



Orthodontic anchorage with mini-implants: A review

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Abstract

Mini implant based anchorage has shown increased popularity in past years. The applications of mini implants for management of malocclusion in different planes are described in this review. A detailed description of how to apply mini implants for complicated malocclusion has been provided in this review. This article introduces what is orthodontic anchorage and then describes how to use mini implants for orthodontic anchorage in situations when conventional mechanics cannot provide adequate anchorage control.

Keywords: orthodontics, mini implants, temporary anchorage devices

Introduction

The resistance to unwanted orthodontic tooth movement is termed as orthodontic anchorage. In the sagittal plane, the anchorage requirements are classified based on the amount of the anchorage loss (or forward movement of molar) and retraction of anterior teeth. This is especially important when the patient's malocclusion demands extraction and the extraction space needs to be utilized for the treatment. With maximum anchorage, anterior retraction is the major movement and there is only minor molar anchorage loss, with moderate anchorage an equal amount of molar anchorage loss and anterior retraction is expected, with minimum anchorage, the majority of space is closed by molar anchorage loss. Absolute anchorage is a term which conveys that almost no molar anchorage loss occurs, and maximum anterior retraction is achieved. This is beneficial in certain situations but cannot be achieved easily with conventional orthodontic treatment. With the help of mini-implants, the quest for absolute anchorage has been realized. The proper biomechanics for maintaining anchorage influence the results for orthodontic treatment. When there is unexpected anchorage loss, it leads to a compromised in the final result. Usually, with conventional mechanics in situations requiring high anchorage, utmost compliance with the anchorage appliances is required. The downside of such appliances is that only with high patient compliance, can good results be obtained. If the patient is non compliant with the appliances, then the results are compromised as well. Compliance is the one factor that increases the risk for failure. That is why, skeletal anchorage with mini implants has been introduced. The introduction of mini implants in orthodontics has broadened the scope of orthodontics tremendously^[1]. The absolute anchorage with mini implants in the early days were used for tooth movement such as retraction of anterior teeth, intrusion of anterior teeth^[2, 3, 4]. Different sites for the insertion of mini implants were reported in the orthodontic literature^[5-7]. In addition to mini implants, mini plates could also be used in orthodontics for complicated cases. Mini plates are inserted into the bone with the help of two to three or even more miniscrews. Mini plates are very stable in the bone and have very high success

rates^[8, 9].

The rise of utilization of mini implants in orthodontics has occurred due to the increased understanding of the effects of mini implants and the increased number of companies manufacturing mini implants. This review will describe the use of mini implants in orthodontic anchorage.

Indications for orthodontic anchorage with mini implants

Indications for use of mini-implants in Sagittal plane

Anchorage consideration is important in cases with severe crowding or severe proclination with lip incompetence. In such cases, mini implants can be used for retraction of incisors. In an extraction case, if mini implants are used for anchorage purposes, then the choice of tooth extraction whether first or second premolar, does not matter as the anchorage will be absolute and maximum retraction of incisors will be achieved regardless^[10]. In patients with Class II malocclusion and increased overjet, maxillary first or second premolars are extracted for the purpose of retraction of maxillary anteriors^[10]. Absolute anchorage will be beneficial in such cases as any anchorage loss in such situations would lead to compromised treatment results.¹¹ Also, the enmasse retraction procedure with mini implants may contribute to reduced treatment time.¹² In patients with missing lateral incisors who are treated with canine substitution, mini implants can be used for orthodontic management. Moreover, mini implants can aid in the protraction of posterior teeth so that the anteriors are not retracted. With mini implants, canine substitution is not only restricted to Class II or End-on class II molar relationship, but it can also be done for patient with Class I molar relationship. Mini implants can also be utilized for the protraction of molars, or posterior segment in cases of missing teeth, extracted teeth, and presence of extraction space. These options can also be performed in patients who cannot have or do not want prosthetic implants. For extraction and protraction of teeth, mini implants can be utilized in combination with aligner therapy to increase the anchorage control^[13]. Mini implants can also be used effectively for distalization of posterior teeth and preventing

the anterior flaring of incisors [14] The treatment of class III patients can be different based on the cervical vertebral skeletal maturation index identified on lateral cephalogram or CBCT [15]. When presented with CVMI stage 3 or lower, class III correction is favorable. Mini implants can also be used in patients Class III malocclusion. In Class III cases, intermaxillary elastics from mini implants in the mandible and maxilla to correct the negative overjet [16]. Intermaxillary elastics preceded by mini implant supported palatal expansion (MARPE) for correction of posterior crossbite have shown positive results for class III correction.¹⁶ Even in retention the correction of Class III is stable when corrected with this approach [16].

Indications for use of mini-implants for malocclusion in vertical plane: In patients with anterior open bite, maxillary posterior teeth can be intruded with the help of mini implants [17] This is useful for correcting the anterior open bite by causing the counter clockwise rotation of mandibular. In hyperdivergent skeletal pattern, this is useful as it could prevent the worsening of anterior open bite during the growth period [18]. Mini implants can also be used to prevent the eruption of mandibular posterior teeth [19]. In a few cases, a combination of the two approaches mentioned above can be used to control both maxillary and mandibular posterior segments in the vertical plane. When posterior teeth are difficult to intrude, osteoperforations can be made along the teeth for more effective tooth movement [20]. It has been shown that osteoperforations can lead to desired results for complex tooth movements [21]. Intrusion can also be performed for maxillary incisors using mini implants for patients with increased gum show or gummy smile. This would be beneficial in patients with deep overbite. In patients with increased curve of spee in the lower arch, mandibular incisors can be intruded using mini implants.²²⁻²⁴ The combination of the above two approaches can be used for the treatment of deep overbite. In some cases, the occlusal plane is canted on one side due to increased eruption of teeth on one side or due to asymmetry. In such cases, mini implants can be used to correct the asymmetry or occlusal canting [25].

Indications for mini-implants for Molar uprighting and other uses: In patients with missing teeth, the adjacent teeth tip into the space. Mini implants can be used to upright such tilted or tipped molars [26]. Mini implants can also be used for movement of a single tooth such as single tooth intrusion or single tooth extrusion. In patients requiring prosthetic implants, a major consideration is the amount of space available for insertion of the implant. In cases where the posterior tooth has extruded because it does not have any opposing antagonist teeth, mini implants can be used to intrude the teeth [27].

Indications for use of mini implants for malocclusion in the vertical plane in transverse plane: In patients with posterior crossbite, palatal expansion can be performed with mini implants. Mini implants can be inserted in the palatal region for the purpose of expansion [22]. Expansion appliance known as mini implant assisted rapid palatal expansion (MARPE) can be inserted with two or four mini implants. Expansion with mini implants or MARPE can also be useful in increasing the nasopharyngeal volume [28] Patients with crossbite on one side can be treated with mini implants on one side of the midpalatal suture in the palate [29] The type of palatal expansion appliance has an effect on the outcomes achieved with orthodontic treatment. Conventional

expansion appliances can be used only in young children and do not provide successful outcomes in late adolescents and adults [30] Mini implant supported expansion appliances can be used in patients in late adolescents or even older. Palatal expansion appliances such as MARPE have been shown to be safe and not cause side effects in the temporomandibular joint [31] The success rates of mini-implants have been documented in different studies. A recent study has shown that the success rates of buccal shelf mini-implants was as low as 20% and the success rates of palatal mini implants was as high as 91% [32] These high success rates or palatal mini implants make MARPE appliances reliable and clinically predictable.

Complex malocclusions are an orthodontic problem that need comprehensive diagnosis and a detailed treatment plan to correct. Maxillary incisor position in relation to upper lip is an important factor to determine the type of tooth movement to achieve [33, 34] Once the treatment objectives and treatment plan is setup, mini implants can be used to help in achieving those objectives. It is important to keep in mind that mini implant insertion and utilization is dependent on the clinician's skills [35, 36] The stability of mini implants in orthodontics has improved but there is still a lot of information not known about mini implants [37-39] Therefore, appropriate clinical skills and diagnosis for good indicators to use mini-implants is necessary for a successful outcome [40]

Conclusions

A range of mini implants are available to the orthodontists varying in size, diameter, and surface characteristics. A mini implant system that enables the orthodontists to perform a diverse range of functions. Mini implants can be used to treat the orthodontic malocclusion in sagittal plane, vertical plane, molar uprighting, and transverse plane. With proper understanding of applications of mini implants, orthodontists can managing complicated malocclusions in an effective manner.

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