Skeletal, Dental and Soft Tissue Changes in Postural Class III Malocclusion Treated with a Maxillary Removable Appliance

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Objective: *This longitudinal retrospective cephalometric study was undertaken in an attempt to evaluate the effect of upper removable appliances on the hard and soft tissue structures in subjects with postural Class III.*
Methods: *The material consisted of cephalometric films of 17 Class III patients (8 females and 9 males, with a mean age of 10.10 ± 1.63). Each treated patient was matched before treatment with Class III subject for sex and age. Differences in treated group at T1 and T2 and between treated and untreated groups were examined using paired t-test and independent t-test respectively.*
Results: *Treated and untreated Class III subjects differed in mandibular prognathism (SNB, P<0.01). Upper incisors proclined and inter-incisal angle reduced during treatment (P<0.001). Soft tissue A point moved anteriorly as maxillary incisors were proclined (P<0.05). Soft tissue profile was improved (NNP, P<0.05; NAP, P<0.01).*
Conclusion: *Skeletal, dental and soft tissue changes were found in patients treated by upper removable appliance in postural Class III patients.*
Clinical relevance: *upper removable appliance is an efficient method to procline upper incisors in postural Class III malocclusion and may be of greater influence in improving soft tissue profile.*
Key words: *Class III; Malocclusion; Soft Tissue.*
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INTRODUCTION

Postural Class III malocclusion refers to the condition where incisors are in crossbite due to forward mandibular displacement.[1] Skeletal relationship is usually Class I or mild Class III. Clinically, distinction is made between postural and skeletal Class III malocclusion by the patient's ability to bite into edge to edge relationship due to retroclined maxillary incisors.

The prevalence of anterior crossbites in a sample of 1003 Jordanian children was 1.9%.[2] According to Rakosi (1970) functionally, two types of class III malocclusion exist: 1- Functionally true Class III, where the path of closure resembles a hinge axis. 2- Postural Class III where the mandible glides from the rest position into a forward direction. Gravely (1984) stated that in postural Class III malocclusion, the normal hinge movement which usually occurs in closing from the resting posture to the position of maximum occlusal contact cannot occur because of premature contact between the maxillary and mandibular incisors. This results in forward displacement of the mandible.

Early correction of postural Class III malocclusion is desirable[3-7] to minimize attrition of the labial surfaces of the maxillary incisors, periodontal problems[8] and to allow the later erupting teeth to come into occlusion on a normal jaw relationship. Treatment of this kind of malocclusion includes the use of removable, functional or fixed appliances or with extra-oral devices such as protraction headgear. The most popular treatment of upper incisors in lingual crossbite is an upper removable appliance with double cantilever spring. The purpose of this study was to evaluate the effect of upper removable appliances on the hard and soft tissue structures in postural Class III malocclusion and to compare the changes with untreated Class III group.

MATERIALS AND METHODS

The sample comprised 17 subjects (8 females and 9 males) with postural Class III malocclusion treated in Orthodontic clinics at Jordan University of Science and Technology Dental Teaching Center. Treatment involved the use of maxillary removable appliance for an average period of 12±1 months. Removable appliance included two Adam's clasps on upper first molars, double cantilever spring to procline upper incisors. Each treated patient was matched before treatment with a Class III (control) subject for sex and age. Control subjects received no orthodontic treatment during the period of investigation.

Cephalometric radiographs were taken for each subject: the first before treatment (T1) at an average age of 10.10±1.63 years and the second at the end of actual treatment (T2). The control group had 2 records: one matched with the treated group at the commencement of treatment (Mean age 10.34±1.55) and the second 1.30±0.34 years after the initial radiograph.

Cephalometric radiographs were taken with a Siemens Orthophos 5 machine using a standardized technique and a fixed anode-mid-sagittal plane distance. The subjects were asked not to swallow, not

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to move their heads and tongues and to contact their teeth lightly while the radiographs were taken. The magnification of the radiographic machine, which was not corrected, was 11.3.

Lateral skull radiographs were traced on acetate paper and 25 hard and soft tissue cephalometric points were registered yielding 13 linear and 10 angular measurements (Figure 1). The definition of most points were conventional, with the addition of arbitrary points SH and SV on sella horizontal and sella vertical lines. In this study the Wits measurement of antero-posterior jaw relationship was measured by projection on the maxillary/mandibular planes bisector[9] to avoid corruption of the Wits measurements by alteration in the angle of the occlusal plane during treatment. The measurements were performed manually using a ruler to the nearest 0.1mm.

Method error

All films were retraced and measured and method errors calculated as recommended by Dahlberg[10] and Houston.[11] Dahlberg error varied from 0.46 and 0.95 mm and from 0.69 to 1.15 degrees. Houston's coefficient of reliability were above 0.90 for all variables.

Statistical analysis

The mean differences in cephalometric measurements between the treated group at T1 and T2 and between the untreated group at T1 and T2 (growth changes) were examined using the paired t-test. In each case the earlier measurement was subtracted from the later measurement, thus positive differences shown in the tables indicate an increase in the measurement. The overall mean changes in control and treated groups were compared using the independent t-test.

RESULTS

Treated postural Class III subjects

The mean changes in treated subjects are shown in Table 1.

Skeletal changes

There was an increase in the lengths of Nasion-Menton (P<0.001) and lower face height (P<0.001). A reduction of 0.19 degrees in SNB angle was observed. Intermaxillary difference of 0.46 degrees (ANB) and 0.07 mm (Wits) was found in treated subjects. However, these differences did not reach any statistical significance.

Dental changes

Maxillary incisor proclination was the main dental effect (P<0.001) which resulted in a reduction of inter-incisal angle (P<0.001) and an increase in overjet (P<0.001).

Soft tissue changes

The facial profile was improved as evidenced from the reduction in the NNP and NNP angles (P<0.05). All vertical and horizontal linear soft tissue measurements were increased.

Untreated Class III subjects (control)

The mean changes in untreated (control) subjects are shown in Table 2.

Skeletal changes

There was an increase in Nasion-Menton (P<0.001), lower face height (P<0.001), SNB angle (P<0.01) and Wits measurement (P<0.05).

Dental changes

In untreated subjects, upper incisors tend to procline (P<0.05) during the observation period.

Soft tissue changes

In untreated subject soft tissue changes due to growth consisted of increased facial concavity (NAP, P<0.05). All vertical and horizontal linear soft tissue measurements were increased.

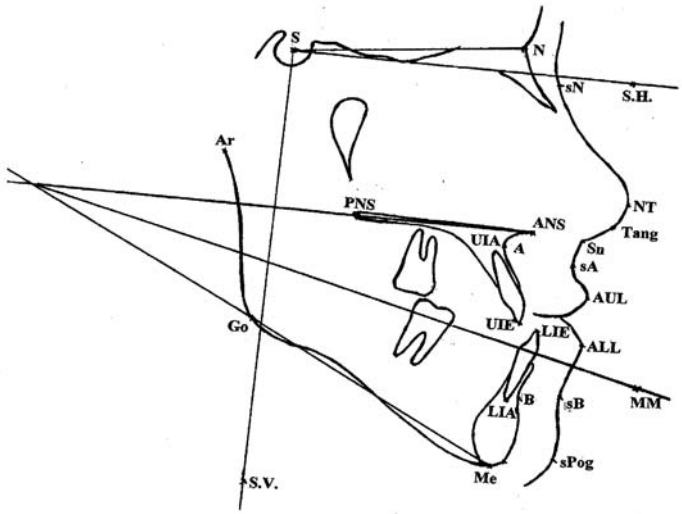

Figure 1 - Hard and soft tissue reference points and reference planes. Sella (S), Nasion (N), Articulare (Ar), Anterior nasal spine (ANS), Posterior nasal spine (PNS), point A, point B, Menton (Me), Gonion (Go), S.H: A point located on the Sella Horizontal line, S.V: A point located on the Sella Vertical line, UIE: Midpoint of upper central incisor edge, UIA: Apex of the upper central incisor, LIE: Midpoint of lower central incisor edge, LIA: Apex of lower central incisor, MM: A point located on the maxillary-mandibular plane bisector, sN: Soft tissue nasion, NT: Most prominent or anterior point of the nose tip, Tang: The most anterior point on the columella of the nose, Sn: The point at which the nasal septum merges with the upper cutaneous lip in the midsagittal plane, sA: Soft tissue point A, AUL: The most anterior point of the upper lip, ALL: The most anterior point of the lower lip, sB: Soft tissue point B, sPog: Soft tissue pogonion, Maxillary plane (Max), Mandibular plane (Mand), Sella Vertical line: Vertical line through Sella, perpendicular to a horizontal at 7 degrees below Sella- Nasion line. Sella Horizontal line: Horizontal line through sella 7 degrees below Sella-Nasion line.

Soft tissue measurements

Nasolabial angle AUL - Sn - Tang (AUST). Soft tissue profile including the nose sN - NT - sPog (NNP). Soft tissue profile excluding the nose sN - sA - sPog (NAP). NV: The perpendicular distance from nose tip to Sella Vertical. sAV: The perpendicular distance from soft tissue point A to Sella Vertical. AUV: The perpendicular distance from anterior upper lip to Sella Vertical. ALV: The perpendicular distance from anterior lower lip to Sella Vertical. sBV: The perpendicular distance from soft tissue point B to Sella Vertical. sPV: The perpendicular distance from soft tissue pogonion to Sella Vertical. sPH: The perpendicular distance from soft tissue pogonion to Sella Horizontal. NH: The perpendicular distance of nose tip to Sella Horizontal.

Comparison between treated and untreated Class III subjects

Differences between mean changes between treated and untreated Class III subjects are shown in Table 3.

Skeletal changes

Treated and untreated Class III subjects differed in SNB angle (P<0.01). Mandibular prominence (SNB) tended to increase in untreated and decrease in treated subjects.

Dental changes

The change in inclination of upper incisors, in the interincisal angle and in overjet differed significantly between the two groups (P<0.001).

Table 1: Means for skeletal, dental and soft tissue measurements and mean differences at the two stages in treated Class III subjects.

Variable	T1	T2	Mean difference	P-value
Skeletal				
SNA°	77.29±2.40	77.59±1.88	0.29	0.429
Na-Me (mm)	111.91±7.28	114.63±6.68	2.72	0.000***
SNB°	78.94±2.24	78.75±2.22	-0.19	0.473
ANB°	-1.63±1.52	-1.18±1.33	0.46	0.225
Wits(mm)	-9.50±2.26	-9.57±2.75	-0.07	0.847
Max/Mand°	28.56±3.45	28.96±3.01	0.40	0.388
LFH(mm)	62.65±5.12	65.94±4.70	3.29	0.000***
FP%	0.56±0.02	0.56±0.02	0.00	0.913
Dental				
Li/Mand°	82.63±4.80	82.71±5.25	0.07	0.927
Ui/Max°	106.26±4.58	113.65±5.16	7.38	0.000***
Ui/Li°	142.71±5.61	134.63±7.56	-8.07	0.000***
OJ(mm)	-2.47±1.97	1.07±1.79	3.54	0.000***
OB(mm)	2.37±2.28	1.72±2.00	-0.65	0.113
Soft tissue				
AUST°	108.38±11.75	108.03±13.23	-0.35	0.847
NNP°	136.91±3.56	135.44±4.57	-1.47	0.013*
NAP°	173.47±3.58	170.56±4.39	-2.91	0.014*
NV(mm)	91.31±5.67	94.32±5.56	3.01	0.000***
AUV(mm)	77.75±5.61	80.85±5.57	3.10	0.000***
ALV(mm)	76.69±6.05	78.75±6.57	2.06	0.018*
sBV(mm)	69.81±6.19	71.90±6.10	2.09	0.002**
sAV(mm)	75.29±5.04	78.24±5.11	2.94	0.000***
sPV(mm)	70.81±7.07	72.84±6.60	2.03	0.005**
NH(mm)	36.06±3.42	37.90±3.42	1.84	0.001***
sPH(mm)	98.94±6.84	101.49±6.29	2.54	0.013*

*significant at P<0.05, **significant at P≤ 0.01, ***significant at P≤ 0.001

Table 2: Means for skeletal, dental and soft tissue measurements and mean differences at the two stages in Class III Control subjects.

Variable	T1	T2	Mean difference	P-value
Skeletal				
SNA°	78.65±4.08	79.92±4.30	0.27	0.241
Na-Me (mm)	113.23±7.17	116.21±7.09	2.98	0.000***
SNB°	79.42±3.83	80.42±3.89	1.00	0.003**
ANB°	-0.87±1.34	-0.83±2.14	0.04	0.913
Wits(mm)	-9.83±2.51	-10.69±3.00	-0.85	0.012*
Max/Mand°	29.38±5.65	28.63±6.45	0.75	0.170
LFH(mm)	66.52±7.87	69.02±8.15	2.50	0.000***
FP%	0.56±0.03	0.56±0.03	0.00	0.094
Dental				
Li/Mand°	86.79±5.56	86.81±5.36	0.02	0.957
Ui/Max°	112.38±5.99	112.94±5.98	0.56	0.049*
Ui/Li°	130.83±7.75	130.38±8.70	-0.46	0.368
OJ(mm)	-1.56±1.68	-1.63±1.62	-0.07	0.555
OB(mm)	0.75±0.97	0.81±1.10	0.06	0.770
Soft tissue				
AUST°	110.42±11.06	112.42±10.16	2.00	0.012
NNP°	133.77±4.69	134.02±4.50	0.25	0.166
NAP°	169.21±2.69	169.96±2.71	0.75	0.023*
NV(mm)	94.13±9.12	96.23±9.08	2.10	0.000***
AUV(mm)	81.40±10.27	83.38±10.29	1.98	0.000***
ALV(mm)	80.08±10.50	81.92±9.67	1.83	0.001***
sBV(mm)	72.00±9.35	74.63±9.01	2.63	0.000***
sAV(mm)	78.50±8.00	79.81±8.09	1.31	0.004**
sPV(mm)	72.13±9.09	74.65±8.80	2.52	0.000***
NH(mm)	37.35±4.78	39.29±4.76	1.94	0.000***
sPH(mm)	101.73±8.07	104.25±8.74	2.52	0.003**

*significant at P<0.05, **significant at P≤ 0.01, ***significant at P≤ 0.001

Soft tissue changes

Facial profile concavity differed between treated and untreated subjects (NNP, P<0.05; NAP, P<0.01). The horizontal distance of soft tissue point A differed between the two groups. point A was more anteriorly positioned in treated Class III subjects.

DISCUSSION

The aim of this study was to investigate the effect of upper removable appliance on the hard and soft tissue structures in patients with postural Class III malocclusion.

Pretreatment radiographs revealed that treated subjects had retroclined upper incisors which caused dental interference during the path of closure of the mandible which led to mandibular displacement.

Several skeletal, dental and soft tissue changes were observed in treated subjects. Although insignificant, SNB and ANB angles and Wits measurements tend to reduce due to treatment. This may be explained by the backward rotation of the mandible which resulted in a more posterior position of B point as Class III incisor relationship was corrected.

Class III incisor relationship was corrected by upper incisor proclination which improved the overjet and reduced the inter-incisal angle.

Soft tissue structures followed the hard tissue structures. This was in agreement with other studies.[12-13] Soft tissue A point moved forward as a result of upper incisor proclination. Soft tissue profile improved toward a Class I profile. This may be explained by the elimination of the forward mandibular displacement as the upper incisor inclination was corrected.

The findings of this study demonstrate that upper removable appliance is an efficient method to procline upper incisors in postural Class III malocclusion and may be of greater influence in improving soft tissue profile.

CONCLUSION

1- Skeletal changes involves reduction of mandibular prognathism (SNB).

2- Soft tissue changes involved improvement of facial profile and forward movement of soft tissue A point.

Table 3: Differences between mean changes between treated and untreated Class III subjects for skeletal, dental and soft tissue measurements.

Variable	Mean Change Treated	Mean change Control	Mean difference	P-value
Skeletal				
SNA°	0.29±1.50	0.35±0.86	0.06	0.902
Na-Me (mm)	2.74±1.15	2.96±1.29	0.22	0.628
SNB°	-0.19±1.07	0.98±0.90	1.17	0.005**
ANB°	0.46±1.49	0.29±0.82	0.75	0.128
Wits(mm)	0.07±1.55	0.85±0.99	0.78	0.136
Max/Mand°	0.40±1.85	0.75±1.77	1.15	0.105
LFH(mm)	3.29±2.03	2.50±0.95	0.79	0.220
FP%	0.00±0.01	0.00±0.01	0.00	0.211
Dental				
Li/Mand°	0.07±3.26	0.02±1.31	0.05	0.958
Ui/Max°	7.38±3.99	0.59±0.89	6.79	0.000***
Ui/Li°	8.07±5.81	0.50±1.71	7.57	0.000***
OJ(mm)	3.54±2.48	-0.07±0.36	3.61	0.000***
OB(mm)	0.65±1.59	0.06±0.72	0.71	0.162
Soft tissue				
AUST°	0.35±7.42	2.00±3.31	2.35	0.300
NNP°	1.47±2.18	0.25±0.58	1.72	0.013*
NAP°	2.91±4.38	0.75±0.99	3.66	0.009**
NV(mm)	3.01±2.01	2.10±0.77	-0.91	0.149
AUV(mm)	3.10±2.60	1.97±0.96	1.12	0.166
ALV(mm)	2.06±3.21	1.79±1.44	0.27	0.790
sBV(mm)	2.09±2.34	2.23±2.05	0.14	0.868
sAV(mm)	2.94±2.52	1.31±1.25	1.63	0.0.049*
sPV(mm)	2.03±2.60	2.52±0.97	0.49	0.540
NH(mm)	1.84±1.83	2.00±0.77	0.16	0.776
sPH(mm)	2.54±3.77	4.44±2.30	0.11	0.931

*significant at P<0.05, **significant at P≤ 0.01, ***significant at P≤ 0.001

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