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Review Article

Bone Anchored Maxillary Expansion and Bone Anchored Maxillary Protraction – A Review

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Abstract:

This review aimed to assess the effects of Bone anchored maxillary expansion (Miniscrew assisted rapid palatal expansion MARPE) and bone anchored maxillary protraction. Maxillary protraction is performed for cases with Class III with facemask therapy. Due to the dental effects of facemask therapy, bone anchored maxillary protraction was introduced in which the maxilla is protracted with miniplates. An alternative protocol is to advance the maxilla with mini implants and class III intermaxillary elastics. Patients with Class III malocclusion also have maxillary transverse deficiency. To correct the transverse deficiency, maxillary expansion is performed. When bone anchored maxillary expansion is performed, it can provide a higher amount of skeletal expansion and also help in maxillary protraction. This review will describe in detail regarding the effects of bone anchored maxillary protraction with and without bone anchored maxillary expansion.

***Keywords:** Rapid maxillary expansion, Cone beam computed tomography, three dimensional imaging, airway.*

Introduction

Facemask therapy has been the key for the management of children with class III malocclusion for a long time. Frequently, it is used in combination with rapid maxillary expansion (RME).[1] The main aim with the rapid maxillary expansion is to apply forces to the maxillary sutures so that there is higher skeletal protraction with the facemask therapy.[2] When the facemask therapy is used, there is additional side effects such as mesialization of maxillary molars, extrusion of teeth, downward-backward rotation of mandible, proclined maxillary anteriors, retroclined mandibular anteriors, and higher lower anterior facial height.[3] Thus it is beneficial for patients with deep bite or horizontal growth pattern as it can help to decrease the overbite.

Bone anchored maxillary protraction

The application of bone anchored maxillary protraction has been a significant change in the treatment of class III malocclusion. In this modality, mini plates can be used to apply the orthopedic forces.[4] The mini plates are anchored to the bone and therefore the forces are directed to the bone directly and not to the teeth.[5] Kircelli et al. described that the application of orthodontic forces can be done to the miniplates with the help of a facemask attached to the mini plates.[4] In addition, for bone anchored maxillary protocols, mini plates can also be used to attach class III intermaxillary elastics from the mandibular parasymphyseal region to maxillary zygomatic region. Mehta et al. described a protocol in which mini implants can be used instead of mini plates to attach the class III elastics.[6] This technique does not require a facemask appliance and thus has a better compliance with the patient as it is more esthetic.[6] The mechanics of the correction of class III with the intermaxillary elastics with skeletal anchorage is the counterclockwise rotation of mandible, protraction of maxilla, and counterclockwise rotation of maxilla with minimum dental effects.[6]

Bone anchored maxillary expansion

In most cases with class III malocclusion there is an accompanying unilateral or bilateral posterior crossbite.[1] Maxillary expansion is therefore commonly undertaken along with maxillary protraction.[2] Maxillary expansion leads to disarticulation of sutures to a certain extent and leads to initiation of the cellular response that can be beneficial for maxillary protraction.[2]

Nevertheless, as the expansion appliance is a tooth anchored appliance, it leads to buccally tipped teeth and also leads to dehiscence in the maxillary posteriors.[3] In the past few years, the use of miniscrews for the purpose of bone anchored expansion has been useful in decreasing such side effects associated with tooth anchored expansion. Such miniscrew assisted rapid palatal expansion (MARPE) appliances or bone anchored maxillary expanders can lead to higher skeletal effects with expansion. These appliances when combine with bone anchored maxillary protraction, can lead to higher anterior movement of maxilla.[7] The higher skeletal effects of bone anchored expansion help in effective loosening of the maxillary sutures and this could be a key factor for the higher maxillary protraction.

Bone anchored maxillary expansion have multitude of effects not only on the maxilla but also on associated structures. It has been shown that bone anchored maxillary expansion can lead to increase in the airway volume when measured on CBCT.[8] The nasopharyngeal volume has been observed to increase by xyz% with bone anchored maxillary expansion compared to controls.[8] Maxillary expansion has been shown to have some effects on the temporomandibular joint right after expansion.[9] In the retention period, it has been found that bone anchored maxillary expansion does not lead to side effects on the temporomandibular joint.[10] Just like rapid maxillary expansion, bone anchored maxillary expansion has also shown an increase in the skeletal width of maxilla compared to controls.[11] The skeletal effects of bone anchored maxillary expansion can be utilized in different designs to correct bilateral crossbite or unilateral crossbite.[12]

Combination of Bone Anchored Maxillary Expansion and Bone Anchored Maxillary Protraction

The common modality used for the correction of class III malocclusion is facemask with or without rapid maxillary expansion.[13] This combination approach with for maxillary expansion and maxillary protraction has been performed for better results.[14] However, there is not much literature on the combination approach with mini implants for bone anchored maxillary expansion and bone anchored maxillary protraction. Different protocols can be followed for bone anchored maxillary protraction.[14] With mini implants, the approach of expansion and protraction can be used with intermaxillary elastics to treat Class III patients to optimal occlusion.[6] It has been found that the changes in the sagittal plane can be achieved effectively with both Bone anchored facemask or bone anchored maxillary intermaxillary elastics.[3,14] This can be observed by the anterior movement of point A, ANS, and PNS. When combined with MARPE, there is an increase displacement of the maxilla and the maxillary complex in the sagittal, transverse, and vertical plane.[3] With facemask therapy, there is usually an increase in the mandibular plane angle.[14] With the intermaxillary elastics approach, there is a tendency to close the mandibular plane angle which makes it an useful approach for patients with anterior open bite or hyperdivergent skeletal pattern.[3] This has been shown to be true even when analyzed in terms of finite element analysis studies. The amount of stress on the maxillary sutures and maxillary complex without MARPE and with MARPE have been found to be considerably different.[21,22]

Maxillary Sutures and their role in maxillary expansion and protraction

Maxillary sutures play a vital role in the growth and development of craniomaxillary region. When orthodontic and orthopedic forces are applied on maxilla, they are transmitted to the maxillary sutures, and distant structures. These forces can lead to strain on the suture which can alter with the vector and amount of orthopedic force.[15] It has been shown that there are significant changes in the sutural system of maxilla when maxillary protraction is undertaken.[16-18] Jackson et al. has shown that the amount of skeletal remodeling that occurs with circummaxillary sutures is directly proportional to the distance of the suture to the applied force.[19] These stresses are higher with bone anchored expansion than no expansion.[20] Higher stresses can lead to higher bone remodeling in the maxillary sutures with the expansion procedure. This explains the favorable results that are obtained with the combination of maxillary expansion and maxillary protraction.

Three dimensional evaluation of effects of Bone anchored maxillary expansion and bone anchored maxillary protraction

The assessment of airway volume in a CBCT requires a careful approach of patient positioning, recording the Effects of bone anchored expansion and bone anchored protraction can be identified with the help of Cone beam computed tomography recorded before the treatment and after the treatment.[21] CBCT evaluation is helpful as it shows the structures without magnification and it is not affected by rotational errors of head. Head rotational errors affect the evaluation of maxillary and mandibular strucutures if measured on two dimensional radiographs.[22] Specifically, it has been shown that structures such as point A can be harder to identify with head rotational errors and that can lead to misdiagnosis of the skeletal maxillary movement.[22] Orthodontists have now understood these limitations of two dimensional radiographs and therefore are now using CBCT to measure the effect of bone anchored maxillary protraction.[23] Using CBCT, it has been shown that bone anchored protraction can lead to significant forward movement of maxilla higher than that expected without treatment. Three dimensional photographs of the face are also used to identify the effects of bone anchored maxillary protraction.[25] It has been shown that there is a significant anterior movement of the mid face with bone anchored maxillary protraction.[25]

Conclusion

Bone anchored maxillary protraction is an effective treatment modality for advancing the maxilla and maxillary complex. The combination of MARPE or bone anchored maxillary expansion and bone anchored maxillary protraction leads to a greater advancement of maxilla. Bone anchored maxillary protraction can be performed with mini plates and facemask therapy. A less invasive approach for bone anchored maxillary protraction is to use mini implants and Class III elastics to advance the maxilla successfully.

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