



## Review Article

## Orthodontics mini implants – A brief review

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## ABSTRACT

In routine orthodontics practice anchorage is a critical factors that determining the success of an orthodontic treatment. For many years' anchorage has been a strenuous factor. Many modalities have been tried for preventing the anchorage loss by using the extra oral and intraoral devices according to various scientific literature, yet the orthodontists did not find any convenient solutions to solve this problem until the mini- implants were emerged to the speciality. During the early 20<sup>th</sup> century introduction of various skeletal anchorage devices which includes prosthetic implants, palatal implants, mini-plates and screws. The implants used in orthodontics for the purpose of effective treatment are also known as Temporary Anchorage Devices (TADs), which helps in bringing down the strenuous efforts employed to prevent anchorage loss and they are easy and small and can be insert and remove without strenous efforts, they can be immediately loaded after insertion, and they can provide absolute anchorage for orthodontic treatment, which require minimal need patient compliance there by increasing its popularity. This article gives a brief reviews of indications, contraindications, safety zones for TADs, their insertion procedure, complications, failures and medico legal aspects.

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## 1. Introduction

For a success of orthodontic treatment anchorage is one of the main factors. Conservation of orthodontic anchorage has been a one of the perennial problem for orthodontist. Conventional techniques use either intra-oral sites or extra oral means. For optimum treatment results various approaches have been employed which includes using implants for anchorage with varying success. Extra oral anchorage is cumbersome to use and it usually requires patient's compliance and may cause injury during their use. The term 'Absolute anchorage' can be defined as when the anchorage unit remains completely stable.

The skeletal Anchorage used in orthodontics are of absolute anchorage which is achieved with the use of orthodontic mini- implants. With the appropriate use of

Orthodontic mini-implants, maximum anchorage is possible which will reduces the unwanted side-effects.<sup>1</sup>

Mini-screws are also known as TAD'S (Temporary Anchorage Device) or Micro-implants or Ortho-implant, by the advent of TADS there is a significant revolution in the field of clinical Orthodontics.

In 1945, Gainsforth & Higley conducted a study in which Vitallium screws & SS wires in the Ramal area of the dog's mandible so as to bring about retraction of upper canines. This was considered to be the first published case where implants are used for orthodontic anchorage.<sup>2</sup> In 1984, Robert & fellow researchers collaborated with the findings of Branemark where they placed titanium implants in rabbits. The study concluded that titanium endosseous implants provides firm osseous anchorage.<sup>3</sup> In 1988, Vitallium implant were used by Creekmore for anchorage for the purpose of intruding upper anterior teeth.<sup>4</sup>

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## 2. Classification of Orthodontic Mini Implant.<sup>5,6</sup>

Orthodontic implant are alloplastic material devices which are surgically inserted into or onto jaw bone and it is classified as:

1. Based on the Location
  - (a) Subperiosteal they lies over the bony ridge. Onplants are the subperiosteal design that are used for orthodontic purposes.
  - (b) Transosseous; These implant body penetrates the mandible completely.
  - (c) Endosseous/ Endosteal are those implants that are partially submerged and are anchored within bone.
2. Based on the form
  - (a) Solid
  - (b) Hollow
  - (c) Vented
3. According to the composition
  - (a) Stainless steel,
  - (b) Cobalt-Chromium-Molybdenum,
  - (c) Titanium,
  - (d) Ceramic Implants.
  - (e) Miscellaneous such as Vitreous carbon and composites
4. According to the surface structure
  - (a) Threaded or Non-threaded
  - (b) Porous or Non Porous.
5. 5) Based on head type –
  - (a) Small head type
  - (b) Long head type
  - (c) Circle head type
  - (d) Fixation head type
  - (e) Bracket head type
6. According to March 2005 classification –
  - (a) Biocompatible TADS
  - (b) Biological TADS

### 2.1. Parts of orthodontic implant

#### 2.2. Orthodontic mini implant screw/plate has three parts

**Implant head**, this is the part where the implant is attached to the driver and the head of the implant serves as the abutment and could be the source of attachment for elastics/ coil-springs

**Neck** –It is the junction between head of the implant and platform for attachment of an elastic, NiTi coil spring or other accessories.

**Head**

**Neck**

**Body**



**Fig. 1:** Parts of orthodontic mini implants

**Body** – It is parallel in shape and self- drilling with wide diameter and have deep thread pitches. It provides better anchorage, good mechanical retention, less loosening breakage. It is the part of mini implant which get embedded inside bone.

### 2.3. Ideal requirements for implant biomaterial

The following are the ideal requirements for implant biomaterial –

1. Biological properties
2. Physical properties

Biological properties –

1. Provide effective Osseo integration.
2. Shouldn't cause any harm to soft tissue and hard tissue.
3. Should not contain the toxic diffusible substance.
4. Should be free agents that may cause an allergic reaction.
5. Should have no carcinogenic potential.
6. Should be tasteless and odourless.

Physical properties –

1. Should be dimensionally stable.
2. Should possess adequate strength and resilience
3. Should able to resist biting or chewing forces.

The osseointegrating orthodontic / dental implants / screws are composed of 99% titanium. The medical grade titanium used are of grade I to IV.

Commercially pure titanium (C P Ti) is used widely for implants fabrication because it possesses excellent biocompatibility and suitable mechanical properties. Use of Ti grades I to IV in for the manufacturing of non –osseointegrated / mechanical retentive miniscrews shows failures as screw were thinner.

Therefore, the titanium alloy (Ti - 6Al - 4V) (grade V) is the material for orthodontic miniscrews / mini implants. Titanium alloy (Ti - 6Al - 4V) increases the modulus of elasticity to six times that of bone so that long and thin

#### 2.4. Indications for implant in orthodontics

Indications for implants in orthodontics are as follows

1. Retract and align anterior teeth
2. In first molar extraction sites they are used for closing the edentulous spaces
3. Intrude or extrude teeth,
4. Protract or retract teeth of one arch,
5. Stabilizing the teeth with less bone support,

#### 2.5. Contraindication for implant placement

There is no absolute contraindication for orthodontic mini implant placement the placement of implant are contraindicated in cases of Psychiatric diseases (psychoses dysmorphobia severe systemic disorder like osteoporosis, blood disorders ,alcoholics ,drug abusers. Patients with poor bone quality and diabetic patients.

### 3. Treatment Considerations<sup>6-8</sup>

#### 3.1. Age of the patient

The age of the patients is an important consideration for implant placement in growing children the use of implant in the anterior maxilla is contraindicated due to opened mid palatal suture Resorption in the posterior part of the maxilla resulting to the exposure of the implants due to growth changes..=

#### 3.2. Periodontal status

Patients with satisfactory periodontal status with adequate amount of bone support and thick compact cortical bone are indicated or mini care should be taken to maintain good oral hygiene.

#### 3.3. Systemic manifestations

One of the predisposed factor for delayed wound healing in case of diabetics are destructive habits like smoking. In case of chronic smokers it is contraindicated to placement

the orthodontic mini-implant and it is noted that delayed or inadequate tissue healing and poor osseointegration is noted.

#### 3.4. Radiographic analysis

During placement of orthodontic mini implants careful observation of Periapical pathology and Radiopaque/radiolucent should be examined and diagnosed in the regions above the inferior alveolar region, the maxillary sinus, adequate space above IAN or below maxillary sinus are to be taken care, During placement of mini-implant a minimum of 2mm from the inferior alveolar canal or below the maxillary sinus with adequate interradicular area should be there.

#### 3.5. Safe zones for implant placement

The most commonly used placement sites for miniscrews in maxilla and mandible are as follows

**In Maxilla:** Inter radicular alveolar –as the buccal cortical bone on the entire maxillary alveolar process is about 3mm to 4mm, so longer screws are needed. Most commonly used sites are –

1. Between second premolar and first permanent molar
2. Between the first and second permanent molar
3. Between the two central incisors, used for intrusion
4. Infrazygomatic region – zygomatic buttress
5. Palatal areas.
6. Maxillary tuberosity region
7. Mid palatal area

**In Mandible:** In the mandible dense cortical bone on the buccal area is present, so the screws of smaller in size should be used, so the possibility of root contact is remote. Most common sites are –

1. Between second premolar and first permanent molar
2. Between first and second permanent molar
3. Between two central incisors
4. Between mandibular canine and premolar buccally
5. Retromolar area
6. Mandibular symphysis facially

Some of the anatomical and vital structures that should be kept care of during micro-implant placement includes- inferior alveolar nerve, artery, vein, mental foramen, maxillary sinus and nasal cavity.<sup>9</sup>

#### 3.6. Implant placement angulation

In Maxilla: micro- implant is placed at an angulation of 30-degree to 40 -degree angle to the long axis of the teeth in the maxilla, it will keep the screw in the widest space available between the roots apically.

In the Mandible, Micro implants are placed at an angulation of 10- degree to 20- degree because the buccal cortex is of dense bone and curves out more buccally from gingival margins. So mini screws of shorter dimension can be used than those used in the maxilla. Also the angle is reduced to 10- degree to 20- degree with little risk of touching the roots.

### 3.6.1. Methods of placing micro screws / micro implants

The method of placement of orthodontic miniscrew into the alveolar bone depends upon the type of screw chosen. There are two different types of screws available –

1. Self-Tapping: First a tunnel is drilled into the bone with the help of pilot drill and then implant is driven into tunnel
  - (a) Tips: blunt, smooth and rounded
  - (b) Threads: - thick rounded and blunt
2. Self-Drilling: Here the implant itself acts as a drill and it is directly inserted into bone Tips: - sharp, hooked and pointed
3. Threads: - thin, pointed

### 3.6.2. Procedure for microimplant placement

The various steps for surgical implant placement are as follows

1. Topical Anaesthesia: Soft local Infiltration usually adequate
2. Aseptic preparation – A disinfecting agent can be used to prepare an intraoral or extra oral site for keeping the surgical area aseptic.
3. Drilling –Mini implants are loaded to the selected micro screw driver, and the screw is inserted at the desired location. Guide bar can be use and placed on the tooth before exposing the patient to IOPA. The guide is placed during micro implant insertion it should be retained, so it can help in placement of a micro- implant. The direction of insertion is first at 90 degrees to occlusal plane and then angulated at 30 - 40 degree in the maxilla and in case of mandible at 10- 20- degree. To ensure proper stability of implants wobbling in the axis of a driver should be avoided. During placement screw should be smooth alternating between turns and stops

### 3.7. Loading of implants

Two types of loading can be employed which includes immediate loading and delayed loading in terms of orthodontic mini-implants, the primary stability is more important than the Osseo integration. Clinical studies have shown that there is no significant difference exists between the immediate loading and delayed loading when the force

levels are between 200- 300gms after achieving primary stability. However, it may be better to wait approximately 2-3 weeks for soft tissue healing.

### 3.8. Stability of orthodontic implants

In cases of orthodontic mini implant 2 types of stability are seen they are Primary stability and the secondary stability.

Primary stability or initial stability is noted immediately after the insertion of an orthodontic mini-implant. Which is the prime factor consideration for healing and loading. The factors that contributing and are responsible for achieving the primary stability includes- Implant diameter, the length of implant, and the number of flutes and design of threads, cortical bone thickness and also the bone density. Primary stability also depends on the placement technique and location of implant placement.<sup>10-14</sup>

Secondary stability is seen after implant placement and the bone regeneration and remodelling which contributes to increasing the stability.<sup>15</sup>

### 3.9. Complication of orthodontic implants

Complications can arise during the placement and after orthodontic loading of TAD's in regard to stability and patient safety.

1. Complications during Insertion includes
  - (a) Trauma to the dental root or to periodontal ligament
  - (b) Orthodontic implant slippage
  - (c) Nerve involvement
  - (d) Air subcutaneous emphysema
  - (e) Nasal and maxillary sinus perforation
  - (f) Implants bending, fracture, and torsional stress
2. Complications under Orthodontic Loading
  - (a) Miniscrew migration
  - (b) Soft-Tissue Complications
  - (c) Aphthous ulceration
  - (d) Soft tissue inflammation, infection, and peri implantitis
  - (e) There can be soft-tissue coverage on to the head of the mini implant and auxiliary
3. Complications During Removal
  - (a) Screw fracture
  - (b) Partial osseointegration

## 4. Conclusion

The introduction of orthodontic mini implants on the field of dentistry had a tremendous impact on dental treatment plans. Mini implants help the orthodontist to overcome the unwanted reciprocal tooth movement happening during routine dental treatment. The presently available implant

systems are ease of placement (able to be placed by orthodontist), least invasive procedure, and best physical design properties to deliver optimum mechanical forces. bound to change and evolve into more patient friendly and operator convenient designs. Long-term clinical trials are awaited to establish clinical guidelines in using implants for both orthodontic and orthopaedic anchorage.

## 5. Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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