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ORIGINAL RESEARCH

A novel system and method for maxillary protraction in class III malocclusion adult patients

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Abstract

Background and Objectives: Given the extensive number of surgical procedures available for correcting CL III anomalies, the present study was conducted in a private clinic from 2014-15 to determine whether simpler orthodontic and surgery techniques could be an alternative to the conventional techniques for resolving such functional and aesthetic problems.
Materials and Methods: The present study was conducted using a sequential before-after design on patients with mild to moderate maxillary deficiency. First, the study records including casts, photographs and radiographs were prepared. A Hyrax appliance with two tongue plates was then constructed for the patient before the Surgically Assisted Rapid Maxillary Expansion (SARME) osteotomy. The surgical technique involved local anesthesia without general anesthesia and the Lefort I osteotomy was performed without down fracture and without the manipulation of the pterygomaxillary suture. The transverse problem was corrected by unscrewing the Hyrax, and the tongue force exerted on the back of the tongue plate corrected the sagittal maxillary deficiency. To evaluate the efficacy of this appliance, the mean changes to the cephalometric indicators before and after the treatment were examined, and the paired t-test was used for the statistical analysis.
Results: The present study was conducted on 11 patients (9 females and 2 males). The mean changes indicated a significant increase in Articular Angle, Jarabak index, and a significant decrease in L1 - NB (mm), L1 - NB (º) and Saddle Angle. The other indicators had either decreased or were not changed.
Conclusion: Using a Hyrax appliance combined with a tongue plate after a SARME surgery is effective in correcting CL III anomalies associated with maxillary deficiency.

Keywords: Malocclusion, CL III, Maxillary deficiency, SARME, Tongue plate, Hyrax.

Introduction

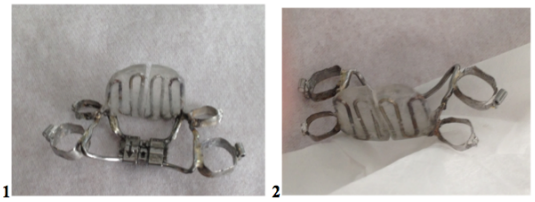
Class III malocclusion is best described by discrepancies of dental or skeletal components in antero-posterior or vertical directions. Retrognathic and narrow maxilla, prognathic and wider mandible, and/ or combinations of both are the common clinical presentations of skeletal class III malocclusion [1]. Management of Class III malocclusion is one of the most challenging treatments in orthodontics, and several methods have been advocated for treatment of this condition [2]. Its diagnosis, prognosis, and treatment have always been a challenge for clinicians [3]. Angle, Tweed, and Moyers classified Class III malocclusions into 3 types: pseudo, dentoalveolar, and skeletal. Clinicians have been trying to identify the best timing to intercept a Class III malocclusion that develops as early as the deciduous dentition [4]. Etiologic factors for Class III malocclusions include a wide spectrum of skeletal and dental compensation components [5]. The treatment of skeletal CL III malocclusion is still one of the main problems in orthodontic [6]. The incidence of CL III among white, blacks and Asians are 1% - 4%, 5% - 8% and 4% - 14%, respectively [7]. The prevalence of CL III in Malaysia and China, with excluding patients with 11 years of age or less, was 15.8%, in Middle East was 10.2%, in European countries was 4.9%, and in Indian was 1.2% [8]. The prevalence of CL III anomalies is reported to be 5-10% among whites, which is either due to maxillary growth deficiency, mandibular prognathism, or a combination of the two [6,9]. Ellis and McNamara claimed that 65-67% of all CL III malocclusions are seen with maxillary retrognathism. In addition, according to Guyer and coworkers, 57% of the patients with either a normal or prognathic mandible showed a deficiency in the maxilla [10], and that maxillary protraction is a major paradigm for the early treatment of CL III anomalies.

Jean Delaire (1970) introduced the concept of maxillary protraction with a face mask [11]. To correct post-puberty transverse maxillary deficiencies, the SARME [12] technique is currently being used, and to correct severe cases of maxillary retrognathism in the sagittal dimension, maxillary advancement surgery is the option [12,13]. RPE is performed for the transverse dimension and osteotomy due to the cut in the parasagittal [14]. However, in cases of severe maxillary deficiencies, SARME [12,13] and distraction osteogenesis are performed [14]. If the CL III anomaly associated with maxillary retrognathism is still not successfully treated, the patient's aesthetic problem might persist, the problems with speech and chewing functions may increase, and psychological problems may then follow.

To correct the midface deficiency in the maxilla through traditional surgery, an extensive LeFort I osteotomy with down fracture is required alongside the use of general anaesthetics [15]. This new technique, however, is simpler and has been performed for the first time without the use of anaesthetics and down fracture and the manipulation of the pterygomaxillary suture. The present study was conducted to investigate the effect of this new method of orthognatihic surgery and the use of a Hyrax appliance combined with two tongue plates to correct mild to moderate maxillary retrognathism in adult patients who visited a private clinic in Tehran.

Materials and Methods

The present sequential before-after study was conducted on 11 patients (9 females and 2 males) aging from 15 to 34 years. Since the maxillary deficiency is likely be three dimensional [16], we selected the patients with a mild to moderate maxillary retrognathism and a reverse overjet of 2 mm maximum in both the anterior and posterior dimensions, and a posterior cross-bite in the transverse dimension. Patients were first briefed on the surgical and orthodontic procedures and then submitted their informed consent forms. The study records including casts, photographs, panoramic radiographs and lateral cephalograms were then prepared. A Hyrax appliance combined with a tongue plate was then constructed for the patient before the osteotomy (Figures 1, 2).



Figures 1 and 2: Occlusal and frontal view of Tongue Plate & Hyrax

This appliance consisted of 4 bands on the maxillary first premolars and the maxillary first molars and two acrylic tongue plates placed on the anterior horizontal arm of the Hyrax and the patient was then prepared for surgery.

The surgical technique included local anesthesia with articaine 4% with 1:100,000 epinephrine without general anesthesia [17]. A horizontal cut was made deep into the maxillary vestibule along the maxillary first molars; an incision like the Le Fort I osteotomy cut was made from the right zygomatic buttress to the same region on the left. A hammer and chisel were then used to hammer the space between the root of the maxillary central teeth [18] for the surgeon to ensure that the two maxillary halves were separated. A Hyrax appliance combined with a tongue plate was inserted in the patient's mouth, in which a separating elastic was already placed on the proximal surfaces of the maxillary first premolar and molar, and was then unscrewed 3-4 times to make sure that the two maxillary halves could be separated by 1 mm with a low force. From the next week forward, the appliance was unscrewed once in the morning and once in the evening. This process continued until the posterior cross bite was corrected. During this period, the force exerted by the hyrax screw on the pterygomaxillary suture had an impact. In addition, a force was also exerted by the tongue on the appliance and subsequently on the maxilla through the two tongue plates, which caused the orthopedic forward movement of the maxilla as a result of the force caused by remodeling taking place in the pterygomaxillary suture.

The present study was conducted on 11 patients and used the Steiner analysis method to observe the efficacy of the appliance according to the following indicators. Saddle/Sella Angle, Articular Angle, Gonial/Jaw Angle (Ar-Go-Me) (º), Sum of Angles (Jarabak) (º), Y-Axis (SGn-SN) (º), P-A Face Height (S-Go/N-Me) (%), Mand Plane to Occ Plane (º), SNA (º), SNB (º), ANB (º), FH - SN (º) , Facial Plane to SN (SN-NPog) (º), Wits Appraisal (mm), U1 - SN (º), U1 - NA (mm), L1 - NB (mm), L1 - NB (º), IMPA (L1-MP) (º), Interincisal Angle (U1-L1) (º), FMA (MP-FH) (º).

The CL III profile with extra oral, intra oral photographs and lateral cephalograms of before and after treatment of one oldest patients is considered in the Figures 3 to 6. She was suffering from the upper lip retrusion and lower lip protrusion, while it has been improved after the treatment (fig. 3).

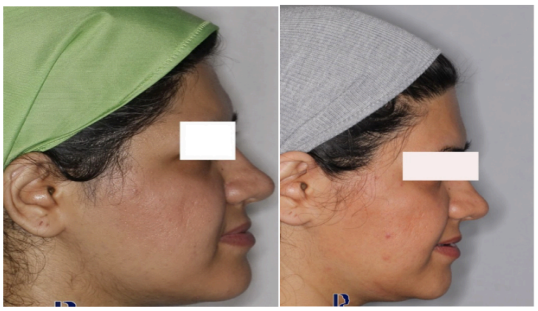


Figure 3: CLIII profile (before and after).

Intra oral photograph of both sides show that the reverse overjet is obvious; besides, the patient is suffering from the lack of tight interdigitation while both of them have been improved after the treatment (fig. 4, 5).

Figure 4: CLIII molar relationship and reverse over jet in the left (before) and right side (after).

Figure 5: CLIII molar relationship and reverse over jet in the left (before) and right side (after).

As it is illustrated in the lateral cephalograms in before treatment, the maxilla is deficient, upper lip is retruded and lower anterior protrusion persists, while all those defects were corrected efficiently after the treatment (fig 6).

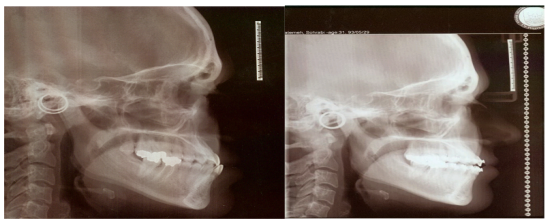


Figure 6: Lateral Cephalometry before treatment and after 6 months of treatment.

The mean and standard deviation of changes made before and after the procedure were calculated. To evaluate the appliance's rate of effectiveness, the statistical analysis was performed in SPSS-22 using the paired t-test.

Results

The present study was conducted on 11 patients (9 females and 2 males) with a mean age of 20.09±6.2 at an age range of 15 to 34 years. The mean changes indicated a significant increase in Articular Angle (P<0.102), Posterior to Anterior Facial Height (S-Go/N-Me) (%) (P< 0.037), SNA (P<0.042) , ANB (P<0.056) and U1 to SN (P<0.090) and a significant decrease in L1 - NB (mm) (P<0.033), L1 - NB (º) (P< 0.085) and Saddle/Sella Angle (p<0.021). The mean changes in the other Steiner analysis indicators were not significant (Tables 1, 2 and 3).

Table 1- Distribution of the mean and standard deviation of skeletal indices in the vertical dimension of patients studied.

Indexes / Stages	Saddle/Sella Angle (SN-Ar) (º)	Articular Angle (º)	Gonial/Jaw Angle (Ar-Go-Me) (º)	Sum of Angles (Jarabak) (º)	Y-Axis (SGn-SN) (º)	P-A Face Height (S-Go/N-Me) (%)	Mand Plane to Occ Plane (º)	FMA (MP-FH) (º)
Before (Mean±SD)	129.82±6.92	135.39±6.92	133.85±6.96	399.07±5.85	68.66±4.04	60.28±4.72	19.53±5.03	34.03±7.63
After (Mean±SD)	125.07±7.02	139.14±9.89	133.15±8.14	397.09±8.63	68.6±5.3	62.16±4.48	21.02±3.85	34.05±8.89
Difference (Mean±SD)	4.75±5.75	-3.75±6.91	0.7±8.32	1.98±7.98	0.06±3.46	-1.88±2.6	-1.49±3.68	-0.03±6.01
P.Value	0.021(S)	0.102(S)	0.786	0.429	0.953	0.037(S)	0.208	0.988

Table 2- Distribution of the mean and standard deviation of skeletal indices in the sagittal dimension of patients studied.

Indexes / Stages	SNA (º)	SNB (º)	ANB (º)	FH - SN (º)	Facial Plane to SN (SN-NPog) (º)	Wits Appraisal (mm)
Before (Mean±SD)	78.3±5.53	79.15±4.63	-0.85±3.1	5.03±3.86	80.02±4.62	-.75±4.58
After (Mean±SD)	81.12±6.69	80.68±5.66	0.46±2.8	3.85±4.37	81.04±5.36	-.83±3.62
Difference (Mean±SD)	-.82±4	-.54±3.05	-.32±2.03	1.18±4.45	-1.02±2.93	-.92±4.19
P.Value	0.042(S)	0.125	0.056 (S)	0.399	0.276	0.160

Table 3- Distribution of the mean and standard deviation of Dental indices in the patients studied.

Indexes / Stages	U1 - SN (º)	U1 - NA (mm)	L1 - NB (mm)	L1 - NB (º)	IMPA (L1-MP) (º)	Interincisal Angle (U1-L1)
Before (Mean±SD)	105.45±6.31	5.07±3.78	2.58±2.66	22.79±6.84	84.56±7.4	130.9±10.7
After (Mean±SD)	109.09±8.28	3.83±3.15	0.68±1.9	18.94±5.41	80.3±7.32	132.46±9.92
Difference (Mean±SD)	-.65±6.44	1.25±3.89	1.9±2.56	3.85±6.69	4.26±8.51	-1.56±10.67
P. Value	0.090 (S)	0.314	0.033 (S)	0.085 (S)	0.128	0.637

Discussion

The present study was conducted on patients with maxillary deficiency in the anterior, posterior, and transverse dimensions. The mean changes indicated a significant increase in SNA and ANB, in such a way that had improved the patients' profiles. While the upper 1 to SN dental indicator had increased, the angle and distance of Lower 1 to NB had decreased. The PFH/AFH×100 had increased and the saddle Angle decreased. The review of literature on the subject found no research similar to the present study conducted on adult patients. However, two similar studies were found but with a difference in the study subjects' age group.

The increase in SNA found in the present study was similar to the study conducted by Vaughn *et al.* [19]. The only difference was that the present study was conducted on adult patients undergoing surgery while the cited study was conducted on patients still in their growing stage. The increase in SNA, ANB and overjet found in the present study was similar to the study conducted by Nienkemper *et al.* [6]; the only difference was that SNB decreased in the cited study while it did not change in the present one. This might have been due to the patients' vertical growth in the former. Patients in the present study were adults and their SNB therefore remained unchanged. In the present study, the increase in U1 to SN and the decrease in L1 to NB might be due to the removal of the tongue pressure on the mandibular anterior teeth and the pressure exerted on the tongue plates. Using a Hyrax appliance combined with a tongue plate after a SARME surgery appears to be effective in correcting CL III anomalies associated with maxillary deficiencies with a normal and horizontal growth pattern.

Conflict of interest

Author declares no conflict of interest.

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