TEMPORARY ANCHORAGE DEVICES IN ORTHODONTICS – A BRIEF REVIEW

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SUMMARY:

Anchorage is the resistance applied by an anatomic unit to displacement. According to Newton's third law of motion, to every action there is equal and opposite reaction. Anchorage control is very important in orthodontic treatment. While moving certain teeth into desired position it is important to prevent undesired effect on the teeth that are not expected to move. According to the need for anchorage, treatment can be planned. Need for Anchorage can be grouped as severe, moderate and mild. Temporary anchorage devices (TADs) can be used in cases with critical anchorage need. With the help of TADs it is possible to get maximum desirable results without unwanted effect on other teeth as the anchorage is obtained from bone.

KEY WORDS: Anchorage, orthodontic treatment planning, TAD's

INTRODUCTION

A key to success in orthodontic practice is anchorage control. Conventional methods of anchorage preservation includes intra oral anchorage and extra oral anchorage. Intraoral anchorage is obtained by transpalatal arch, lingual holding arch, lip bumper, etc. Extraoral anchorage is obtained by headgears, face mask etc. According to Newton's third law "For every action there is an equivalent opposite reaction", the intra-oral anchorage would lose some anchorage somehow even in the maximum anchorage control. The main disadvantage of extra-oral anchorage is its dependence on patient compliance.

Development of mini- implants has provided a means of absolute anchorage in Orthodontics. Mini-screws are also known as TAD'S i.e. Temporary Anchorage Device or Micro-implants or Ortho-implant. The success of the micro implant anchorage is dependent on micro screw design, proper insertion site and careful operation. The clinician can expect absolute anchorage control without patient compliance.

HISTORY[1-5]

- The first case of implant supported orthodontic anchorage was published in 1945 by Gainsforth and Higley. For this study they used Vitallium screws & Stainless Steel wires in the ramal area of the mandible in dogs to bring about the retraction of upper canines.
- In 1995 Block and Hoffman introduced the palate as a location for anchorage device by invention of the Onplant.
- Kaomi in 1997 introduced Mini implants.
- Kyu Rhim Chung in 2002 developed C micro implant system.
- Maino et al in 2003 introduced spider screw system implant for skeletal anchorage.

TEMPORARY ANCHORAGE DEVICE

CLASSIFICATION OF IMPLANT[6]

a) According to site of placement/ anchorage components

- Subperiosteal implant
- Transosteal implant
- Endosteal/ Endosseous implant

b) According to surface texture

- Treaded
- Perforated

c) According to form –

- Solid
- Hollow
- Vented

d) According to spray of coating of hydroxyapatite or plasma sprayed titanium –

- Coated
- Non-coated

e) Based on head type –

- Small head type
- Long head type
- Circle head type
- Fixation head type
- Bracket head type

f) According to implant morphology –

- Plate design
- Skeletal anchorage implant
- Graz implant supported system
- Zygoma anchorage system
- Screw design
- Orthosystem implant
- Straumannortho implant
- Aarhus implant
- Mini implant system
- Micro- implant
- C – implant
- Spider screw
- Implant disc

g) According to March 2005 classification –

- Biocompatible TADS
- Biological TADS

TYPES ACCORDING TO METHOD OF INSERTION [7]

There are two types of mini screws according to the method of insertion namely Self tapping and self drilling. Self tapping type requires pre drilling. A tunnel is drilled into the bone first with pilot drill and then implant is driven into tunnel. Tip of the self tapping type miniscrew is blunt, smooth and rounded and Threads are thick rounded and blunt. Whereas in self drilling type, the implant itself acts as a drill and it is directly inserted into bone. Its Tip is sharp and Threads are thin and sharp.

ORLUS SYSTEM[7]

This system features with three major type of mini-screw;

- Standard type
- Wide collared type
- Long collared type

Standard type (universal) has 1.8mm diameter at collar region, 6mm length for bone penetration and 1mm smooth collar portion. It is indicated in maxillary buccal alveolus, mandibular buccal alveolus, midpalatal area and where soft tissue thickness is minimal.

Wide collared type has 2.2mm diameter in coronal region. It is indicated when host bone quality is thin or soft, previous miniscrews are failed and in growing children with immature cortical bone.

Long collared type has 2-5mm of non-threaded portion. It is indicated in site with relatively thick soft tissue like maxillary palatal slopes and the mandibular retromolar pad region.

PARTS OF ORTHODONTIC IMPLANTS [7]

The orthodontic mini- implant made up of titanium alloy grade V (Ti - 6AL - 4V). It has 4 components;

- Head – Has a slot for placement of orthodontic archwire.
- Neck –It is an isthmus between head and platform for attachment of an elastic, NiTi coil spring or other accessories.
- Platform – It is of three different sizes (1mm, 2mm, and 3mm) for an accommodation of different soft tissue thickness at different implant site.
- Body – It is parallel in shape and is self-drilling with the wide diameter and deep thread pitches. It provides better mechanical retention, less loosening breakage, and stronger anchorage.

SAFE ZONE FOR MINI- IMPLANT PLACEMENT[8]

It is easy to place in any part of alveolus as the mini screw is small and thin. The screws used for orthodontics anchorage purpose must be thin (1.3mm to 1.5mm) and tapered to prevent accidental root contact.

Generally, for maxilla length should be 8mm to 10mm and for mandible length should be 6mm to 8mm because of dense bone.The placement is entirely operator dependent. There are various options for location of mini-screws that functions as anchors.

In Maxilla the most commonly used sites are; [8]

- Between second premolar and first permanent molar
- Between the first and second permanent molar
- Between the two central incisors, which is particularly good for intrusion
- Infrazygomatic region – zygomatic buttress
- Palatal areas where the thickness and quality of cortical bone are excellent.
- Maxillary tuberosity region
- Mid palatal area

In Mandible the most common sites are; [8]

- Between second premolar and first permanent molar
- Between first and second permanent molar
- Between two central incisors
- Between mandibular canine and premolar buccally
- Retromolar area
- Mandibular symphysis facially

SCREW ANGULATION[8]

In maxilla the cortical bone is thin buccally from canine to second premolar therefore, the angulation of mini-screw is required to prevent root contact in this region.The space between the roots is shaped like an inverted pyramid. when we place the mini-screw at 30^0 to 40^0 angle to the long axis of the teeth in the maxilla then at that time the screw in the widest space available between the roots apically.

In the mandible, the buccal cortex is of dense bone and curves out more buccally from gingival margins. So the shorter screw can be used than those used in the maxilla. The angle is reduced to 10^0 to 20^0.

STABILITY OF IMPLANTS

Stability of implants is the factor of great concern whether the implant is Osseo integrated or mechanically retentive. It includes the Primary stability and the secondary stability

Primary stability or initial stability is achieved immediately after the insertion of an implant. It is the prime factor of consideration for healing and loading.

Secondary stability after the implant placement the bone regeneration and remodelling contributes to increasing the stability which is referred to as the secondary stability.

IMPLANT FAILURES[9]

1. IMMEDIATE FAILURES

Causes of immediate failure include:

- Improper insertion site
- Improper handling during insertion including wobbling or abrupt change in position of insertion.
- Recent extraction sockets
- Redundant overlying soft tissue or the patient having thick mucosa.
- Excessive tightened screws tend to fracture at thetime when the neck has reached periosteum.

2. DELAYED FAILURES [9]

Even if the initial fixation appeared favourable, mini-screw loosening may take place during active orthodontic treatment. Possible reasons include:

- Excessive loading from the elastic component
- Sudden impact on the micro screw head during mastication
- Possible contact with root surface
- Excessive or insufficient bone

Remodelling around the micro screw.

Reinsertion of a failed micro screw at same site will increase the chances of failure. The implant should be placed at an adjacent site and if the site is crucial using a mini- screw with a wider diameter of re-insertion, 2-3 months later, is advised. [9]

FACTORS AFFECTING SUCCESS RATE OF TAD[10,11]

The success rate of TADs reportedly ranges from 80% to 100%, depending on the region, the type of TAD, and the patient involved. The success rate of TAD's is slightly lower success rate compared with that of the miniplates.

It depends on factors such as implant-related, patient-related, location-related, orthodontic-related, and implant-maintenance factors.

A) Failure related to the device
   1. Fracture of miniscrew because of thin diameter or low strength in neck area. This problem can be solved by choosing a slight conical screw with a solid neck and diameter compatible with the bone
   2. Infection around the screw can lead to its failure. This can be avoided by selecting a screw system with variable neck length so that all the transmucosal parts are smooth.

B) Failure related to the dentist
   1. In self drilling screw excessive pressure can lead to fracture of cutting tip. This can be avoided by using gentle pressure until the screw grips.
   2. It is crucial to stop turning the screw otherwise it will become loose. The screw should not be over tightened.
   3. While placing the screw if wiggling forces are used then it will lead to loosening.

C) Failure related to the patient
   1. If cortical bone thickness is less than 0.5 mm then primary stability cannot be obtained. Another insertion site can be used in such cases.
   2. In the patients with thick mucosa, the distance between point of force application and the screws centre of resistance increases. Thus large moment is generated when force is applied. Longer screws can be selected in such cases.

INDICATION OF TAD'S [10,11]

1. Where maximum anchorage is necessary
2. correction of gummy smile
3. molar up righting
4. molar intrusion
5. molardistalization.
6. Mini-implants are useful in adult treatment, when there is a decrease in the number of teeth, in case of pre-prosthetic treatment
7. Melsen, 2005 suggested use of miniscrew implants as an anchorage choice in cases
8. where the forces on the reactive unitwould generate adverse effects, in patients who need asymmetrical tooth movements.
9. The use of extra-oral appliances has high compliance need and causes discomfort to the patient.
10. Patientsconsidering lingual orthodontics as an option.

RETRACTION USING TAD'S

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