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International Journal of Current Research
Vol. 5, Issue, 12, pp.4265-4267, December, 2013

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

REVIEW ARTICLE

TEMPORARY ANCHORAGE DEVICES: IMPLANTODONTICS IN ORTHODONTICS

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ARTICLE INFO

Article History:
Received 10th September, 2013
Received in revised form
17th September, 2013
Accepted 19th October, 2013
Published online 25th December, 2013

Key words:
Temporary anchorage devices,
Orthodontics, Malocclusion.

ABSTRACT

The term Temporary anchorage devices presents professional dilemma in the field of orthodontics. Though there are many anchorage devices which are used in the treatment of various malocclusion by orthodontist, Temporary anchorage devices has been recently widely accepted. These devices compose a broad array of implants used to support orthodontic treatment. This article reviews about the various aspects of temporary anchorage devices in the field of orthodontics.

INTRODUCTION

Patient compliance, anchorage preservation and lack of anchor units often present a perplexing problem in the field of orthodontics. There are various anchorage devices which can be used by an orthodontist such as headgears but drawback of these appliances is the patient compliance. Most current miniscrews are titanium or titanium alloy and are manufactured with a smooth, machined surface that is not designed to osseointegrated. Thus, most TAD's are removed after orthodontic treatment. At present, the most common TAD's include miniscrews, microscrews, palatal implants, retromolar implants as well as functionally loaded prosthetic implants. Therefore, TAD's can range from non-integrated miniscrews to implant supported prostheses with temporary orthodontic attachments. Temporary anchorage devices have developed into important orthodontic adjuncts for expanding the scope of biomechanical therapy and enhancing clinical outcomes (Giansforth *et al.*, 1954; Gray *et al.*, 1983). Computed tomography can provide a fully reconstructed 3D model of the maxilla and the mandible as well as additional diagnostic information on dental root positioning, morphology of sites for TAD placement.

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History of orthodontic implantable devices

First orthodontic TAD dates back to 60 years where it was placed in the mandible of dogs. Gainsforth (Giansforth *et al.*, 1954) placed cobalt-chromium alloy screws in the mandibles of dogs as anchors for the application of orthodontic forces. Gray *et al.* (1983) examined the movement of bio-glass coated and vitallium endosseuos implants loaded with constant orthodontic forces in the femurs of rabbit. Other orthodontic TAD were developed in the early 1990's. Kanomi (1997) described the use of small Ti bone screws for orthodontic anchorage. In 2005, Kim *et al.* (2005) described the use of drill free screws in which 32 screws were inserted into the jaws of two beagles.

Uses of tad's in orthodontics

Temporary anchorage devices (TADs) for orthodontic anchorage are widely accepted. They are changing the way orthodontists treat some patients' malocclusions. The two main groups are 1) miniplates with various transmucosal extensions (Umemori 1999) and 2) Single screws or mini implants. Melson and Verna (2005). TADs provide a fixed point from which to apply force to move teeth. They can be placed in many different sites in the mouth. Placement is customized for each patient. TADs may contribute to predictable results, shorter treatment time and completion of active treatment on schedule. Kesling considered the following problems purported to be solved by miniscrews are actually caused by treatment:

1) Deepening of the anterior bite when closing posterior spaces.
2) Difficulties associated with intruding anterior teeth and correcting dental midlines.
3) Need for heavy forces to overcome sliding and active friction and to correct Class II and Class III interarch discrepancies.

Limiting skeletal anchorage to patients who can truly benefit results in the following indications

1) Patients with insufficient teeth for the application of conventional anchorage. (Fig. 1)
2) Patients in who forces to the reactive unit would generate adverse effects.
3) Patients with a need for asymmetric tooth movement in all planes of space.
4) In select patients as an alternative to orthognathic surgery.
5) As anchorage for tooth movements to generate bone for dental implant.

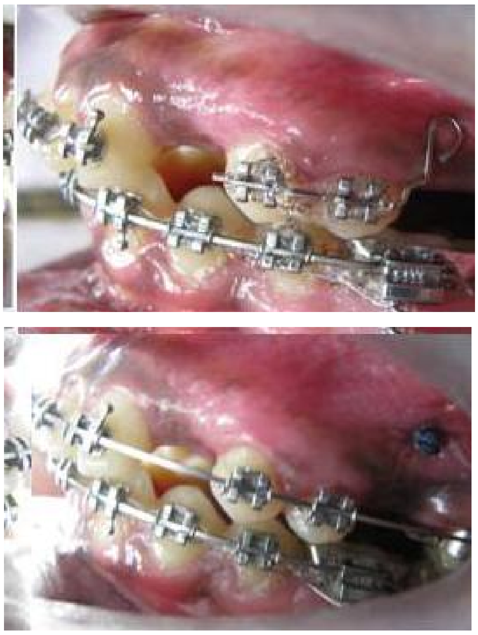

Fig 1. Mini – Implants placed for retraction in the case missing first molat tooth

Orthodontic forces applied to anchorage devices

When we review the literature comparing the loading protocols for osseointegrated and mechanically retained orthodontic TAD's, 11 articles met selection criteria. In the five studies with osseointegrated TAD's (Ohashi *et al.* 2006), the no-load healing period was 2 to 12 months and the range of applied orthodontic forces was 80 – 550 g. In the six studies with mechanically retained TAD's four applied orthodontic forces immediately after TAD insertion two applied force after two weeks. The orthodontic forces are used for both osseointegrated and mechanically retained TAD's. Freudenthaler *et al*. (2001) described one of the first reports on immediately loaded, mechanically retained orthodontic TADs

Drugs that may eefect anchorage devices: cyclooxygenase-2 inhibitors

COX is the rate limiting enzyme responsible for the conversion of archidionic acid onto prosthoglandins. In Animal models, inhibitors of COX-2 cause a delay in fracture healing (Radi And Khan 2005).

Bisphosponates

They are two classes of drugs that inhibits the resorption of bone. Administered orally or intravenously, the two classes of bisphosphonates are nitrogenous and non-nitrogenous. Though they do not seem to interfere with osseeointegration of Ti-implants in animal models (Chacon *et al.,* 2006) and may even increase bone implant contact and removal torque in animal models with reduced bone mass. Duarte *et al.* (2005) In addition, the American Society of bone and mineral research recommends that in osteoporosis patients taking bisphosphonates, "dental surgery should be limited to that required for good dental health and undertaken only when conservative non-surgical therapies are either not appropriate or ineffective". (Shane *et al.,* 2006) Therefore placement of TAD's in patients taking nitrogenous bisphosphonates for osteoporosis is inadvisable.

Minicrew success and failures

Three factors are critical for the prolonged stability of the minicrew: 1) miniscrew design 2) proper insertion site and 3) careful operation. In 1999, Park and Kim (1999) reported a success rate of 82% after 5 months of observation. In 2003 a 93% success rate was reported during a 15.8 month observation period. Other studies have shown a similar level of success (Miyawaki *et al.,* 2003).

Types of failures

1) Fracture occurs resulting from thin screw diameter or low strength in screw neck area which will be submitted to greater stress at removal.
2) Infection around the screw because not all the transmucosal part has a smooth surface.
3) In case of self drilling screws, excessive pressure is used at the start of the insertion, leading to fracture of the cutting tip.
4) The screw is tightened excessively. Once the smooth party has reached the periosteum,it is crucial to stop turning screw, otherwise it will become loose.
5) Loosening occurs resulting from "wiggling" forces during insertion because of faulty handling of the screwdriver or during removal of the screwdriver,
6) Too little bone present. In patients with cortical thickness less than 0.5 mm and low trabecular bone density, primary stability cannot be obtained.
7) In patients with thick mucosa, the distance between the point where force is applied and screws centre of resistance is increased: thus a large momentum is generated.
8) The patient has a systemic alteration in the bone metabolism because of disease, medication use, or heavy smoking.

Conclusion

The role of the TAD's in orthodontics is more than a replacement for other anchorage devices for class II/III elastics, headgear or patient compliance. It expands the spectrum of orthodontics to orthognathic-like orthodontics, new territories, where clinicians need to be aware of the migration of miniscrew, biological boundries that encompass risk of fenestration, treatment period, apical root resroption and post treatment relapse.

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