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Versatility of Mini-Implants in Orthodontics: A Review.

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ABSTRACT

The use of miniscrew implants to obtain absolute anchorage has recently gained popularity in clinical orthodontics. The temporary uses of these implants and a simple insertion procedure have increased their popularity, establishing them as a necessary treatment option in complex cases that would have otherwise been impossible to treat. The aim of this review is to present and discuss the development, clinical use, sites of placement, insertion, loading and removal techniques of the mini-implants used for skeletal anchorage. Lastly, the advantagesand potential complications accompanying their use are presented.

Keywords: mini-implants, anchorage, TSADs

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INTRODUCTION

Anchorage preparation is a very important part of orthodontic treatment. The success of orthodontic treatment generally to a great extent relies on the anchorage protocol planned for that particular case. When preparing anchorage, the clinician must be realistic enough to foresee the possibility of losing some anchorage.

Obtaining maximum anchorage has always been of paramount importance for the orthodontist, often resulting in a condition, dreaded by most, called anchorage loss. Anchorage loss is the reciprocal reaction of the anchor unit that can obstruct the success of orthodontic treatment by complicating anteroposterior correction [1].

In the anteroposterior dimension, the orthodontist faces three anchorage situations traditionally defined by the ratio of incisor retraction to molar protraction. Maximum anchorage means that most of the space is closed by retraction of the incisors, while moderate anchorage entails reciprocal space closure and minimum anchorage means that most of the space is closed by protraction of the buccal segments.

To maximise anchorage, many appliances and techniques have been devised; Nance holding arch, transpalatal bars, extraoral traction, and multiple teeth at the anchorage segment and differential moments are the commonly used ones. However, all these methods have a few inherent disadvantages such as complicated designs, need for exceptional patient cooperation, elaborate wire bending and so on [2]. Therefore, over the past 60 years, methods have been developed to create absolute skeletal anchorage and thus widen the scope of orthodontics [3].

The advent of temporary skeletal anchorage devices (TSADs) such as mini-implants and mini-screws has, however, significantly simplified orthodontic biomechanics by providing independent absolute anchorage rather than the conventional active-reactive type of anchorage between dental units [4]. Consequently, TSADs are quickly becoming the preferred method of skeletal anchorage.

Because of the versatility of mini-implant–enhanced mechanics, certain malocclusions might be treated in a shorter time or at least with a more predictable outcome. In thesesituations, mini-implant anchoragecan prove to be very beneficial.

Clinical implications

Corrections in the anteroposterior dimension [3]

- When anchorage consideration is not the primary concern, the choice between first or second premolars can be made by considering tooth anatomy, periodontal and restorative status
- In adults with Class II malocclusion and severe overjet undergoing extraction of the maxillary first or second premolars and retraction of the maxillary anterior teeth absolute anchorage is required as anchorage loss is unfavorable in this situation. Treatment time can be reduced by en-masse retraction.
- In bimaxillary protrusive patients with an unpleasant profile or lip incompetence, use of mini-implants after four premolar extractions allow for maximum retraction with maximum impact on profile (Figure 1).
- Patients requiring canine substitution because of lateral incisor agenesis might benefit. A traditional contraindication for canine substitution is a Class I molar relationship but absolute anchorage allows for protraction of the posterior segments in such cases thus making canine substitution an option.
- Mini-implants can be used for protraction of posterior segments for extraction space closure or tooth loss if prosthetic replacement is not desired.
- Mini-implants can also be used in patientsrequiring molar distalization for correction of Angle Class II malocclusion and relief of crowding.
- Mini-implants can be used for distalization of the entire arch (maxillary in case of Angle Class II malocclusion; mandibular in case of Angle Class III malocclusion) for correction of anteroposterior molar relation and profile (Figure 2).

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Figure 1: Mini-implant placed in buccal alveolar bone between maxillary second premolar and first molarfor enmasse retraction of anterior teeth after extraction of first premolars in bimaxillary protrusion patient

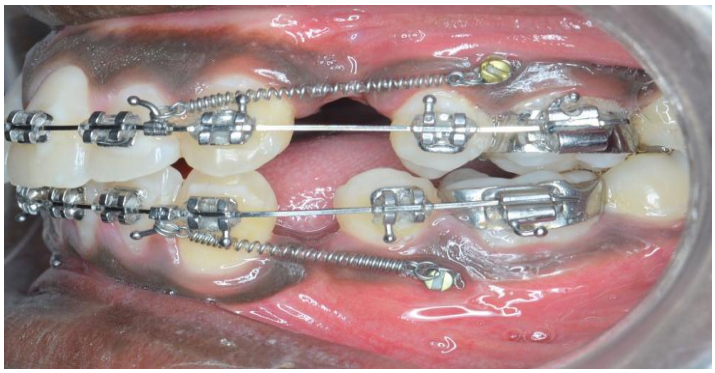
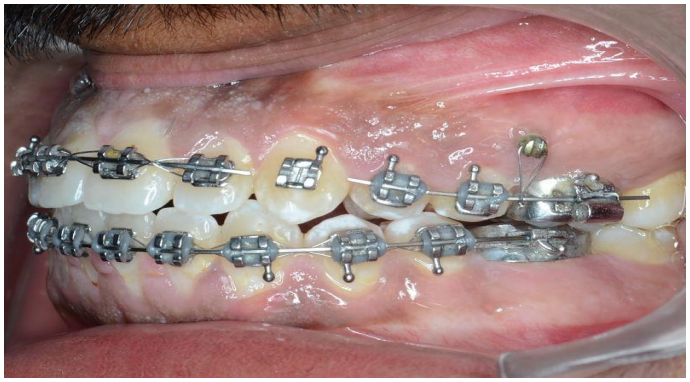


Figure 2:Mini-implant placed in maxillary palatal alveolar bone between first and second molars in Angle Class II malocclusion for distalization of maxillary dentition

Corrections in the vertical dimension [3]:

- In patients with posterior maxillary excess, anterior open bites can be corrected by the intrusion of the maxillary posterior segments with the help of mini-implants (Fig 3).
- In high-angle patients, mini-implants can be used for vertical control of mandibular posterior segments
- Anterior open bites can be corrected by a combination of the above.
- Intrusion of maxillary incisors in patients with deep bite and excessive gingival display.
- Mandibular incisors can be intruded in patients with deep bite and deep curve of Spee.
- Deep bites can be resolved by a combination of the above.
- Canted occlusal planes can be resolved.

Figure 3:Mini-implant placed inbuccal alveolar bone between maxillary second premolar and first molar for molar intrusion in anterior open bite patient



Corrections in the transverse dimension [10]:

- Palatal mini implant supported rapid palatal expansion

Preprosthetic orthodontics, single tooth movement, and mutilated dentition [3]

- Mini-implants can be used for molar uprighting, space management, and single-tooth intrusion in patients with extruded antagonists.
- Desirable anchorage situations can be predictably achieved in patients with mutilated dentition.

IMPLANT SITE SELECTION

Selecting the proper implant site can be an important factor for the overall success. Five factors are important in determining an adequate site for implant placement.

- Indication and required mechanics- An orthodontic mini-implant is placed keeping in mind the treatment objective and how long the implant will remain in situ. Mechanics should be simple and efficient to obtain maximum results.
- Placement in attached gingiva- Ideally sufficient attached gingiva should be present for placement of the mini-implant. This prevents patient discomfort, tissue overgrowth and reduces the chance of long-term implant failure. Mini-implants should be placed clear of the frenum.
- Sufficient interradicular distance- The implant must be placed between roots that are wide enough apart so that no damage is inflicted. Periapical radiographs or 3-dimensional cone-beam computed tomography can be useful tools for evaluating potential implant sites. Preparatory root uprighting might be necessary if the preferred implant site is obstructed by root proximity.
- Avoiding other anatomical structures- Other anatomical structures can interfere with the placement of an orthodontic mini-implant: eg, inferior alveolar nerve, artery, vein, mental foramen, maxillary sinus, and nasal cavity. Again, 3-dimensional digital imaging can help evaluate the anatomical relationships [8].
- Adequate cortical bone thickness- Cortical bone thickness is an important factor in mini implant stability [9].Adequate bone thickness ensures better primary stability and long-term success of the mini-implant.

Clinical procedures of implant insertion

Miniscrew implant placement procedures are usually available in the product brochure. Some basic guidelines which are followed:

- A small amount of local anesthesia is usually sufficient for the placement of miniscrew implants, and it is advocated not to achieve profound anesthesia of the teeth but only of the soft tissue [5].
- In case of non-self-drilling miniscrew implants, a pilot hole is necessary. Pilot drilling should be done in a surgical environment, and if necessary, by an oral surgeon. Firstly, soft tissue from the site of the placement is either incised or removed using a soft tissue punch. Thereafter, a pilot hole is drilled using a drill rotating no more than 1000 rpm. The pilot drill is usually 0.2 to 0.3 mm thinner than the miniscrew implant [7].The miniscrew implant is then screwed in place by using an appropriate screwdriver.
- In case of self-drilling miniscrew implants, no incision or soft tissue removal is necessary. Infection control is similar to that for an extraction. After selecting the appropriate site, the miniscrew implant and the corresponding site of placement, it is inserted in place.

Loading

In contrast to dental implants, orthodontic miniscrews can be loaded immediately, and most authors suggest the use of light forces initially. No significant association was found between the success rate and immediate loading, and it was concluded that immediate loading is possible if the applied force is less than 2 N [6].

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IMPLANT REMOVAL

Usually, miniscrew implant removal can be achieved without the use of anaesthesia, but topical or local anaesthesia can be used. The implant driver of the corresponding manufacturer is used to derotate the implant in a counterclockwise direction.

COMPLICATIONS

As with any treatment, potential complications are associated with orthodontic mini-implants.A common complication is failure of the mini-implant. Currently, approximately 10% of orthodontic mini-implants fail. This might be because the orthodontic mini-implant is not designed to osseointegrate. Osseointegration would complicate implant removal and is therefore not desired. The reasons for reduced implant success are improper implant site selection, overheating of the bone when drilling a pilot hole, lack of primary stability, gingival inflammation around the implant, trauma, poor oral hygiene, and idiopathic factors. Implant failure might delay treatment time [3].

Damage to adjacent structures can occur even though orthodontic mini-implants and pilot drills are specifically designed to not cut into roots. Therefore, damage of the root proper is rare, but it is possible to damage the structures of the periodontal ligament. Theoretically, other structures such as the inferior alveolar nerve or the maxillary sinuses are also at risk, but they can usually be avoided by proper treatment planning [3].

CONCLUSION

Anchorage control is a prerequisite for a successful orthodontic treatment. Mini implants are efficient sources of intra oral anchorage. The advantages of the treatment approach were - elimination of compliance-depended intraoral and extraoral anchorage aids, favourable esthetics, immediate force application and relatively predictable outcomes. The screw insertion and retrieval procedures are quick, simple and painless. Orthodontic mini-implants are a powerful aid in resolving challenging malocclusions. Today, mini-implants can be used in most intraoral locations and with efficient biomechanics and some improvisation, a variety of malocclusions can be successfully corrected. Wide selections of implants are available today and a suitable versatile system that allows for a variety of mechanical applications should be selected.

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