Understanding Skeletal Anchorage in Orthodontics: A Review

Manisha Khanna[1], Tarun Kumar[2], Santosh Kumar[3], Archana Jaglan[4], Renu Yadav[5]

Post Graduate Student[1]
Department of Orthodontics,
Faculty of Dental Sciences,
SGT University,
Gurgaon, Haryana, 122505
Professor and Head[2]
Department of Orthodontics,
Faculty of Dental Sciences,
SGT University, Gurgaon,
Haryana, 122505,
Professor[3]
Department of Orthodontics,
Faculty of Dental Sciences,
SGT University, Gurgaon,
Haryana, 122505,
Assistant Professor[4]
Department of Orthodontics,
Faculty of Dental Sciences,
SGT University, Gurgaon,
Haryana, 122505,
Post Graduate Student[5]
Department of Orthodontics,
Faculty of Dental Sciences,
SGT University, Gurgaon,
Haryana, 122505

Abstract

The aim os this review article is to obtain a basic insight on different types of skeletal anchorage used in orthodontics. The aim is to gain absolute anchorage and to avoid any unfavourable tooth movement in the name of anchorage loss. There are many devices available some of which are anchorage from the zygomatic bone, Miniplates Miniscrews and mid palatal implants. By eliminating the unpredictable reactions of periodontal anchorage, the potential of skeletal anchorage offers the practitioner complete control of anchorage and expands the current orthodontic treatment spectra, reducing unwanted side effects.

Key words: Skeletal anchorage, Miniscrews, Absolute anchorage, mini plates, zygomatic anchorage

Introduction

In orthodontics when a tooth is moved in a desired position some unfavourable movement occurs complying to the Newton's third law of motion ' every action has an equal and opposite reaction.' Anchorage is the resistance to displacement provided by a unit when used for movement of tooth. This can be easily explained by the unwanted forward movement of the maxillary posteriors when the anteriors are moved posteriorly according to Graber.[1] Different cases require different anchorage. The different types of anchorage are-simple, reciprocal and stationary depending upon the application of force. According to the anchorage demands it can be classified into maximum (type A anchorage), moderate (type B anchorage), minimum (type C anchorage) and Absolute anchorage.

1. Absolute Anchorage

Here, the anchorage unit is prevented from any kind of unwanted forward movement. There has been intro-duction of different types of absolute anchorage over the past years-Temporary Skeletal Anchorage Devices (TSAD) also called mini-screws. They are screwed into the alveolar process and provide skeletal anchorage.[2]

Types of Skeletal Anchorage

It is an absolute anchorage provided by the bone causing no unfavourable tooth movements.[3] Listed below are come skeletal anchorage systems: 1. Zygomatic anchorage 2. Miniplates 3. Mid palatal implants 4. Mini screws or TADS

1.1 Zygomatic Anchorage

The use of micro implants and mini plates has now been incorporated into day to day practice for the purpose of absolute skeletal anchorage. Titanium miniplates were positioned in the zygomatic region for absolute anchorage by **Erverdi et al**[4] and Sherwood et al[5] . Zygomatic anchorage was also used by **De Clerck et al**[6] to move the upper teeth posteriorly. This was done by developing a zygomatic anchorage system. The mini-plates were fixed with three Miniscrews at a distance from the molar roots. The inferior border of the Zygomatic buttress was considered between the two molars which caused the centre of resistance os the first molar to be near the point of force application.

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Corresponding Author:

Manisha Khanna
Post Graduate Student
Department of Orthodontics,
Faculty of Dental Sciences
SGT University, Gurgaon,
Haryana, 122006,
Email: manishakhanna16@gmail.com

The concluded that it was useful since the forces cam be applied right after the installation of the plates. As a result the zygomatic anchorage System appears to be a good substitute for the traditional skeletal anchorage extra-orally.

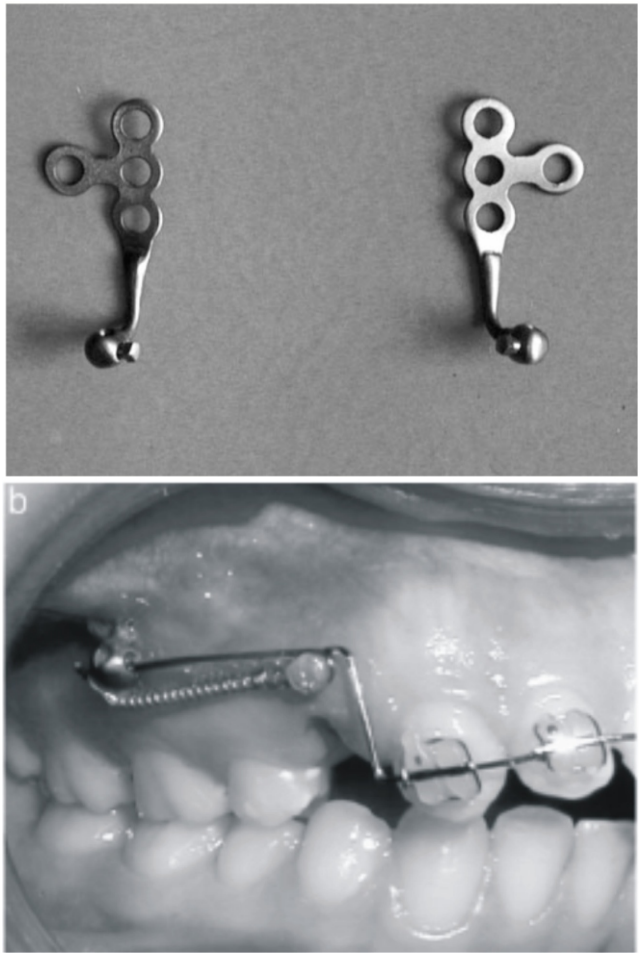

Figure 1: a) zygomatic implants, b) placement of zygomatic implants intraorally[26]

1.2 Miniplates

Sugawara introduced the use of titanium Miniplates and mono cortical screws implanted into the maxilla or mandible that provided absolute skeletal anchorage. It was termed as Skeletal Anchorage Systems (SAS).[7] Beyond the capabilities of modern mechanics, the dento alveolar complex can be remoulded using Mini plate.[8] The dento alveolar complex can be modified with mini plate in ways that conventional mechanics cannot. Miniplates also enable repositioning of the bone and growth regulation; by transferring orthopaedic stresses directly to the facial skeleton, thereby minimising the unfavourable side effects. The Miniplates are the most beneficial when it comes to the expected and planned intrusion and distalization of upper and lower molars.[9] There are 3 parts of a miniplate- head, body and arm. According to the way the teeth move and the direction of the hooks, there are two sorts of head portions.[10] The head segments are used to attach the coil springs, modules or elastics and for placing of auxiliaries. The implantation site, bone density (two or three screws), the depth of the buccal sulcus, and the facial typology are the factors considered while choosing the length of the stem and type of miniplate- I, Y OR T- Plate.[8] Some advantages include: 1. When it comes to skeletal anchorage, Miniplates are one of the most firm systems available 2. They do not require patients to be compliant, unlike other extra oral anchorage. 3. They are positioned far from the teeth hence do not hinder orthodontic tooth movement 4. Movement of molars is relatively easy without the loss of anchorage 5. Surgery is nor required in cases where occlusal plane adjustments are needed 6. Overall helps in non extraction and Orthognathic Surgery cases On the other hand, acute infections are one of the most common complications, characterised by discomfort, edoema, and pus production at the site of implantation of the miniplate. Additionally, mucosal outgrowth over the miniplate head and very infrequent numbness are potential concerns.[11,12] Miniplates have allowed the treatment time to be reduced and opened up new possibilities for orthodontic treatment. It reduces reliance on patient compliance and help with non extraction cases and orthognathic surgery.

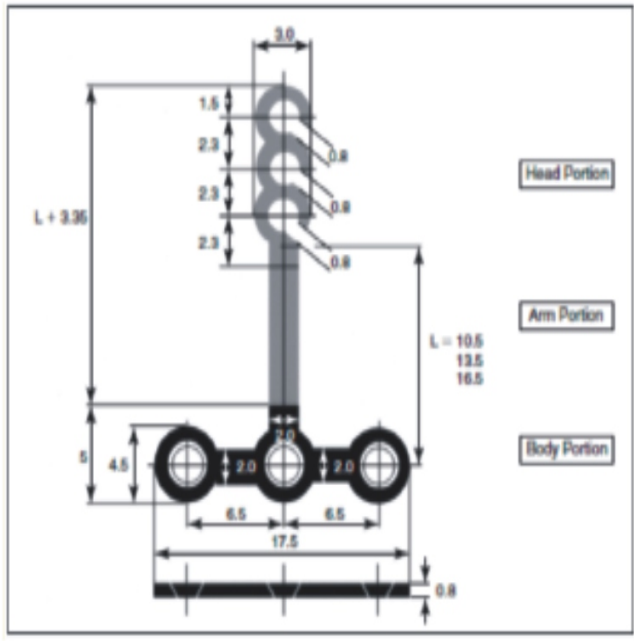

Figure 2: T type mini plate design[25]

1.3 Mid Palatal Implants

Because of the more porous nature of the maxillary bone, miniscrews placed in the maxilla are less stable than those placed in the mandible. But because it is made of solid cortical bone, the midpalatal suture area has been identified as the optimum anchorage site in the maxilla. [13] but also the quantity and quality of the cortical bone influence the stability of the implants placed Also in terms of soft tissue characteristics, the mid palatal area is made up of thin and keratinised tissue making it more favourable than the thick tissue found on the palatal slope for implant placement.[14] A one-mm uniform soft tissue thickness was also noted by Yun et al in the mid-palatal region, four mm posterior to the incisive papilla. Therefore, the midpalatal region's soft tissue is ideal for miniscrew implantation.[15] The distance of the screw from the teeth is a spatial limitation that was overcome by using extension arms in conjunction with miniscrew insertion. Additionally, by splinting two miniscrews together, screw stability was increased even further in a case report done by **Jong-Suk Lee et al.**[14] Mid palatal implants have hence become a promising technique to increase the anchorage in orthodontic treatment.

Figure 3: Trans palatal arch with mid palatal implants[27]

1.4 Temporary Anchorage Devices Or Mini Screws

The TADS or orthodontic Miniscrews or mini implants are smaller than the prosthetic implant and the dimension is up to 10 mm in length. 16 Compared to prosthetic dental implants, the surfaces of orthodontic mini-implants are flatter and more finished. The explanation is because orthodontic mini-implants rely on mechanical retention for retention rather than osseointegration with bone. Under local anaesthetic, they can be placed in the dentist chair. The majority of modern orthodontic mini-implants self-drill, eliminating the need for a pilot drill during placement.[17]

By exerting the required effort, orthodontic mini-implants can be loaded right away. After serving their intended purpose, orthodontic mini-implants can be taken out by grasping the head of the mini screw and unscrewing it with a driver. Mini-implants were initially used to acquire the most anchoring possible in the Antero-Posterior dimension, which was not possible using conventional techniques.[18] but to the resent day, Miniscrews are being used for orthodontic movements other than those in the anterior-posterior direction. Some of these uses include the treatment of open bite with the insertion of posterior teeth and the treatment of impactions with the eruption of teeth using orthodontic mini-implants. Additionally, orthodontic mini-implants are utilised in conjunction with mini-implant-based expanders to widen the restricted maxilla (MARPE)[19] The major advantage of using Miniscrews is the high rate of acceptance in patients since they are inserted intra orally The Headgear appliance or the Nance appliance are typically used to provide orthodontic anchorage in the anterior posterior dimension[20]. However, orthodontic mini-implants are more successful in the for anchoring reinforcement due to compliance concerns with headgear and the inefficiency of the Nance appliance [21]. It can be utilised to achieve direct anchorage in which the orthodontic mini-implant applies force from the retraction to the teeth in front when implanted between the premolar and molar region. A power arm on the front teeth or the brackets themselves can both receive the retraction force. Molars can be distalized using TADS in Class II malocclusion cases. When distalization is performed with traditional appliances, the anterior teeth experience an equal and opposite force that causes them to procline. Mini-implants prevent side effects such anterior teeth Figure 3: Trans palatal arch with mid palatal implants[27] proclination since the anchorage is not acquired from the teeth in front but rather from the mini-implants that are placed in the bone [22]

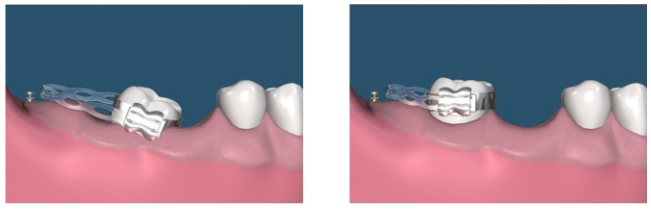

Figure 4: Molar distalization with mini screws a) before distalization b) after distalization

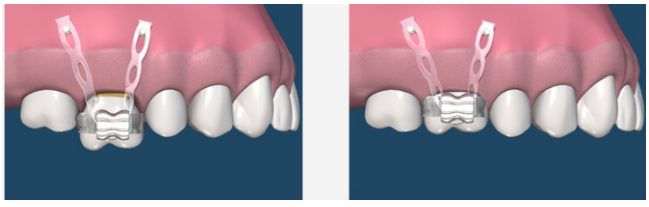

Figure 5: Molar intrusion with mini screws a) before intrusion b) after intrusion

Mini screws help in correcting maxillo mandibular discrepancies in the vertical dimension like anterior open bite where the usual treatment requires the extraction of pre molars, extrusion and retraction. Mini-implants offer non-surgical alternatives for treating anterior open bites. To exert an intrusive force on the molars and pre molars, orthodontic mini-implants can be placed in the buccal mucosa. Additionally, mini-implants can be utilised in the palate to exert orthodontic stresses for the insertion of posterior teeth and the treatment of an anterior open bite.[23,24] Expanders can be used in conjunction with mini-implants to strengthen anchoring and lessen dental side effects (known as MARPE, or mini-implants supported rapid palatal expansion)[18]. Mini-implants supported expansion has been shown to support orthopaedic expansion to a greater extent than traditional expansion. Furthermore, long-term research indicates that expansion aided by a mini-implant has no negative consequences on the temporomandibular joint. Midline correction due to premature exfoliation of the deciduous tooth can also be done through mini implants. With the diverse range of uses of mini implants in orthodontics Mini-implants are anchorage enhancement devices that are secure, less traumatic, and can be used to supplement orthodontic anchorage with no patient compliance. To treat orthodontic malocclusion in the anteroposterior, vertical, and transverse dimensions, mini-implants can be inserted at various places in the maxilla and mandible. Future research on the long-term effects of mini-implants in orthodontics will be necessary to advance our understanding of their efficacy and the rate of relapsing.

Conclusion

The various techniques of Skeletal Anchorage has primarily transformed the possibilities and treatment approaches for orthodontics. The use of absolute anchorage in causing orthodontic movements and reinforcing anchorage for the desired results have provided high rates of patient acceptance to orthodontic treatment and relatively reduced treatment duration. With these skeletal anchorage options it is now easy to treat adult cases, patients who desire re treatment and other complex orthodontics problems. Complications are always associated to such invasive techniques but it is necessary to evaluate the risks and advantages in each specific situation to justify their usage and obtain informed consent.

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