International Journal Dental and Medical Sciences Research
Volume 3, Issue 6, Nov-Dec 2021 pp 419-422 www.ijdmsrjournal.com ISSN: 2582-6018

Bone-anchored maxillary protraction – A Literature review

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Submitted: 01-12-2021 Revised: 13-12-2021 Accepted: 16-12-2021

ABSTRACT: Treating Class III malocclusion patients is a challenge. Orthodontists can use different treatment approaches for the treatment of class III malocclusion. Early treatment of skeletal Class III patients is usually handled with the use of maxillary protraction face mask. An alternative treatment is skeletal anchorage comprised of temporary anchorage devices (TADs), which uses two titanium plates fixed with mini-implants placed in the zygomatic process of the maxilla and two side plates between the lower canine and right and left incisors and the use of intermaxillary elastics.

Keywords- Maxillary advancement, Class III malocclusion, Bone anchored maxillary protraction.

I. INTRODUCTION:

The incidence of class III malocclusion is relatively low (6%) in Caucasian patients and relatively high (22.4%) in the Asian population (Mills, 1966; Willems et al., 2001; Soh et al., 2005; Rodríguez de Guzman-Barrera et al., 2017). A class III skeletal deformity may be caused by a hypoplastic maxilla, prognathic mandible, or a combination of both. In Asians, 47.7% of class III deformities are due to mandibular prognathism, whereas in the Caucasian population a hypoplastic upper jaw is the main cause of a skeletal class III deformity (Ellis and McNamara, 1984; Baik et al., 2000)

In the past, many different orthopaedic appliances have been used for maxillary protraction to treat children with maxillary deficiency, such as bionator,FR-3 appliances,reverse twin-block as well as removable mandibular retractors,double piece correctors (Feng et al., 2012; Yang et al., 2014; Woon and Thiruvenkatachari, 2017) and chin cup.

As a new treatment option, bone-anchored maxillary protraction (BAMP) pulls the maxilla forward by using intraoral intermaxillary elastics anchored in bone plates. This therapy has been shown to cause an average maxillary protraction of 4 mm in Class III patients.

Indications for Bone anchored maxillary protraction

The best age for starting of this treatment seems to be around 12 for boys and 11 for girls[1].The ideal age to start treatment depends on two factors: The complexity of interdigitation of the sutures and the bone quality at the infrazygomatic crest[2]. As beyond the abovementioned age, the thickness of the bone in the maxilla is sufficient to obtain a stable mechanical retention of the screws. However, the growth potential in the sutures decreases with age. This may be explained by an increasing interdigitation degree of the sutures and increasing resistance against mechanical disruption[3].

Surgical Procedure

In the BAMP orthopedic protocol, 4 miniplates were placed on the left and right infrazygomatic crest of the maxillary buttress and between the mandibular left and right lateral incisors and canines. Small mucoperiosteal flaps were elevated, and modified miniplates (Bollard, Tita-Link, Brussels, Belgium) were secured to the bone by 2 (mandible) or 3 (maxilla) screws (diameter, 2.3 mm; length, 5 mm). The extensions of the plates perforated the attached gingiva near the mucogingival junction. Three weeks after surgery, the miniplates were loaded. Class III elastics applied an initial force of about 150 g on each side, increased to 200 g after 1 month of traction, and to 250 g after 3 months. The patients were asked to replace the elastics at least once a day and wear them 24 hours per day[4].

De Clerck[5] et al proposed skeletal anchorage using upper and lower miniplates, together with intermaxillary elastics (I-SAMP), as a method for correcting skeletal class III malocclusions. This technique is referred to as ZAS (Zygoma anchorage system) or BAMP (Bone

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anchor maxillary protraction), and involves four orthodontic miniplates (two on each side): the upper plates are inserted at first and second molar level (in the infrazygomatic crest), while the lower plates are inserted between the lateral incisor and the canine. The authors proposed more apical insertion with respect to the insertion of traction miniplates, in order to minimize possible root damage. Surgical placement of the miniplates in young patients is complicated, since the maxillary alveolar height is limited and the lower canines have not yet erupted. As a result, orthopedic treatment with miniplates usually does not begin before 10 years of age. Delaying maxillary traction offers the advantage of a shorter post-orthopedic and adult treatment period, thereby reducing the influence of the skeletal Class III pattern.

II. RESULTS AND OUTCOMES[4]

Skeletal Effects on the Midface

The forward displacement in the horizontal plane is noted in every patient with the average advancement of 3.7 mm with a range difference from 1.5 mm to 8.5 mm. One explanation for the high variations in treatment response between patients might be due to the diversity of the skeletal Class III discrepancy presented with a severe −5.0 mm overjet, while others manifested a mild edge-to-edge incisor relationship. Other reasons for the high variation on treatment response include compliance with elastics, skeletal age, and maturation of the cranial sutures at the onset of treatment. Because of the application of a continuous, forward traction on the maxilla results in a stretching of the fibers in the sutures and stimulation of bone apposition[6].

Skeletal Effects on the mandible and temporomandibular joint (TMJ)

The changes in the anterior mandibular region were more variable in both magnitude and direction than that of the maxilla. Many subjects exhibited a distal displacement of the chin, while some continued to grow in the expected normal forward direction[7]. While the anterior position of the chin remained in relatively the same position throughout the course of treatment (-0.1 mm), this was significantly different from the mean forward growth of 2.2 mm in matched untreated Class III subjects during the same time interval. It also is interesting that ISAMP and untreated Class III subjects showed nearly identical growth changes in the mandibular body length (gonion to gnathion) and ramus height (condylion to gonion), suggesting that the this protocol did not restrain endochondral growth of the mandible. In addition, there was

small mean posterior displacement of the condyles accompanied by an adaptive remodelling of the glenoid fossa. Long-term studies are needed to evaluate the stability of this compensatory mechanism as well as the health of the TMJ complex. There was bone apposition at the anterior eminence of the TMJ which correlates well with the posterior displacement of anterior surface of the condyle.[8]

Effects on the Dental and Dentoalveolar Parameters

Study by Elnager et al shown that maxillary advancement can be accomplished using skeletally anchored maxillary protraction protocols with elimination of teeth movements and dentoalveolar changes. Maxillary or mandibular arch depth did not change significantly before and after maxillary protraction. Similarly, after the observation period maxillary or mandibular intermolar width remains almost unchanged. Superimposition of the pre-treatment and post-treatment or on comparing 3-dimensional digital models showed that no spontaneous improvement in transverse deficiency was seen after correction of the anteroposterior deficiency at this age. Therefore, in patients with transverse maxillary deficiency before or during the skeletally anchored protraction, the rapid maxillary expansion appliance should be added to improve the transverse deficiency[9].

Effects on the Soft tissue

The 3-dimensional soft tissue analysis showed significant treatment effects of this modality. The major changes were observed in the upper lips, cheeks, and middle of the face, which had a significant positive sagittal displacement when compared to control group. The lower lip and chin area showed significant negative sagittal changes that indicated that the soft tissue growth in this area was restrained with backward displacement. The intra-oral skeletal anchored maxillary protraction protocols effectively improved the Class III concave soft tissue profile[10].

Effects on the Airway

From the previous study, they have concluded that skeletally anchored maxillary protraction is effective in restraining mandibular growth. However the development of the oropharynx did not appear to affective by this restrain of anterior-posterior growth of the mandible[11].

III. DISCUSSION:

Ricardo Alves de Souza et al, concluded that the mini-implant protocol reduced the undesirable effects of the conventional technique, within a shorter treatment time. Other advantages of these temporary anchorage devices were the reduction in discomfort during the surgical procedure, low cost, and greater ease of insertion when compared with miniplates and lesser treatment time when compared with conventional face mask therapy[12,13].

IV. CONCLUSION

Although it is proved to be a good treatment protocol and the results have been significant, the lack of randomization of the sample and lack of long term follow up shows that further studies are required to evaluate the stability of this treatment protocol.

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