

TAD: Background Of Mini Implant And The Conceptual Review On Clinical Application Of Mini Implants In Orthodontics

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Abstract : *Orthodontic appliances with mini implants became more popular in the field of orthodontics for past many years .There are wide array of mini implant designs, various materials are available for a variety of clinical uses in orthodontic practice. Absolute anchorage facilitated by mini implant system plays foremost role in successful orthodontic treatment .This literature review explains about historical background, parts, materials, types of mini implants and various clinical application in orthodontic purposes.*

Keywords: *Mini implants, clinical application,temporary anchorage device .*

1. INTRODUCTION

Teeth alone will not support anchorage system in the literal sense, but there is altering degree of resistance.^[1] The word anchorage defined as a resistance to unwanted tooth movement.^[2] It is highly essential for treating the skeletal and dental malocclusion.^[3,4] The significance of anchorage in orthodontics was realised by most famous orthodontist like Gunnell, Angle and Desirabode and they put forth the limitations of moving teeth against other teeth where they can be used for anchorage purpose .Weinberger introduced different method of anchorage like occipital, occlusal and stationary anchorage in the year 1926.

Anchorage is important consideration in orthodontics because of following reason such as resistance is obligatory to prevent unwanted tooth movement and anchorage helps in decide the type of resistance offered by tooth, because it point out the desired tooth movement. Furthermore, anchorage is considered to be one of the factor in shaping the type of appliance and type of desired tooth movement.

Absolute or infinite anchorage is lack of movement in anchorage unit where there is lost zero anchorage. This type of anchorage can be attained through anchor unit like ankylosed teeth or dental implant and this reactive forces can be used for orthodontic tooth movement .^[5] Anchorage supported by implants or mini screw implants acquire by enhancing the reactive unit (i.e. indirect anchorage) or by directly fixing the anchor unit (i.e. direct anchorage).This current review is to explain about the history, types and material of mini implant, clinical implications of the miniscrew implants in the field of orthodontics and dentofacial orthopaedics.

2. HISTORY

1945	Vitallium screws was placed in the ascending ramus of six dogs for retracting canine.(Gainsforth and Higley). ^[6]
1983.	The anatomical site like anterior nasal spine where vitallium screws was inserted to treat deepbite case.(Creekmore and Eklund). ^[7]
1989	The study was conducted in dog mandible where osseointegration was achieved by 94 % of titanium implants (Roberts WE et al). ^[8]
1990	The endosseous implant was positioned in the retromolar area of the mandible and it acted as rigid anchorage in order to mesialize two molars 10-12 mm respectively.(Roberts WE et al). ^[9]
1995	Reviewed many animal studies in order to demonstrate unilateral tooth movement towards onplants . ^[10]
1996	The titanium endosseous orthodontic implant was used as palatal anchorage. ^[11]
1997	Osseointegrated titanium implants was used effectively for replacing missed teeth. ^[12]
1998	The purpose of the mini screw as anchorage was introduced for different orthodontic tooth movement .The stability was restricted when loaded with torsion. ^[13]
1999	Titanium mini plates were fixed temporarily in the maxilla or the mandible region as an immobile anchorage and further established the skeletal anchorage system for intruding lower molars in case of open-bite. ^[14]

3. CLASSIFICATION OF MINI IMPLANTS

The application of mini implants in the field of orthodontics was introduced by Labanauskaite et al in the year 2005.^[15]The mini implant was classified depending on the size, shape, bone contact and their application are as follow.^[16]

According to the shape and size

- Conical (cylindrical)
 - Miniscrew implants
 - Palatal implants
 - Prosthodontic implants

- Miniplate implants
- Disc implants (onplants);

According to the implant bone contact

- osseointegrated
- nonosseointegrated

According to the application

- Orthodontic purposes (orthodontic implants)
- Prosthodontic and orthodontic purposes (prosthodontic implants).

4. MINI IMPLANT DESIGN

The mini implants are mainly contains titanium alloy .Various diameter and length are available for purpose of orthodontic anchorage. Orthodontic mini implant has different parts, they are explained below.^[17]

Head -The head of the mini implant is outer portion which is exposed to the oral cavity .The different designs of miniscrew implant systems are available for accommodating direct and indirect anchorage and in order to keep away from soft tissue irritation. Commonly available are spherical button like design ,double sphere-like shape ,hexagonal shape and remaining design of head includes both bracket and hook design.

COLLAR - It connects the mini implant head and platform. It can be used for orthodontic attachments such as elastics, NiTi coil spring etc to the part of head. At times, it has a round hole with diameter of 8 mm and can be used as auxiliary tube for an placement of archwire.

BODY-The shape of the body is conical or parallel tapering at the end . The body of the mini implant has threads or grooves for better interlocking in bony part. In 2005, study conducted by Costa et al and concluded that miniscrew implants of 4 to 6 mm in length are safe in both maxilla and mandibular region.^[18] It is self-drilling or self-tapping type. Various diameter and length of mini implants are available. Diameter thread varies from 1.2 to 2 mm and length varies depend on the different part of maxillomandibular region. ^[19-22] The smaller length of mini implant such as 7mm, 10mm and 12mm were used in the interdental area whereas mini implants of 14mm and 17mm length were placed in the zygomatic buttress region.

5. MINI IMPLANT PLACEMENT SITE:

Maxilla

Palatal site

- The location for placement of mini implant was 2mm to 8mm away from the alveolar crest and interradicular space connecting maxillary second premolar and first molar.
- The location for placement of mini implant was 2mm to 5mm away from the alveolar crest and interradicular space connecting maxillary first and second molar.

Buccal or palatal site

- The location for placement of mini implant was 5 mm to 11 mm away from the alveolar crest and interradicular space connecting the first and second premolar.
- The location for placement of mini implant was 5 mm to 11 mm away from the alveolar crest and interradicular space connecting canine and first pre-molar.

Buccal site

- The location for placement of mini implant was 5 mm to 8 mm away from the alveolar crest and interradicular space connecting second premolar and first molar

Mandible

- Interradicular space between the 1st and 2nd molar.
- Interradicular space between the 1st and 2nd premolar.
- The location for placement of mini implant was 11mm away from the alveolar crest and interradicular space connecting 2nd premolar and 1st molar
- The location for placement of mini implant was 11mm away from the alveolar crest and interradicular space connecting canine and 1st premolar.^[23]

6. CLINICAL APPLICATION OF MINI IMPLANT

6.1. *Closure of extraction spaces*

Anchorage loss in the posterior segment is one of the major troublesome in extraction cases which may worsen the curve of spee and it deepen the bite. Mini screw acts as a reliable skeletal anchorage for anterior retraction in both en mass retraction and segmental retraction.

Placement :- Maxillary miniscrews are usually placed in the space connecting the roots of the 1st and 2nd premolars, where the interradicular space typically allows easy insertion without interfering the roots of the adjacent tooth. The screw heads can be situated at or above the mucogingival line, depending on the desired line of action. If both intrusive and distalizing forces are needed, the miniscrew should be positioned above the mucogingival line. The primary movement is to be a distalizing vector, the miniscrew should be placed at the line of mucogingival junction. For some instance, in order to prevent irritation of the soft tissue where monkey hook can be used to keep the chain or coil spring away from the soft tissue.

6.2. *Correction of a canted occlusal plane*

A canted occlusal plane was inconceivable to treat with conventional orthodontic treatment. In other way, mini implants present skeletal anchorage for intrusion of the teeth present on the canted side.

Placement site- Miniscrews can be placed between their roots of upper lateral incisors and canines, upper canines and premolars, or lower lateral incisors & canines.

6.3. *Correction of dental midline*

Dental midlines are usually corrected with the aid of intermaxillary elastics where patient cooperation is much needed. One of the foremost drawback of elastics is bite deepening due to vertical force. So, miniscrews may be a useful alternative. A screw can be placed either buccally or lingually and the head stands out at the crown margins where the line of force is directed more occlusally with an improved horizontal vector.

6.4. *Molar Mesialization*

In some cases, molars moved mesially in order to close extraction space. Furthermore, mesialization of molar is complicated procedure which may cause trouble like anterior anchorage loss and molar tipping. The placement of mini screw after the initial stage, helps in engagement of full-size archwire and it avoid mesial crown tipping of the molar during space closure. A miniscrew can be placed mesial to the space, where it generate force vector close to the center of resistance of the molar.

6.5. *Molar distalization*

Many removable and fixed appliances are available for treating molar distalization, but many studies of distalization shows anterior anchorage loss. The usage of TAD system in molar distalization is considered to be ideal choice. The ideal site of placement is palate. If the size of mini implant is less than 2mm shows insufficient stability for palatal anchorage.

6.6. *Intermaxillary anchorage*

The undesirable side effects produced by the intermaxillary elastics are bite opening and excessive proclination and protruded lower incisors. The interradicular space between the roots of 2nd premolar and 1st molar is wider than the space between the 1st and 2nd molar. Placement of mini screw mesial to the first molar may also avert mesialization of

entire lower arch. In critical cases like class III, the maxillary arch needs to be advanced where mini screws can be placed between the interradicular space of the lower canines and first premolars. If the mandibular arch has to be repositioned distally, so the miniscrew can be placed between the interradicular space of the upper 1st and 2nd molars or 2nd premolars and 1st molars.

6.7. *Molar Intrusion*

Miniscrews can be a consistent anchorage, it is complicated to place in the narrow interradicular space between the roots of the first and second molars without disturbing the roots.^[24] Few cases, it needs more than one mini implant to withstand the high force. Consequently, it is indicated to use for single molar intrusion. In case of open bite malocclusion, there is need to intrude molar bilaterally which is not proper solution to treat through TAD system.^[25]

6.8. *Upper Third Molar Alignment*

Miniscrews can also be useful in cases with multiple missing teeth where conventional orthodontic mechanics are difficult to apply. For example, an upper third molar can be uprighted with a fixed sectional wire, utilizing a palatal miniscrew for skeletal anchorage to limit unnecessary extrusion of the molar.

6.9. *Extrusion of Impacted Canines*

Many procedures have been suggested to prevent anchorage loss and avoid canting of the occlusal plane while an impacted canine is pulled down into occlusion. Few authors have recommended inserting auxiliaries such as kilroy springs on the main archwire.^[26] Others have proposed using superelastic overlay archwires.^[27] Miniscrews can be used instead when heavy forces are required to bring an impacted canine into occlusion, without relying on the rest of the teeth for anchorage. Whether the canine is impacted palatally or lingually, the miniscrew can be placed to provide the most appropriate force vector; it can even be removed and relocated as the canine is extruded.

7. LIMITATIONS

- Inflammation mostly occurs in non-keratinized tissue, due to this factor there is reduced success rate of mini-implants.
- Under heavy occlusal forces, there is reduced stability of mini implant in immediate loading.
- Loosening of mini-implants.
- Pain.
- Swelling around the placement site.

8. CONCLUSION

To conclude, mini implant system considered to be excellent when used as temporary anchorage device. The acceptability rate of the patient, severity of adverse reaction of TAD is several factors that impact success of the mini implant. Even though, it offers other advantages like simple placement and removal, economical and require minimum patient cooperation.

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