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Temporary Anchorage Devices – A Review

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ABSTRACT:

Temporary Anchorage Devices (TADs) are innovative orthodontic tools used to facilitate the movement of teeth in a controlled manner. These devices, which include mini-implants, plates, and screws, serve as stable anchor points, making application of forces to teeth without the need for traditional anchorage methods, such as adjacent teeth. The use of TADs enhances the precision of tooth movement, reduces treatment duration, and improves overall treatment outcomes for patients with complex dental issues. This review elaborates on the types, applications, and advantages of TADs in modern orthodontics, emphasizing their role in advancing clinical practices and patient satisfaction.

KEYWORDS: MINISCREW, IMPLANT, ANCHORAGE, MINI-IMPLANT, TAD

INTRODUCTION:

A temporary anchorage device (TAD) is a device that is temporarily fixed to the bone to enhance orthodontic anchorage either by supporting the teeth of the reactive unit or by obviating the need for the reactive unit altogether and is subsequently removed after use.

In modern orthodontic protocols, temporary anchoring devices, or TADs, have found widespread use in treating nearly all malocclusions, whether they result from a dentoalveolar component, a skeletal component, or a mix of the two. By using bone as an anchor unit, TAD flexibility has opened up new treatment possibilities for orthodontics. The path of TADs through Kuhn's paradigm is explored in this review, starting from its modest origins in animal research and progressing to case reports, randomized control trials, and meta-analyses.

The scientific field of orthodontics has also gone through Kuhn's "Paradigm Shift/Revolutionary Period." Some examples of this include cephalometry, bonding agents, pre-adjusted brackets, aligners, 3D diagnostic aids, CAD/CAM applications, and temporary anchorage devices (TADs). All of these advancements and improvements have unquestionably contributed to "steadfast advancements" and "greater improvements" in the development of "treatment strategies."

Kuhn's 'Paradigm shift' and its relevance to temporary anchorage devices(TADs) :

The emergence of TAD essentially reflects Kuhn's "paradigm shift/revolutionary stage" philosophy in spirit as well as truth, with a crucial shift in providing the "hard fact" that TAD gives us an "absolute anchoring" which was previously inconceivable by any other contemporary anchorage modalities.

Figure 1. Kuhn's 'paradigm cycle' explains the different phases of TADs. [1]

Classification:

Implants were categorized by Labanauskaite et al. as follows:

- *According to shape and size*

a. Conical (cylindrical)

- miniscrew implants

- Palatal implants

- Prosthodontic implants

b. Miniplate implants

c. Disk implants (onplants)

- *According to implant bone contact*

Fig. 2: Types of mini-screws. [3]

a. Osseointegrated

b. Non-osseointegrated

- *According to the application*

a. Orthodontic implants

b. Prosthodontic implants

- *The implantable anchorage devices can also be classified based on the types of anchorage device*

1. Conical (cylindrical)

✓ miniscrew implants

✓ palatal implants

✓ prosthodontic implants

2. Mini plate implants

3. Disc implants (onplants)

Indications for the use of TADs

1. Absolute anchoring with the highest possible retraction limits.

2. TADs are a good alternative for anchoring in patients who refuse to wear headgear.

3. TADs can serve as anchors and assist in wise space management if the first molars are lacking.

4. For challenging dental movements such as molar uprighting, en masse distalization of the upper and lower arches, anterior/posterior intrusion, and molar distalization.

5. For intricate tooth movements in adult orthodontics.

6. If anchorage units are not available, TADs can also be utilized to attach orthopedic forces to jaws.

7. Correction of the cant of occlusion and midline asymmetry.

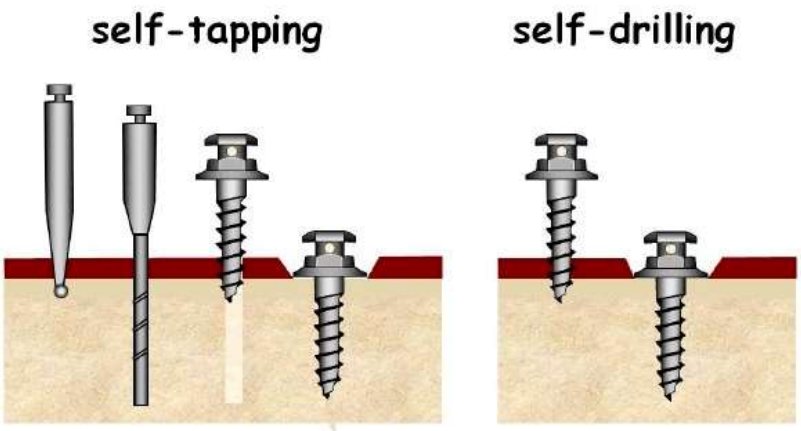
Implant Driving Method

There are two methods of placement of mini-implants.:

1 Self-tapping method: This technique taps the implant during implant driving by forcing the mindscrew into the bone tunnel created by drilling. When using mini-screws with small diameters, we employ this technique.

2. Self-drilling method: Here, the mindscrew is drilled straight into the bone. When using mini-screws with a bigger diameter (greater than 1.5 mm), this procedure can be applied.

Fig. 3: Screw selection-self drilling and self-tapping



Sites for mini-screw placement:

Mini implants are frequently positioned in the mandibular and maxillary arches' interradicular gaps. Implant insertion is thought to be best done in inter radicular locations, particularly the mandible and posterior maxilla, to enhance the horizontal component of applied force and avoid root injury. Except for the area distal to the maxillary second molars, where the buccal cortex average was thin, Baumgartel and Hans observed that the buccal cortical bone was thinnest in the anterior sextants of both jaws and gradually increased towards the posterior region.

Because of the minimal bone and wisdom teeth present, it is not advised to insert mini-screws in the maxillary posterior region above 8–11 mm from the gingival border to prevent injury to the sinus and the tuberosity region.

It is typically advised to place implants at the palatal site as opposed to the buccal side. To enable lengthier screw insertion, screws are placed in the maxilla at an angle of between 30 and 40 degrees. The mandibular space between the first and second molars and the first and second premolars is the safe zone for implant insertion.

Loading of the implant:

Orthodontic miniscrews can be immediately loaded with light forces, in contrast to dental implants. In certain cases, the implant may migrate during orthodontic loading, thus it's best to provide at least 2 mm of space between it and the neighboring tooth root.

Immediate vs delayed loading:

- Immediate loading:

-The orthodontic forces are applied to the micro implant as soon as it is placed, usually on the same day.

-When initial bone-to-implant contact (primary stability) is sufficiently obtained during implant placement, it is the preferred outcome.

- Immediate loading can shorten treatment duration, but to prevent implant failure, cautious case selection is necessary. Delayed Loading:

- In delayed loading, After a healing phase that typically lasts a few weeks to a few months, forces are applied. This improves implant stability and permits osseointegration, or the formation of bone around the implant.- In regions with poor bone quality or when primary stability is subpar, delayed loading is employed.

Implant removal:

The miniscrew can be removed using the same screwdriver with or without local anesthesia. Normally, the wound after implant removal does not require any special treatment and heals uneventfully. In case the screw cannot be retrieved during the removal appointment, it is advisable to wait for 3 to 4 days. The microfractures or bone remodeling caused due to the initial attempt will loosen the screw. In case of implant fracture during removal, a small surgical procedure may be required for removal. [4]

Problems encountered with Mini-implant:

Screw-related problems

- If a screw is too small or the neck area is not robust enough to support the force of removal, the screw may break.
- Selecting a conical screw with a sturdy neck and a diameter suitable for the bone's quality is the answer.
- If there is any unevenness in the transmucosal section, infection may occur around the screw.
- The physician can choose a screw system that is appropriate for the specific implant site if one with different neck lengths is employed.

Operator-related problems

- When inserting a self-drilling screw, applying too much pressure can break the screw's tip.
- A screw can loosen if it is overtightened.
- As soon as the smooth portion of the neck reaches the periosteum, it is imperative to cease twisting the screw.
- The ligature should be positioned on top of the screw in the slot perpendicular to the wire using a screw head that resembles a bracket.
- If the patient turns the ligature around the screw, the area will never be able to be free of irritation.
- It's crucial to remove the screwdriver from the screw head without wriggling it. If the lengthy extension is taken off before the area around the screw, the screwdriver won't stick.

Patient-related problems

- When the trabecular bone density is low and the cortex is thinner than 0.5 mm, the prognosis for primary stability of a mini-implant is poor.
- Patients with thick mucosa will have a larger force application moment because of the increased distance between the screw's center of resistance and the point of the force application.
- When the trabecular bone density is low and the cortex is thinner than 0.5 mm, the prognosis for primary stability of a mini-implant is poor.
- Patients with thick mucosa will have a larger force application moment because of the increased distance between the screw's center of resistance and the point of force application.

- Even when primary stability has been achieved, loosening may still occur if a screw is positioned in an area where there has been extensive bone remodeling as a result of either post-extraction healing or the resorption of a deciduous tooth.
- Mini-implants should not be administered to patients who have systemic alterations resulting from disease, medication, or heavy smoking that affect bone metabolism.

Limitations of TADs:

Orthodontic implants should not be used in patients with systemic bone problems or in situations where their health is compromised. TAD placement is not recommended for patients under the age of 12 who have not yet finished their skeletal growth. Miniscrews should not be positioned next to deciduous teeth or in parts of the bone that are undergoing remodeling, such as repairing sockets. One restriction on miniscrew placement is thin cortical bone measuring less than 0.5mm. A critical component of implant usage is the clinician's expertise. One limitation is the invasive nature of the technique, which raises ethical concerns.

CONCLUSION:

Temporary anchorage devices (TADs) offer robust and consistent attachment for a variety of procedures, revolutionizing orthodontic treatments. These tools, which might be plates, screws, or mini-implants, assist lessen the need for cumbersome appliances like headgear, resulting in more pleasant and effective therapy.

In conclusion, TADs offer several advantages:

1. Increased Treatment Flexibility: They make complicated orthodontic procedures easier to handle by enabling more exact control over tooth movement.
2. Less Need for Patient Compliance: TADs provide a more independent solution than conventional techniques, which may rely on patient participation.

3. Enhanced Efficiency: Treatments can frequently be finished faster and with fewer modifications when using TADs.

4. Minimised Side Effects: When TADs are utilized correctly, they can assist limit undesired motions and lower the chance of causing tissue damage.

Overall, the integration of TADs into orthodontic practice represents a significant advancement, contributing to more effective, comfortable, and patient-friendly orthodontic care.

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