Original Article

Evaluation of long-term soft tissue changes after bimaxillary orthognathic surgery in Class III patients

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ABSTRACT

Objective: To assess soft tissues in the short and long term after bimaxillary surgery in Class III patients by comparing the hard tissue changes and results between time periods.

Materials and Methods: Twenty-six Class III adult patients treated with bimaxillary surgery were included in the study. Cephalometric records were taken before surgery (T1) and 5 months (T2), 1.4 years (T3), 3 years (T4), and 5 years (T5) after surgery.

Results: There was no significant relapse in skeletal parameters. Overjet was significantly reduced between T4-T3 time intervals ($P < .01$). There were significant increases in Sn-HR, ULA-HR, LLA-HR, B-B^ ($P < .01$), and B^-HR ($P < .05$) between T4-T3 time intervals. There was no significant change in the soft tissue parameters between T5-T4 time intervals.

Conclusion: Soft tissue vertical relapse occurs in skeletally stabile Class III bimaxillary surgery patients in the first 3 years after surgery. (*Angle Orthod.* 2015;85:631–637.)

KEY WORDS: Bimaxillary surgery; Soft tissue; Class III

INTRODUCTION

Combined orthodontic and orthognathic surgical treatment has become a common treatment modality for the correction of facial deformities. The aim of the treatment is not only to correct the dental malocclusion but also to establish acceptable facial esthetics and long-term stability.

The focus of many studies has been on skeletal changes with little attention given to long-term soft tissue changes. The factors that have been suggested to influence postoperative stability of the soft tissues include the preoperative soft tissue thickness,[1–3] gender,[1,4] and the amount of surgical movement.[1,5] The relationship between hard tissue and soft tissue changes may be complex because soft tissue morphology, thickness, posture, and tonicity vary from person to person.[6] Although edema and muscular adaptation are expected to resolve by 6 to 12 months, soft tissue changes of the lower lip and chin continue to occur up to 3 years post surgery after mandibular advancement.[7]

Skeletal Class III malocclusion is reported to be the most frequent anomaly corrected by combined orthognathic surgery and orthodontic treatment.[8–10] Although the use of bimaxillary procedures is widespread, there are relatively few reports based on the long-term changes in the soft tissues after bimaxillary orthognathic surgery. Lir et al.[11] evaluated long-term (postsurgery 1 and 3 years) skeletal and soft tissue stability of 40 Class III bimaxillary surgery patients. Jacobsone et al.[12] analyzed long-term soft tissue profile in bimaxillary patients by using five time points in 3 years. Bailey et al.[13] studied radiographs of 32 Class III bimaxillary surgery patients at 1 year and 5 years postsurgery follow-up. However, those studies differ in materials and methodologies, and the results are inconsistent.

The current literature does not permit an accurate determination of long-term soft tissue response after orthognathic surgery in bimaxillary Class III patients. To establish a proper surgical treatment plan, analysis of the tendency of skeletal and soft tissue relapse after bimaxillary surgery is vital. Therefore, the aim of our study was to assess soft tissues in the short and long

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Table 1. Time Intervals Between the Cephalometric Films Taken at Different Treatment and Retention Periods[a]

Treatment and Retention Periods	Mean Time Interval ± SEM, mo
T2-T1	4.68 ± 4.52
T3-T2	11.71 ± 14.48
T4-T3	21.89 ± 17.2
T5-T4	22.78 ± 18.79

[a] T1 indicates presurgery; T2, postsurgery; T3, posttreatment; T4, first retention; T5, second retention; and SEM, standard error of the mean.

term after bimaxillary surgery in Class III patients by comparing the hard tissue changes and results between time periods. It may be hypothesized that changes in the soft tissue occur in the first 3 years after surgery.

MATERIALS AND METHODS

The subjects of this study were selected among the patients treated at the University of Ankara, Faculty of Dentistry, Department of Orthodontics and Maxillofacial Surgery between 1998 and 2011. The material consisted of lateral cephalometric films of Class III orthognathic surgery patients. Inclusion criteria were nonsyndromic adult patients older than 17 years with skeletal Class III (ANB less than -4°) and dental Class III deformity, surgical treatment consisting of bimaxillary surgery without mandibular border recontouring, and lateral cephalograms of good quality. Exclusion criteria included previous orthognathic surgery, genioplasty, obstructive sleep apnea, cleft, and craniofacial anomalies. Ethical committee approval from the University of Ankara, Faculty of Dentistry, and patient consent from each patient were received for this study.

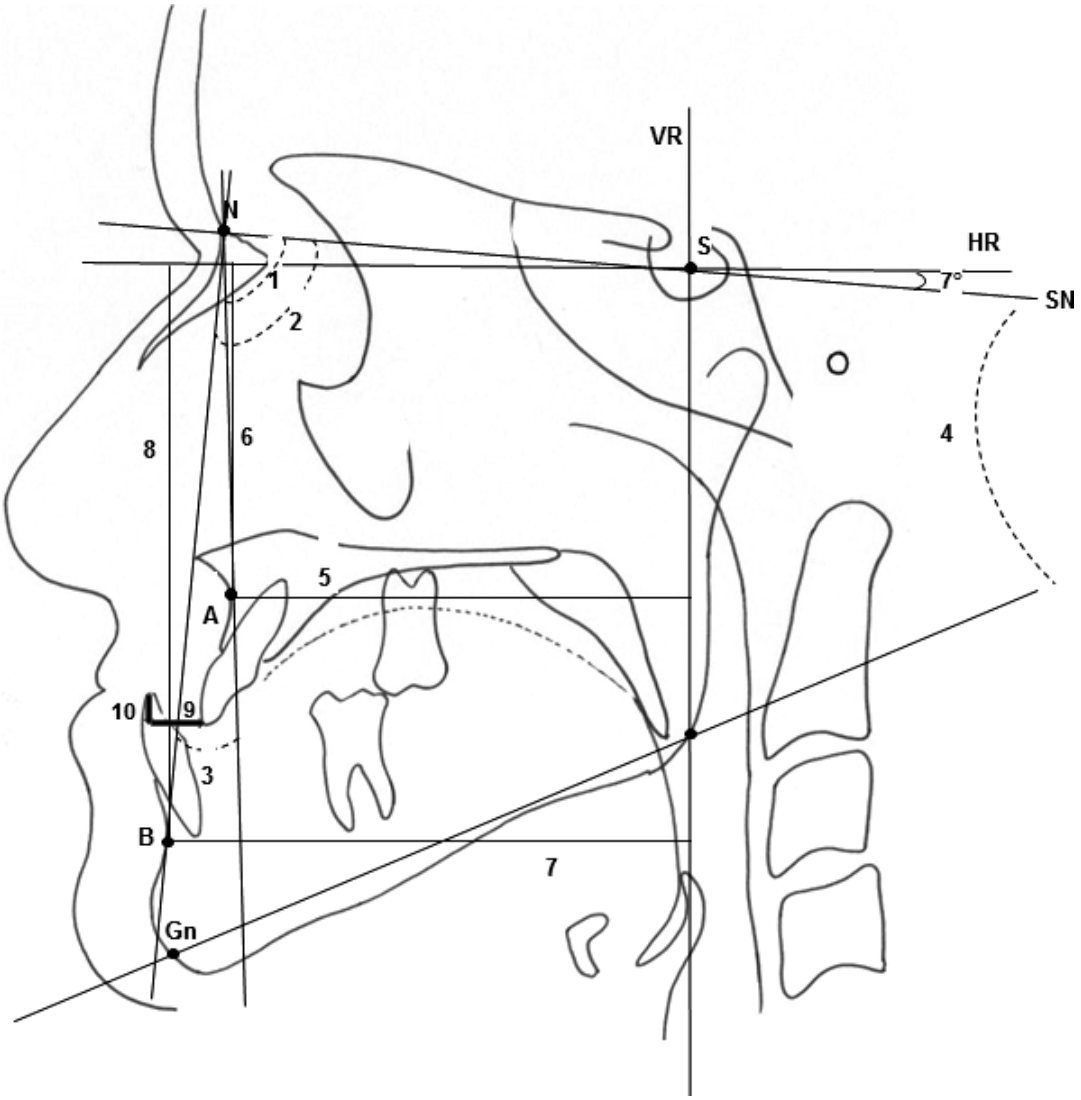

Figure 1. Skeletal and dental variables. (1) SNA. (2) SNB. (3) ANB. (4) GoGn/SN. (5) A-VR. (6) A-HR. (7) B-VR. (8) B-HR. (9) Overjet. (10) Overbite.

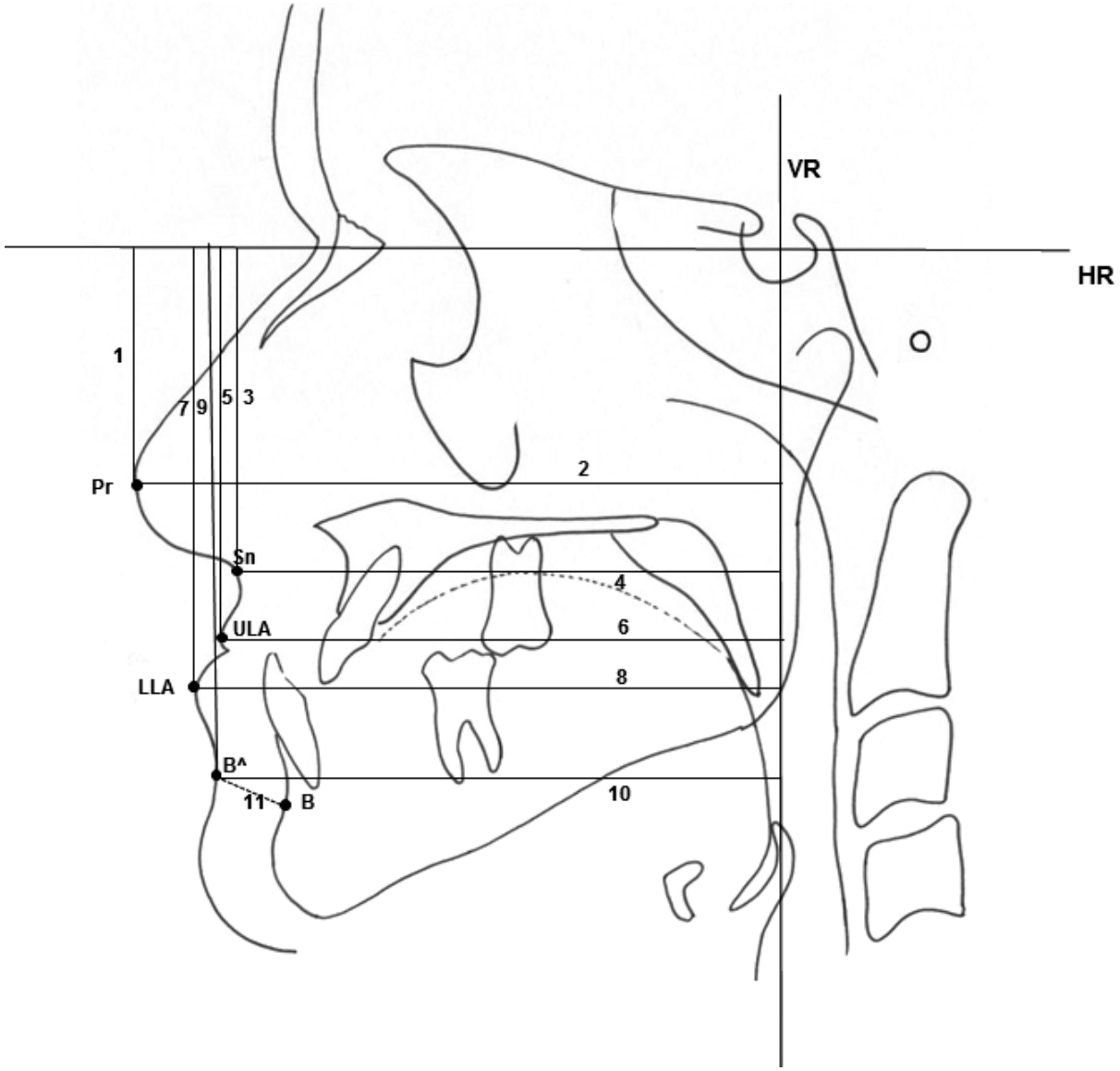

Figure 2. Soft tissue variables. (1) Pr-HR. (2) Pr-VR. (3) Sn-HR. (4) Sn-VR. (5) ULA-HR. (6) ULA-VR. (7) LLA-HR. (8) LLA-VR. (9) B^-HR. (10) B^-VR. (11) B-B^.

Twenty-six adult patients (between 17 and 29 years of age) were included in the study. All of the patients were treated orthodontically and surgically with the same doctor and treatment protocol. Bilateral sagittal split ramus osteotomy with semi-rigid fixation and Le Fort I osteotomy with rigid fixation were used for the mandible and maxilla. In the Le Fort I surgical technique, the maxilla was positioned upwards when needed.

The lateral cephalometric films taken at different treatment and retention phases were used for the study. The number of lateral cephalometric films used at different time periods are:

- T1: presurgery radiograph (n = 25)
- T2: postsurgery radiograph (n = 11)
- T3: posttreatment radiograph (at the end of the fixed treatment) (n = 26)
- T4: first retention radiograph (n = 24)
- T5: second retention radiograph (n = 9)

The time intervals between treatment and retention periods are shown in Table 1.

Cephalometric Analysis

The lateral cephalometric radiographs were taken by the same operator on the same machine under standardized conditions in natural head position with the mandible in centric relation; and a relaxed lip position was obtained by requesting the patients to gently stroke their lips and relax.[14] Lateral cephalo-

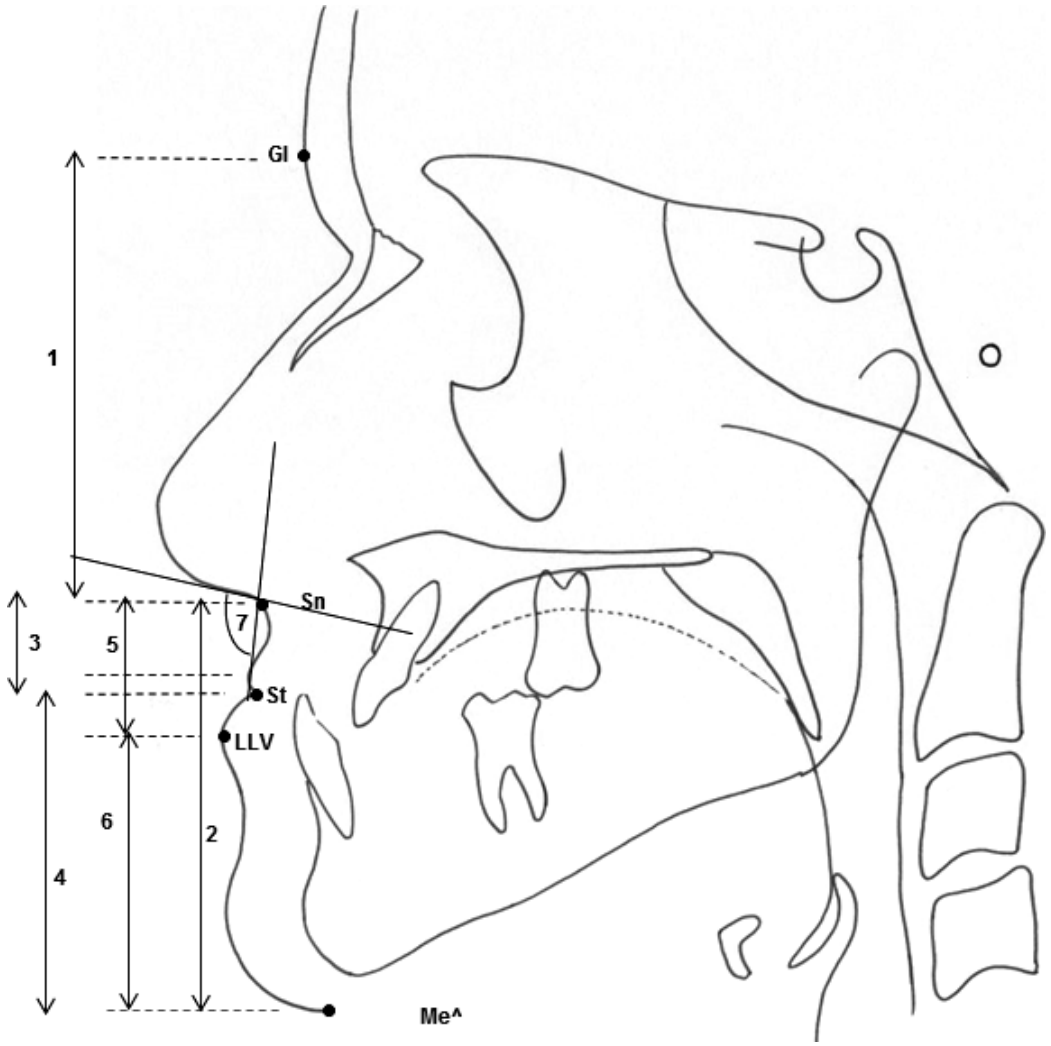

Figure 3. Soft tissue variables. (1) Gl-Sn. (2) Sn-Me^. (3) Sn-St. (4) St-Me. (5) Sn-LLV. (6) LLV-Me^. (7) Nasolabial.

grams were traced and cephalometric reference points were determined by using acetate paper. Seven degrees to the sella nasion plane through sella point was taken as the horizontal reference plane (HR) and perpendicular to HR through S point was taken as the vertical reference plane (VR) (Figure 1). These reference planes were used as the guides in measuring the projected distances of the reference landmarks (Figure 1). Ten skeletal and dental (Figure 1) and 18 soft tissue parameters (Figures 2 and 3) were used in the study. Linear and angular measurements were done with the help of the PorDios (Purpose on Request Digitizer Input Output System, Institute of Orthodontic Computer Science, Aarhus, Denmark) cephalometric analysis program.

Statistical Analysis

The mean values and standard error of the means at each time interval were calculated. To determine the differences between the periods T2-T1, T3-T2, T4-T3, and T5-T4, paired *t*-test was used.

Error Study

All digitizing points and measurements were repeated on 35 randomly selected radiographs. Measurements were compared and correlation coefficients (r^2) were obtained. Cephalometric landmarks of the radiographs were digitized twice to eliminate errors in measurements.

RESULTS

The reliability of the method was high, with the correlation coefficients ranging between 0.9910 and 0.9963. The mean values and standard error of the means of the variables at each time interval are presented in Table 2. The mean amount of maxillary advancement was 4.34 and mandibular setback was 3.97 mm. In Table 3, the statistical means of the

Table 2. Means and Standard Error of the Means of the Parameters According to Time Intervals[a]

	T1 (n = 25)	T2 (n = 11)	T3 (n = 26)	T4 (n = 24)	T5 (n = 9)
Parameters	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM
Skeletal and dental					
SNA, degrees	78.85 ± 2.94	82.89 ± 2.49	82.27 ± 3.41	81.87 ± 3.34	83.02 ± 3.01
A-VR, mm	65.49 ± 4.47	68.77 ± 5.73	69.26 ± 5.19	68.95 ± 5.00	68.95 ± 3.26
A-HR, mm	57.71 ± 4.21	56.80 ± 3.65	56.67 ± 4.10	56.85 ± 4.03	56.97 ± 4.21
SNB, degrees	83.13 ± 3.88	82.37 ± 2.93	81.31 ± 3.43	80.90 ± 3.48	81.37 ± 3.59
B-VR, mm	70.32 ± 7.11	67.73 ± 7.16	66.77 ± 6.30	66.10 ± 6.30	65.75 ± 5.79
B-HR, mm	102.93 ± 7.73	97.26 ± 6.21	98.67 ± 7.41	99.31 ± 6.42	100.58 ± 6.22
ANB, degrees	−4.27 ± 3.06	0.53 ± 2.51	0.96 ± 1.98	0.98 ± 2.01	1.64 ± 2.15
GoGn/SN, degrees	37.80 ± 4.65	34.24 ± 3.79	34.93 ± 4.62	34.94 ± 5.38	37.24 ± 4.47
Overjet, mm	−7.03 ± 3.46	2.63 ± 3.40	3.13 ± 1.16	2.69 ± 0.94	3.04 ± 0.97
Overbite, mm	−2.29 ± 2.58	1.29 ± 1.72	1.10 ± 1.08	1.24 ± 1.07	1.36 ± 0.63
Soft tissue					
Pr-HR, mm	46.23 ± 4.86	45.14 ± 4.23	45.03 ± 4.20	46.11 ± 4.70	46.18 ± 5.13
Pr-VR, mm	101.12 ± 7.56	102.15 ± 7.60	102.22 ± 7.65	102.25 ± 7.66	102.30 ± 8.09
Sn-HR, mm	56.57 ± 4.92	55.98 ± 4.87	55.73 ± 5.04	56.29 ± 4.83	56.57 ± 5.09
Sn-VR, mm	83.88 ± 5.83	85.57 ± 6.75	85.98 ± 6.406	85.68 ± 6.12	85.56 ± 5.13
ULA-HR, mm	72.12 ± 6.28	71.17 ± 6.07	72.22 ± 6.47	72.92 ± 6.23	74.37 ± 7.24
ULA-VR, mm	85.85 ± 6.01	88.90 ± 6.68	88.06 ± 6.27	87.97 ± 5.99	87.58 ± 4.10
LLA-HR, mm	87.07 ± 8.23	87.24 ± 8.30	87.24 ± 8.15	88.33 ± 7.49	89.72 ± 8.07
LLA-VR, mm	89.64 ± 7.43	87.08 ± 7.20	86.10 ± 6.59	86.19 ± 6.61	85.03 ± 5.03
B^-HR, mm	101.34 ± 9.01	97.93 ± 7.34	98.43 ± 8.71	99.24 ± 8.18	101.04 ± 7.82
B^-VR, mm	82.90 ± 7.17	79.62 ± 7.08	78.87 ± 6.46	78.65 ± 6.57	77.63 ± 5.85
B-B^, mm	13.05 ± 1.33	12.14 ± 1.19	12.32 ± 1.03	12.89 ± 1.30	12.10 ± 0.98
Gl-Sn, mm	76.51 ± 5.73	76.75 ± 5.24	76.23 ± 5.57	76.76 ± 5.21	76.16 ± 5.75
Sn-Me^, mm	80.57 ± 7.69	76.23 ± 5.70	78.99 ± 8.79	78.96 ± 7.80	79.78 ± 7.09
Sn-St, mm	22.18 ± 3.35	22.59 ± 3.29	23.86 ± 3.43	24.15 ± 3.36	25.63 ± 3.40
St-Me, mm	58.69 ± 5.07	53.42 ± 3.56	55.33 ± 5.82	55.09 ± 5.05	54.25 ± 3.91
Sn-LLV, mm	32.20 ± 4.13	32.12 ± 5.94	32.34 ± 4.69	33.03 ± 4.46	34.18 ± 4.96
LLV-Me^, mm	52.86 ± 4.65	46.84 ± 3.44	48.88 ± 4.76	48.58 ± 4.49	47.72 ± 2.57
Nasolabial, degrees	149.38 ± 13.48	95.29 ± 12.21	97.40 ± 10.04	96.68 ± 11.27	97.33 ± 8.45

[a] T1 indicates presurgery; T2, postsurgery; T3, posttreatment; T4, first retention; T5, second retention; and SEM, standard error of the mean.

differences and the standard error of the means of the parameters between time intervals are presented.

There was no significant relapse in skeletal parameters. Overjet was significantly reduced between T4-T3 time intervals ($P < .01$). There were significant increases in Sn-HR, ULA-HR, LLA-HR, B-B^ ($P < .01$), and B^-HR ($P < .05$) between T4-T3. There was no significant change in the soft tissue parameters between T5-T4 time intervals.

DISCUSSION

A total of 26 subjects were used in the study. There were missing radiographs at the time intervals of some patients; however, we included those patients as well because long-term material is valuable for research. Therefore, the comparisons differ in terms of the number of subjects between time intervals.

We used several retention records to make a more detailed evaluation of postsurgery soft tissue outcome. Our statistical analysis was based on the mean changes between T2-T3, T3-T4, and T4-T5.

In our study, the mean amount of maxillary advancement was 4.34 with no impaction, and mandibular setback was 3.97 mm. There was a decrease in anterior face height with the mean amount of mandibular upward movement, 4.09 mm, and the mean amount of the decrease in GoGn/SN, 3.29° after surgery. No significant relapse was detected in skeletal variables between postsurgery, posttreatment, and retention records. There was a significant decrease only in overjet ($P < .01$) between the posttreatment record and the 3-year follow-up record.

According to our results, we detected significant soft tissue changes mostly between posttreatment and first retention records. Significant changes occurred in the vertical parameters such as Sn-HR, ULA-HR, LLA-HR, and B^-HR. This can be interpreted as vertical downward repositioning of upper lip, lower lip, soft tissue B point, and subnasale.

In the normal aging and maturation of the soft tissues, significant typical changes occur, including thinning of the lips and downward movement of the lips relative to the teeth, an apparent lengthening of the

Table 3. Means and Standard Error of the Means of the Parameters According to Time Intervals[a]

	T2-T1 (n = 10)	T3-T2 (n = 11)	T4-T3 (n = 24)	T5-T4 (n = 9)
Parameters	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM
Skeletal and dental				
SNA, degrees	4.06 ± 2.27***	0.45 ± 1.40	−0.28 ± 1.44	−0.15 ± 1.04
A-VR, mm	4.34 ± 2.52***	0.77 ± 1.87	0.02 ± 1.52	−0.09 ± 1.12
A-HR, mm	−0.82 ± 3.38	0.91 ± 1.97	0.32 ± 1.89	−0.12 ± 0.88
SNB, degrees	−1.40 ± 2.64	−0.09 ± 1.27	−0.19 ± 1.24	−0.28 ± 0.91
B-VR, mm	−3.97 ± 5.28***	0.05 ± 2.58	−0.09 ± 2.29	−0.45 ± 1.53
B-HR, mm	−4.09 ± 4.21**	−0.19 ± 1.22	0.50 ± 1.88	0.51 ± 1.55
ANB, degrees	5.46 ± 2.26***	0.55 ± 2.18	−0.09 ± 0.59	0.13 ± 0.36
GoGn/SN, degrees	−3.29 ± 3.49*	−0.47 ± 2.55	−0.21 ± 2.15	−0.40 ± 1.46
Overjet, mm	9.56 ± 3.67***	0.69 ± 3.33	−0.52 ± 0.71**	−0.13 ± 0.73
Overbite, mm	3.05 ± 3.62*	1.01 ± 1.80	−0.26 ± 0.88	−0.11 ± 0.74
Soft tissue				
Pr-HR	−1.57 ± 2.16*	−0.41 ± 1.21	0.45 ± 2.11	0.54 ± 2.40
Pr-VR	1.29 ± 1.96*	0.09 ± 1.14	0.18 ± 1.29	0.02 ± 1.37
Sn-HR	−1.01 ± 1.45	−0.09 ± 1.22	0.68 ± 1.07**	0.55 ± 1.56
Sn-VR	2.61 ± 2.67*	−0.38 ± 1.53	0.07 ± 1.16	−0.29 ± 0.95
ULA-HR	−0.66 ± 2.18	0.05 ± 1.11	0.91 ± 1.26**	1.21 ± 1.45
ULA-VR	3.77 ± 4.76*	−0.96 ± 2.27	0.29 ± 1.95	−0.12 ± 1.31
LLA-HR	1.16 ± 5.65	−1.38 ± 3.23	1.07 ± 1.66**	1.28 ± 1.71
LLA-VR	−2.32 ± 4.66	−0.67 ± 2.45	0.62 ± 2.25	−0.45 ± 1.38
B^-HR	−2.57 ± 5.60*	−1.05 ± 2.24	0.93 ± 1.75*	1.39 ± 2.54
B^-VR	−3.63 ± 5.37*	0.15 ± 2.99	0.40 ± 2.39	−0.80 ± 1.29
B-B^	−1.03 ± 1.10*	0.02 ± 0.53	0.59 ± 0.96**	−0.65 ± 1.33
Gl-Sn	−0.42 ± 4.06	−0.23 ± 2.75	0.84 ± 2.53	−0.62 ± 3.16
Sn-Me^	−1.35 ± 3.81	−0.92 ± 2.43	−0.05 ± 2.27	−0.03 ± 1.84
Sn-St	1.26 ± 2.58	−0.00 ± 1.32	0.23 ± 1.04	0.65 ± 1.15
St-Me	−3.18 ± 2.28**	−0.47 ± 2.65	−0.21 ± 2.30	−0.64 ± 1.56
Sn-LLV	1.21 ± 4.81	−1.40 ± 2.90	0.55 ± 1.25	0.67 ± 1.02
LLV-Me^	−4.34 ± 2.85***	−0.05 ± 2.75	−0.21 ± 2.21	−0.63 ± 1.85
Nasolabial	−0.81 ± 9.37	−0.27 ± 5.47	−0.45 ± 3.84	−0.84 ± 2.14

[a] T1 indicates presurgery; T2, postsurgery; T3, posttreatment; T4, first retention; T5, second retention; and SEM, standard error of the mean.

lower face, and flattening of the upper lip on profile view.[15–18] The significant vertical changes of the soft tissues between posttreatment and 3-year retention records might be attributed to maturation. However, no significance was observed in those parameters between postsurgery 3 years and 5 years follow-up, though those parameters also slightly increased between those periods. We can conclude that maturation together with vertical relapse caused significant soft tissue changes between those periods.

Bailey at al.[13] evaluated long-term soft tissue changes in Class III bimaxillary surgery patients at postsurgery 1 year and 5 years.[13] They used Sn-St (upper lip length), Sn-Me (inferior soft tissue face height), and B^-St (lower lip length) for vertical measurements, and they did not find any significant change in those parameters. However, they did not analyze ULA, LLA, Sn, and B^ separately. In our study, we also did not find significant changes in the parameters Gl-Sn, Sn-Me^, Sn-St, St-Me, Sn-LLV, and LLV-Me^.

There was a significant increase in B-B^ between posttreatment and first retention periods. The increase of this soft tissue thickness result might be attributed to downward positioning of upper lip, lower lip, and subnasale.

It has been suggested that most of the postsurgical change in the soft tissue profile takes place during the first year.[1,13,19,20] However, in our study we detected most of the significant changes in the postsurgery 3-year follow-up.

CONCLUSION

- Soft tissue vertical relapse occurs in skeletally stabile Class III bimaxillary surgery patients in the first 3 years after surgery.

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