zajc I, Macan D.* Evaluation of sensitivity of teeth after mandibular fractures. *Int J Oral Maxillofac Surg.* 2011;40:266-70.
- [7] *Samson J, John R, Jayakumar S.* Teeth in the line of fracture: To retain or remove? *Craniomaxillofac Trauma Reconstruction.* 2010;3:177-84.
- [8] *Macan D, Virag M, Zaklan-Kavić D.* Promjene senzibiliteta i vitaliteta zuba u prijelomnoj pukotini donje čeljusti. *Chir Maxillofac Plast.* 1985;15:103-14.
- [9] *Macan D.* Promjene senzibiliteta zuba poslije prijeloma donje čeljusti. Magistarski rad. Zagreb: Stomatološki fakultet, 1985.
- [10] *Ellis III E.* Management of fractures through the angle of the mandible. *Oral Maxillofac Surg Clin N Am.* 2009;21:163-74.
- [11] *Spinnato G, Alberto PL.* Teeth in the line of mandibular fractures. *Atlas Oral Maxillofac Surg Clin N Am.* 2009;17:15-8.
- [12] *Yamamoto K, Matsusue Y, Murakami K, Horita S, Matsubara Y, Kuraki M, Kurihara M, Imai Y, Sugiura T, Kirita T.* Fate of developing tooth buds located in relation to mandibular fractures in three infancy cases. *Dent Traumatol.* 2010;26:353-6.
- [13] *Suei Y, Mallick PC, Nagasaki T, Taguchi A, Fujita M, Tanimoto K.* Radiographic evaluation of the fate of developing tooth buds on the fracture line of mandibular fractures. *J Oral Maxillofac Surg.* 2006;64:94-9.

Sažetak

Sudbina zuba u prijelomnoj pukotini donje čeljusti

Prijelomna pukotina u kojoj je zub komunicira preko parodontne pukotine s usnom šupljinom, što predstavlja ulazna vrata infekciji. Osim toga, takav zub može izgubiti opskrbu krvlju zbog oštećenja apeksnih žila pa u slučaju nekroze pulpe postaje izvor infekcije. Metode ispitivanja "vitaliteta" zuba osnivaju se na boli tako da dolazi do nerazlikovanja vitaliteta koji je funkcija vaskularizacije pulpe i senzibiliteta koji je funkcija inervacije. Ako ozljeda uzrokuje prekid vaskularizacije pulpe doći će do smrti pulpnog tkiva uključujući i živac, a ako dođe samo do ozljede i ispada funkcije živca, vitalitet pulpe nije ugrožen.

Cilj ovog rada bio je ispitati promjene "vitaliteta", tj. senzibiliteta zuba u prijelomnoj pukotini donje čeljusti i utvrditi u kojem broju i u kojem vremenskom razdoblju će doći do normalizacije senzibiliteta zuba ili do devitalizacije. Prospektivnom analizom obrađeno je 50 bolesnika s prijelomom donje čeljusti. Zub u prijelomnoj pukotini imalo je 39/50 bolesnika. Analizirano je 39 bolesnika s ukupno 63 prijeloma i 84 zuba u prijelomnoj pukotini, od čega je 48 bilo inicijalno "avitalno". Mjesec i pol nakon ozljede reinervirano je 31%, a godinu dana nakon ozljede 81% inicijalno "avitalnih" zuba u prijelomnoj pukotini. Godinu dana nakon ozljede reinervirano je 84% sjekutića, 75% očnjaka, 83% pretkutnjaka i 80% kutnjaka. Tijekom druge i treće godine ne dolazi do reinervacije, ali moguća je devitalizacija denerviranih zuba. Pulpa zuba je vitalno stabilna godinu dana poslije ozljede.

Denervirani zub ne treba smatrati devitaliziranim i ne treba ga liječiti i/ili ekstrahirati ako nema kliničkih ili radioloških znakova devitalizacije. Kad bi ispitivanje senzibiliteta bilo jedini kriterij za ekstrakciju, tj. kad ne bismo uvažavali kliničke i radiološke kriterije devitalizacije, 95% lažno avitalnih, tj. samo denerviranih zubi proglasili bismo devitaliziranima i nepotrebno ih liječili ili ekstrahirali.

Ključne riječi: prijelom donje čeljusti; prijelomna pukotina; zub; vitalitet; senzibilitet.

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