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Leonardo Pereira Alexandre
IBO- Belo Horizonte, Minas Gerais, Brazil

Letícia Nava Lopes Cançado
IBO- Belo Horizonte, Minas Gerais, Brazil

Claudio Renato Jordão
IBO- Belo Horizonte, Minas Gerais, Brazil

Corresponding Author:
Leonardo Pereira Alexandre
IBO- Belo Horizonte, Minas Gerais, Brazil

Absolute orthodontic anchorage: A brief review

Leonardo Pereira Alexandre, Letícia Nava Lopes Cançado and Claudio Renato Jordão

Abstract
There are many types of orthodontic movements that make the clinical routine a real challenge. With the arrival of the skeletal anchorage, it became easier to solve many problems, such as anchorage, tipping, intrusion among others. The purpose of this article was to review absolute anchorage, including indications, implantation site, and any type of orthodontic feature.

Keywords: Skeletal anchorage, mini implants, intrusion, tipping, mandibular shelf, miniplates

Introduction

Since the beginning of orthodontics, anchorage problems have been a major challenge in the clinical routine. It has always been necessary to use an efficient system to improve the overall correction of many types of malocclusions.

It has been found, however, that the teeth selected for the anchorage often move simultaneously with those in which movement is desired and that little or no effect can be produced on the basal bone because of the instability of teeth when used for the purpose of anchorage. Since teeth have been found to lack sufficient stability to produce certain changes desired in the dentures and basal bone, some other source of resistance has become desirable. Therefore, it was thought that if anchorage could be gained from a point within the basal bone, stability would be greatly increased [1].

The first absolute system of anchorage was performed by B. L. Gainsforth and Higley [1] in 1945. They used vitallium screws in mongrel dogs to create absolute anchorage for tooth movement. Orthodontic anchorage is defined as resitence to undesired tooth movement [2].

Skeletal anchorage involves implanting surgical screws, mini-plates, or prosthetic devices into the bone and using them for absolute anchorage. Among various implants, mini-screws are widely used because they are relatively simple to insert, and force can be applied to them almost immediately. Other advantages include fewer limitations of the implant site and lower costs [3].

In the anteroposterior dimension three anchorage situations are traditionally defined by the ratio of incisor retraction to molar protraction. While moderate anchorage entails reciprocal space closure, maximum anchorage means that most of the space is closed by retraction of the incisors, and minimum anchorage means that most of the space is closed by protraction of the buccal segments. Absolute anchorage, when the anchorage units remain completely stationary, is sometimes desirable but is usually unattainable with traditional orthodontic mechanics. Therefore, over the past 60 years, methods have been developed to create absolute skeletal anchorage and thus widen the scope of orthodontics [3].

Based on the present results, TAD-anchored MP might have greater effect of maxillary advancement. Some side effects are reduced by TAD-anchored MP, such as mandibular rotation, extrusion of maxillary molars, and proclination of maxillary incisors [4].

With the use of dental implants, miniplates, and screws as anchorage, the distal movement of the anterior teeth or posterior teeth (or both) without anchorage loss has become possible. Among these devices, the microscrew implants have the advantages of easy placement and removal, with minimal anatomical limitations because of their small size and low cost [5].

According to Papadoullus [6], there are two types of miniscrew implants and they can provide two types of anchorage: direct and indirect. When used for indirect anchorage, they

are connected through bars or wires to the reactive unit, whereas when used for direct anchorage, they directly receive the reactive forces by acting as an anchor unit.

Different sites have been used for mini-screw insertion: palatal bone, the palatal side of the maxillary alveolar process, the mandibular retromolar area, the infrazygomatic crest, the maxillary and mandibular bucco alveolar cortical plateand the posterior palatal alveolar process. Recently, the mandibular buccal shelf (MBS) has been proposed as a suitable extra-alveolar mini-screw insertion site. The MBS is located bilaterally in the posterior part of the mandibular body, buccal to the roots of the first and second molars and anterior to the oblique line of the mandibular ramus [7].

Skeletal anchorage with temporary anchorage devices (TADs) has been widely incorporated into orthodontic treatment for expanding the boundary of tooth movement without patient compliance. TAD skeletal anchorage is especially useful for treating malocclusion with vertical problems such as openbite and overerruption of teeth due to loss of antagonists. Traditionally, skeletal openbite requires aggressive surgical impaction to reduce the maxillary dentoalveolar height. Super-erupted teeth were usually corrected by endodontic intervention and crown restoration at the expense of tooth vitality before TAD skeletal anchorage became popular. However, orthodontic intrusion with TAD skeletal anchorage provides a conservative treatment approach with little irreversible damage if patients can accept a longer treatment time [8].

Indications

Rapid Maxillary expansion

The palate constitutes a site of choice for the insertion of miniscrews for orthodontic purposes. The thickest part of the palate is the anterior part of the palate. The bone thickness in the posterior region of the palate is also suitable for the insertion of screws of appropriate thickness [9].

Rapid palatal expansion might be recommended for patients at the final pubertal growth stage, in addition to adult patients with maxillary constriction. It represents a treatment solution that can potentially avoid surgical intervention. When performed in association with rapid palatal expanders, it might enhance the skeletal effects of the latter. Of the various designs of expansion appliances, MARPE (miniscrew-assisted rapid palatal expander) has been modified in order to allow its operational advantages and outcomes to become familiar in the clinical practice [10].

Tooth-borne expanders are the commonly used treatment option to correct narrow maxillary arches. However, they often cause dental tipping, root resorption, and periodontal damage. Mommaerts [11] introduced a bone-borne technique to prevent these side effects (TPD distractor). However, some studies have reported that these distractors are associated with a high risk of root lesions or infections. Mini-implants have attracted considerable attention in recent years, since they are less invasive, low in cost, and easy to use clinically. More recently, expansion appliances have been developed that use palatal mini-implants, minimizing the forces that are placed on the teeth. Implant-supported rapid palatal expansion has been developed to maximize skeletal expansion and minimize the dental side effects [12].

Tooth intrusion

Intrusion has been a great dare during orthodontic movimentation. A supraerupted molar is one of the most common clinical findings in adult patients and is due to the consequences of not replacing a missing posterior tooth. While 18% of the patients have no demonstrable supraeruption, 82% may require clinical approaches before replacement of the lost tooth in the opposing arch because of interocclusal space challenges.1 In addition, supraeruptions greater than 2 mm occur in 24% of unopposed teeth.1 For treatment of supraerupted teeth, the most common conventional approach has been restoration in conjunction with intentional root canal treatment if needed [13].

The overeruption of maxillary molars usually results from early loss of antagonistic teeth. The elongated dentoalveolar process may cause problems of occlusal interferences and functional disturbances and may result in great difficulty during prosthetic reconstruction.

In published incisor intrusion studies, the miniimplants are located in the anterior region between the central incisors, the central and lateral incisors, or the laterals and canines. Though the effectiveness of anteriorly placed mini-implant-assisted intrusion, mechanics have been investigated thoroughly, the information on root resorption of the incisors is limited, and no data has been published about incisor intrusion supported by posterior mini-implants [14].

Adult patients commonly present with one or more molars that have extruded into edentulous areas of the opposing arches. Adequate prosthodontic restorations may be difficult to place without first intruding the molars. Until the development of skeletal anchorage, 1 this was virtually impossible in cases with insufficient remaining anchorage units, such as periodontally compromised patients-especially when the extruded molars were in the lower arch [15].

Anteroposterior discrepancies corrections

Extra oral appliances has been rejected by the patients and their Family, because of it`s lack of aesthetics and also comfort. The mini implants are, nowadays, a great resource for these problems. They are very efficient for class II and Class III corrections, moving molars forward and backward, and so as the canines, leadind the patient to a class I relationship.

Nowadays, clinicians seek alternative anchorage protocols, which will not incorporate extraoral appliances and which will not require patient cooperation. Recent developments in the field of osseointegration have made possible the use of implants for orthodontic anchorage [16].

Therefore, their clinical applications have been expanded, and they have been adopted for distalization of the mandibular molars. The nature of absolute anchorage allows for retraction of the anterior teeth with simultaneous distal movement of the posterior teeth. However, the treatment effects of the microscrew implants have not been quantified [17].

Moderate to severe Class II malocclusions cannot only cause esthetic and functional problems but can also lead to psychological problems of varying intensity, depending on the amount of anterior-posterior discrepancy and its interaction with the related soft tissue structures. Treatment for the correction of Class II malocclusions in non-growing patients usually involves selective removal of permanent teeth, with subsequent dental camouflage to mask the skeletal discrepancy and provide a good facial balance. In moderate to severe malocclusions, orthognathic surgery can also be an option. Extractions can involve two maxillary premolars or two maxillary and two mandibular premolars. The extraction of only two maxillary premolars and anterior teeth retraction is generally indicated when there is no crowding or cephalometric discrepancy in the mandibular arch. While

retracting anterior teeth in a full cusp Class II malocclusion, anchorage control assumes profound importance because maintaining the posterior segment in place becomes very critical. A loss in molar anchorage cannot only compromise correction of the anterior-posterior discrepancy, but can also affect the overall vertical dimension of the face.

With the introduction of dental implants, miniplates, and microscrews as anchorage units, it has now become possible to obtain absolute anchorage for the posterior teeth and close the extraction spaces completely by anterior teeth retraction. However, there still seems to be a paucity of accurate scientific evidence pertaining to the treatment effects of skeletal anchorage in Class II malocclusions [18].

Treatment of Class III malocclusion in growing patients has been one of the most challenging orthodontic procedures in daily orthodontic practice. Numerous treatment protocols have been reported for correction of Class III malocclusion. In growing patients, interceptive approaches include removable functional appliances, chin cup, protraction headgear / facemask, and skeletal anchorage systems. The use of reverse functional appliances, including the Frankel III (FR-III) or reverse twin-block appliance, in cases involving Class III malocclusion have been reported in the literature; Loh and Kerr [19] reported the successful correction of a developing Class III malocclusion with the FR-III appliance [20].

Uprighting Molar position

Tooth loss can be a cause of inclinations of the others. So, mini-implants can be a good tool of uprighting teeth.

On the other hand, the impaction of lower third molars is a common clinical finding, with a prevalence between 9.5% and 39% among different populations. The uprighting of mesially tipped or impacted third molars would be an alternative to extraction, it is usually not feasible before debonding due to the late development of third molars. Skeletal anchorage offers the potential to upright molars separately with localized mechanics [21].

Anchorage system for extraction treatments

Extraction is still been used in orthodontic treatment plans, and the anchorage systems can be enhanced with the mini-implants and miniplates.

When managing low-angle patients with crowding in the mandibular arch, the extraction of teeth might be considered, but extraction may deepen the anterior overbite and make treatment more difficult. Alignment of the teeth without extractions may flare the incisors and deleteriously affect the facial profile. To minimize these problems, the mandibular molars should be distalized [22].

Traditionally, orthodontic treatment often involves the extraction of four first premolars and demands the least amount of anchorage loss, therefore headgear used to be an unavoid- able fate of these patients. Nowadays, along with the development of implant anchorage, more and more patients have benefited from the implant-aided orthodontic treatment, even escaped from orthognathic surgery. However, for extremely severe cases, orthodontists seem to still have to face the limitation of orthodontic treatment and turn to surgeons for cooperation. In this case, we will see how dramatic changes happened on an adult patient with severe bimaxillary dentoalveolar protrusion malocclusion after the orthodontic treatment with microscrew implants as the temporary skeletal anchorage with the patient's written informed consent, and then we may find with the help of microscrew implants orthodontists even may challenge the work of surgeons [23].

Open Bite treatment

Skeletal anterior open bite is a complicated malocclusion characterized mainly by overgrowth of the maxillary and mandibular posterior dentoalveolar heights, resulting in a longer vertical facial dimension and a steeper mandibular plane. It is difficult to decrease the heights of posterior dentoalveolar regions in the treatment of anterior open bite. Many methods have been introduced to intrude the posterior teeth, such as passive bite blocks, active bite blocks with magnets or springs, high-pull headgear, fixed appliances, and vertical elastics. However, these traditional techniques often cannot intrude the molars, especially in adult patients. Thus, surgical impaction of the maxilla is often the only way to obtain counterclockwise rotation of the mandible and a reduction of anterior facial height in adult patients with severe skeletal open bite. According to Chunle [24] the open bite treatment with mini screws is based on intrusion of posterior segment, that provide a stable skeletal anchorage to achieve molar intrusion. Skeletal open bite can be effectively corrected by this orthodontic treatment option without orthognathic surgery, especially in nongrowing potential borderline surgery patients.

Conclusion

Over the years, the use of skeletal anchorage has considerable increased: social problems, like bulling in young patient, when using extraoral appliances have led to the routine use of such features. Moreover, the mechanical resources when using the mini screws, buccal shelfs and miniplates, are immense and can reduce treatment time. In addition, there is an increase in patient comfort when using this system. Besides that, cooperation issues can possible be eliminated.

Nowadays the costs of the skeletal anchorage are affordable, making daily use of these devices much more common.

Finally, the absolute anchorage system is the key to successful of orthodontic treatment, avoiding complications such as instability and collateral effects of undesirable forces. The use of this type of treatment may provide greater control of orthodontic treatment.

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