

The Effects of Tooth Extraction and Nonextraction on the Soft Tissue Profile in Patients With Class II Division 2 Malocclusion

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ABSTRACT

Objective: To determine and compare change in the position and area of the upper and lower lips in patients with Class II division 2 malocclusion treated with and without tooth extraction.

Materials and Method: This retrospective study included 40 female adolescent patients with Class II division 2 malocclusion who were divided into an extraction treatment group (group E, n=20) and a nonextraction treatment group (group NE, n=20). Pretreatment (T1) and posttreatment (T2) cephalometric variables, and upper-lower lip area (via digital planimeter) were measured on lateral cephalometric radiographs. For soft tissue profile area measurement the upper lip was divided into 2 parts (area 1 and 2), and the lower lip was divided into 3 parts (area 3, 4, and 5). The paired *t* test was used to determine intragroup differences, and the Student *t* test was used to determine intergroup differences.

Results: Mean age in group E was 15.8 years vs 15.4 years in group NE. A wide range of individual responses to the treatment protocols were observed, and none of the skeletal or soft tissue changes differed significantly between the groups.

Conclusion: Despite great variability in posttreatment soft tissue changes—including area measurements—the mean values for all measurements were similar in group E and group NE. Nonetheless, due to the observed variation in soft tissue response, we think that treatment planning should be carefully tailored to the needs of each patient. (*Turkish J Orthod* 2014;27:63–69)

KEY WORDS: Class II division 2 malocclusion, Digital planimeter, Soft tissue profile

INTRODUCTION

The prevalence of Class II division 2 malocclusion varies between 1.5% and 7.0%.^{1–3} Deep bite is an extremely deep vertical overbite of the upper and lower incisors.⁴ Patients with Class II division 2 malocclusion have reduced lower face height,^{2,5} a high lip line, and strong overlapping of the upper central incisors by the lower lip.^{2,5,6} In all cases of malocclusion, improved facial esthetics is the primary aim of orthodontic treatment, and in recent years it has acquired even more importance, both for patients and orthodontists. Patients think that orthodontic treatment will improve their dental and facial esthetics, and consequently their social life.^{7,8} Facial harmony is often determined by the morpho-

logic relationships and proportions of the nose, lips, and chin^{9,10}; the balance between these structures can be altered by orthodontic treatment. Some treatments, including premolar extraction, produce changes in the facial profile.

Orthodontists continue to debate the validity of extracting permanent teeth to improve the dento-skeletal profile. Much of the negative commentary concerning extraction has centered on the claim that the extraction of 4 premolars produces an unesthetic soft tissue profile because of “flattening” or “dishing-in” of the lips relative to the chin and nose¹¹; however, according to some researchers, extraction

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Table 1. The mean, minimum, and maximum values of the chronologic ages of the patients for stages T1 (pretreatment) and T2 (posttreatment)

Chronologic Age	T1			T2		
	Mean	Min	Max	Mean	Min	Max
Extraction (n=20)	15.7	12.1	19.1	18.3	13.3	22.4
Nonextraction (n=20)	15.4	12.7	19.1	17.1	13.6	21.2

and nonextraction treatments do not produce very different results.^{12–14} Nowadays, protrusive lips are considered to be attractive.^{7,15,16} Variations in occlusion and in the thickness of the upper and lower lip vermilion unquestionably have a significant influence on the perception of facial attractiveness.^{7,15,16}

The literature includes many studies on lip posture changes after premolar extraction in patients with Class II division 1 bimaxillary protrusion and in Class I patients, but there are limited data on the effect of tooth extraction on the soft tissue profile in patients with Class II division 2 malocclusion. As such, the present study aimed to determine and compare changes in soft tissue lip position and thickness in patients with Class II division 2 malocclusion treated with and without extraction. To the best of our knowledge, the present study is the first to evaluate lip thickness before and after extraction and nonextraction treatment in patients with Class II division 2 malocclusion.

MATERIALS AND METHODS

This retrospective study included 40 female adolescent patients with Class II division 2 malocclusion who were treated at the University of Ankara, School of Dentistry, Department of Orthodontics, Ankara, Turkey, between 2000 and 2010. The patients were divided into an extraction group (group E, n=20), in which the 4 first premolars were extracted, and a nonextraction group (group NE, n=20) (Table 1).

Inclusion criteria were as follows:

- adolescent patients with a Class II molar relationship;
- overbite >3 mm;
- negative history of orthodontic treatment;
- no missing teeth or craniofacial anomalies;
- >2 retroclined upper incisors; and
- lateral cephalograms of good quality.

Patients in both groups were treated with Roth prescription brackets. Patients with crowding >7 mm

in both maxillary and mandibular arches were treated using first premolar extraction. In group E, intramaxillary and intermaxillary elastics for space closure were used. Second molars were also banded, and minimal force was used to avoid mesialization of the molars. In group NE, Class II intermaxillary elastics were used to obtain a Class I canine and molar relationship. In order to prevent excessive mandibular incisor protrusion due to use of Class II intermaxillary elastics in group NE, vestibular root torque (6°) was applied to 0.017 × 0.025-inch stainless steel arch wires accompanied by elastics.

Cephalometric Analysis

Lateral cephalometric radiographs were obtained before (T1) and after treatment (T2) by the same operator under standardized conditions; patients were in centric occlusion, and a relaxed lip position was achieved by instructing the patients to gently stroke their lips and relax.¹⁷ This procedure was repeated several times to ensure a relaxed position without any muscular contraction. Lateral cephalograms were traced, and cephalometric reference points were determined using acetate tracing paper. The SN plane was accepted as the horizontal reference plane, and the perpendicular to the SN plane through the S point was accepted as the vertical reference (VR) plane. These reference planes were used as guides for measuring the projected distances of the reference landmarks. The PorDios (Purpose on Request Digitizer Input Output System, Institute of Orthodontic Computer Science, Aarhus, Denmark) cephalometric analysis program was used to calculate 21 variables (Figs. 1 and 2).

Upper and lower lip areas (mm²) were measured on the lateral cephalograms using a digital planimeter (Ushikata X-Plan380dIII/460dIII, Tokyo, Japan) (Fig. 3a,b).¹⁸ The upper lip was divided into 2 parts (area 1 and 2), and the lower lip was divided into 3 parts (area 3, 4, and 5) (Fig. 4).¹⁸

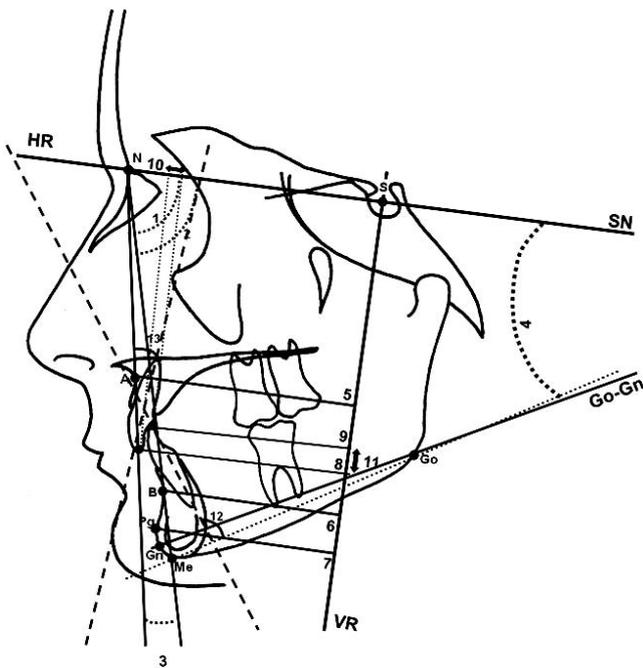


Figure 1. Skeletal measurements: (1) SNA. (2) SNB. (3) ANB. (4) SN/GoGn. (5) A-VR. (6) B-VR. (7) Pg-VR. Dental measurements: (8) U1i-VR. (9) L1i-VR. (10) Overjet. (11) Overbite. (12) U1/ANS-PNS. (13) L1/Me-Go.

Statistical Analysis

The paired *t* test was used to determine intragroup differences, and Student *t* test was used to determine intergroup differences.

Error Study

Cephalometric landmarks in each radiograph were digitized twice, and the PorDios program automatically rejected the digitizing procedure if the 2 digitized points did not match. Area measurements were performed 3 times by the same investigator, and mean values were calculated to eliminate measurement errors.

RESULTS

Pretreatment mean values in both groups are shown in Table 2. At T1 there were no significant differences in any of the parameters between the 2 groups. Differences and the standard error of the differences between T2 and T1 values are shown in Table 3. There were no significance differences in posttreatment lip, dental, or skeletal measurements in either group, except for a significant decrease in overbite ($p < 0.001$). There were slight changes in the area measurements post treatment; area 3 and 4 decreased in both groups as the mandibular incisor

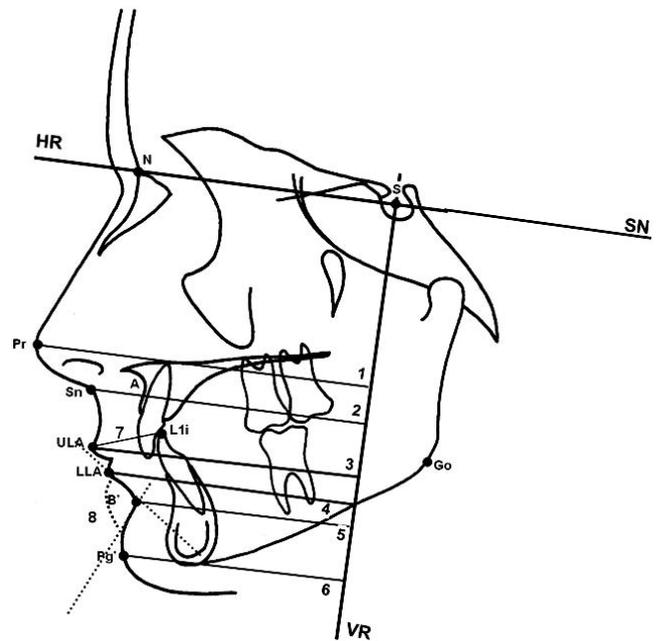


Figure 2. Upper lip-related soft tissue measurements: (1) Pn-VR. (2) Sn-VR. (3) ULA-VR. Lower lip-related soft tissue and skeletal measurements: (4) LLA-VR. (5) B-VR. (6) Pg-VR. (7) L1i-VR. (8) LLA-B-Pg.

and point B moved forward, but the decrease was greater in group E. Area 1 and 5 decreased (not significantly) in group E and increased in group NE, as the corresponding hard and soft tissues moved forward. Area 2 increased in both groups, but the increase was greater in group NE.

DISCUSSION

It is difficult for most clinicians to judge how much a patient's soft tissues will be influenced by the movement of the dentition following orthodontic treatment, which makes the decision to extract premolars difficult. It is generally accepted that tooth extraction causes an increase in overbite; so, unless there is severe dental crowding and/or midline discrepancy, deep bite cases are mostly treated without extractions.¹⁹ This is in contrast to the present findings, as the patients in group E and group NE were treated successfully, with the elimination of deep bite; however, the treatment lasted longer in group E. In order to prevent excessive mandibular incisor protrusion in group NE, vestibular root torque (6°) was applied to the lower 0.017×0.025 -inch stainless steel arch wires, accompanied by intermaxillary Class II elastics. When using full brackets, some researchers have suggested that negative torque for mandibular

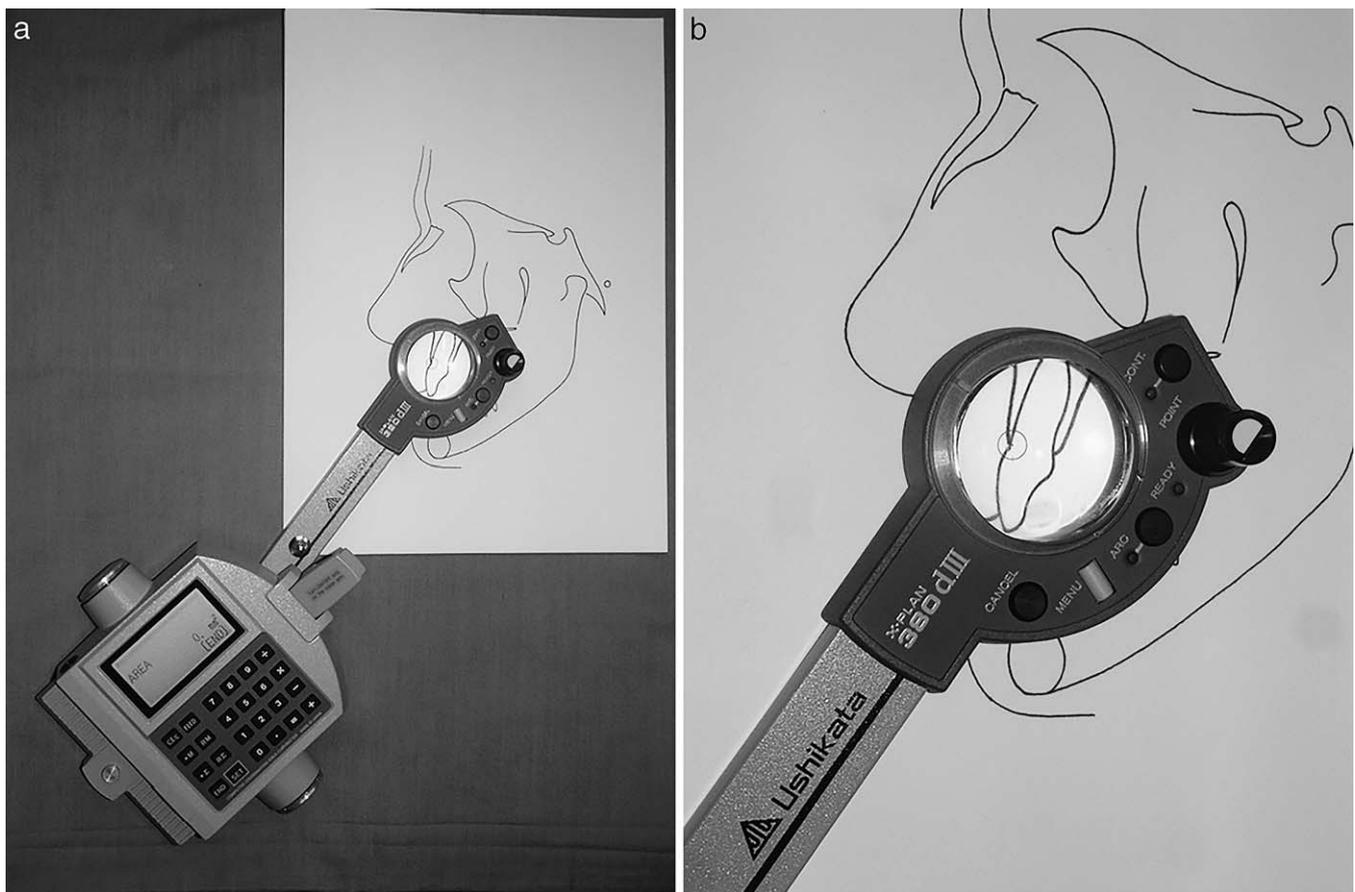


Figure 3. (a) Digital planimeter. (b) Measurement of the areas using the digital planimeter.

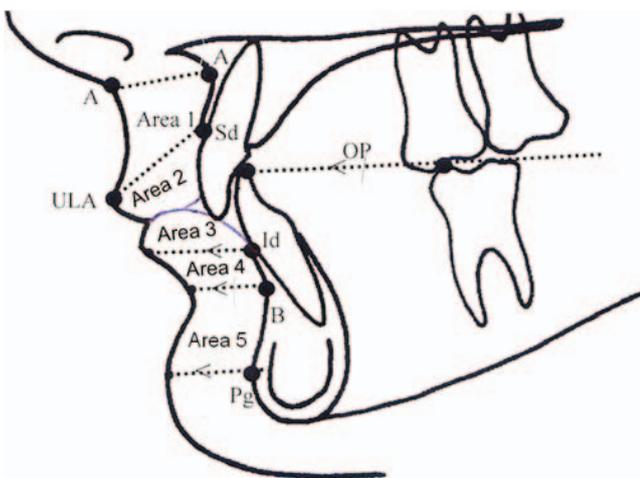


Figure 4. Area measurements: The upper lip was divided into 2 parts (area 1 and 2). Area 1: superior upper labial area—the area between point A, subnasal, upper lip anterior, and supradental point. Area 2: inferior upper labial area—the area below the supradental and upper lip anterior line. The lower lip was divided into 3 parts (area 3, 4, and 5), from the incisal edge of the mandibular central incisor (L1i), infradentale (Id), B point, and pogonion point. Lines dividing the lower lip areas were constructed parallel to the mandibular occlusal

incisor brackets will provide added resistance to proclination of the lower incisors.²⁰

At T1, both groups in the present study had almost identical hard and soft tissue profile characteristics. After treatment, a Class I canine and molar relationship, with ideal incisor inclination, overjet, and overbite, was achieved in all patients. One limitation of the present study is the age distribution of the sample; both groups consisted of patients aged 12.1–19.1 years. According to Pecora *et al.*,²¹ soft tissues continue to change until late adulthood.²¹ The lips of adolescents become relatively more retrusive over time, substantially longer, and somewhat thicker,^{22,23} and the regions of the nose and chin exhibit anterior growth changes in adolescents.²⁴ Adults exhibit more limited growth changes.²⁵ To overcome this limitation, the patients in both groups of the present study were age matched.

←

plane. Area 3: superior lower labial area. Area 4: middle lower labial area. Area 5: inferior lower labial area.

Table 2. The comparison of the mean and standard error of the mean of the soft and skeletal tissue variables at the beginning of treatment (T1) between groups, by Student *t* test

Pretreatment Parameters	Extraction		Nonextraction		Test
	Mean	±Sx	Mean	±Sx	
Skeletal measurements					
1. SNA, degrees	79.58	4.31	79.69	4.03	NS
2. SNB, degrees	74.73	3.67	74.04	2.84	NS
3. ANB, degrees	4.85	1.06	5.65	2.20	NS
4. SN/GoGn, degrees	32.04	5.25	35.98	3.96	NS
5. A-VR, mm	59.00	4.99	59.40	3.37	NS
6. B-VR, mm	44.72	6.34	43.17	4.50	NS
7. Pg-VR, mm	43.06	6.86	39.63	5.14	NS
Dental measurements					
8. U1i-VR, mm	57.75	7.27	56.47	4.83	NS
9. L1i-VR, mm	54.46	6.05	53.81	4.46	NS
10. Overjet, mm	5.94	2.99	5.08	2.17	NS
11. Overbite, mm	5.08	1.79	5.43	1.49	NS
12. U1/NA, degrees	19.32	16.59	16.46	9.70	NS
13. L1/Me-Go, degrees	45.03	9.92	43.88	6.87	NS
Upper lip measurements					
14. Pn-VR, mm	94.03	5.00	95.41	2.07	NS
15. Sn-VR, mm	76.85	5.60	77.09	3.11	NS
16. ULA-VR, mm	73.12	6.52	73.44	3.93	NS
17. Area 1, mm ²	176.14	21.30	197.27	33.06	NS
18. Area 2, mm ²	79.90	17.47	88.38	12.67	NS
Lower lip measurements					
19. LLA-VR, mm	66.33	5.97	66.06	3.92	NS
20. B'-VR, mm	56.31	6.16	54.37	4.50	NS
21. Pg'-VR, mm	56.12	7.55	52.51	5.70	NS
22. L1i-LLA, mm	16.85	2.05	16.85	1.97	NS
23. LLA-B'-Pg', degrees	122.46	10.97	131.24	10.90	NS
24. Area 3, mm ²	105.71	24.58	128.04	35.36	NS
25. Area 4, mm ²	93.63	17.17	95.15	29.63	NS
26. Area 5, mm ²	217.5	41.9	208.00	27.05	NS

Within each of the present study's 2 groups there were no significant differences between pretreatment and posttreatment lip parameters. Similarly, Zierhut *et al.*¹¹ reported no significant differences in profile change between Class II division 1 patients treated with 4 premolar extraction and nonextraction; however, others reported retrusion of the lips and flattening of the profile following extraction.^{13,26,27} In fact, the concept "extraction therapy flattens the profile" assumes that a greater degree of incisor retraction occurs secondary to tooth extraction and that the soft tissues follow the underlying dental changes by a corresponding and predictable degree; however, in the present study there was no significant posttreatment movement of the upper or lower incisors in either group, and harmonized facial esthetics were obtained in both groups. Surprisingly, no retraction of the lips was noted in group E, which

might have been due to the fact that the patients selected for the study had >7 mm of crowding, and as such there was no/minimal extraction space left for incisor retraction after crowding was resolved. This finding should be evaluated further in patients with severe crowding.

Some studies have used ratios to quantify the response to incisor retraction in premolar extraction cases, showing that there is no 1:1 relationship. The ratio of maxillary incisor retraction to posterior movement of the upper lip has been reported to vary from 1.2:1 to 3.2:1.²⁸⁻³⁵ The ratio for the response of the lower lip ranges from 0.4:1 to 1.8:1²⁹⁻³³; however, it should be noted that the ratio implies that the relationship between hard and soft tissue changes is linear, even though studies have shown that this is not necessarily the case.³⁴

Table 3. Mean difference and the standard error of the differences between posttreatment and pretreatment values according to groups

Treatment Changes	Extraction		Nonextraction		Test
	D	±Sx	D	±Sx	
Skeletal measurements					
1. SNA, degrees	-0.65	6.22	0.83	4.32	NS
2. SNB, degrees	0.14	5.86	0.75	4.62	NS
3. ANB, degrees	-0.79	1.25	0.09	2.40	NS
4. SN/GoGn, degrees	-0.35	6.58	2.01	7.33	NS
5. A-VR, mm	1.08	5.12	1.54	4.61	NS
6. B-VR, mm	2.20	7.97	1.86	7.13	NS
7. Pg-VR, mm	2.74	8.86	2.25	9.79	NS
Dental measurements					
8. U1i-VR, mm	0.48	9.70	1.39	7.22	NS
9. L1i-VR, mm	0.56	8.21	0.48	5.87	NS
10. Overjet, mm	0.44	3.31	1.00	1.99	NS
11. Overbite, mm	-3.01**	2.28	-3.52**	2.11	NS
12. U1/NA, degrees	0.99	16.59	3.32	13.44	NS
13. L1/Me-Go, degrees	-5.76	12.34	-0.64	8.99	NS
Upper lip measurements					
14. Pn-VR, mm	0.80	6.46	0.86	7.14	NS
15. Sn-VR, mm	0.46	6.44	0.66	6.84	NS
16. ULA-VR, mm	1.48	6.77	1.43	6.80	NS
17. Area 1, mm ²	-1.90	39.30	22.50	139.00	NS
18. Area 2, mm ²	3.47	22.54	9.75	92.87	NS
Lower lip measurements					
19. LLA-VR, mm	0.93	7.66	1.31	6.70	NS
20. B'-VR, mm	1.63	8.06	2.25	8.43	NS
21. Pg'-VR, mm	2.32	8.98	2.51	11.39	NS
22. L1i-LLA, mm	1.00	2.44	0.47	2.39	NS
23. LLA-B'-Pg', degrees	-0.30	14.73	1.25	12.92	NS
24. Area 3, mm ²	-7.56	37.53	-3.83	43.24	NS
25. Area 4, mm ²	-8.45	23.09	-4.57	40.47	NS
26. Area 5, mm ²	-0.87	77.47	28.94	91.00	NS

* $p < 0.05$; ** $p < 0.01$. NS indicates not significant.

Although changes in the parameters ULA-VR, LLA-VR, B'-VR, and Pg'-VR were quite similar in both groups, area measurements differed slightly. Results of area measurement in the present study showed significant individual variability due to variation in lip morphology, tonicity, and thickness.³⁵ Such changes and differences in cross-sectional area measurements between the groups can be disregarded, because they are so small relative to changes reported in similar previous studies¹⁸; as such, additional research based on volumetric measurements could provide more useful data on lip posture.

CONCLUSION

The common belief that extraction therapy negatively affects the profile was not confirmed by the

present findings. Slight differences between the extraction and nonextraction groups were observed, but they were too minor to be associated with the side effects of extraction. Based on the present findings, we think that in routine clinical practice the lip posture and thickness of each patient should be evaluated carefully before deciding to extract any teeth.

REFERENCES

1. Delevianis HP, Kuftinec MM. Variation in morphology of the maxillary central incisors found in Class II, division 2 malocclusions. *Am J Orthod.* 1980;78:438-443.
2. Karlsen AT. Craniofacial characteristics in children with Angle Class II div. 2 malocclusion combined with extreme deep bite. *Angle Orthod.* 1994;64:123-130.
3. Peck S, Peck L, Kataja M. Class II, Division 2 malocclusion:

- a heritable pattern of small teeth in well-developed jaws. *Angle Orthod.* 1998;68:9–20.
4. Mayrhofer B. *Lehrbuch der Zahnkrankheiten*. Jena, Germany: G Fischer; 1912.
 5. Mills JR. The problem of over bite in Class II division 2 malocclusion. *Br J Orthod.* 1973;1:34–48.
 6. Lapatki BG, Mager AS, Schulte-Moenting J, Jonas IE. The importance of the level of the lip line and resting lip pressure in Class II division 2 malocclusion. *J Dent Res.* 2002;81:323–328.
 7. Birkeland K, Bøe OE, Wisth PJ. Relationship between occlusion and satisfaction with dental appearance in orthodontically treated and untreated groups. A longitudinal study. *Eur J Orthod.* 2000;22:509–518.
 8. Kiekens RM, Maltha JC, van't Hof MA, Kuijpers-Jagtman AM. Objective measures as indicators for facial esthetics in white adolescents. *Angle Orthod.* 2006;76:551–556.
 9. Ricketts RM. Esthetics, environment, and the law of lip relation. *Am J Orthod.* 1968;54:272–289.
 10. Czarnecki ST, Nanda RS, Currier GF. Perceptions of a balanced facial profile. *Am J Orthod Dentofacial Orthop.* 1993;104:180–187.
 11. Zierhut EC, Joondeph DR, Artun J, Robert M, Little RM. Long-term profile changes associated with successfully treated extraction and nonextraction Class II division 1 malocclusions. *Angle Orthod* 2000;70:208–219.
 12. Paquette DE, Beattie JR, Johnston LE Jr. A long-term comparison of nonextraction and premolar extraction edgewise therapy in “borderline” Class II patients. *Am J Orthod Dentofacial Orthop.* 1992;102:1–14.
 13. Bishara SE, Cummins DM, Jacobsen JR, Zaher AR. Dentofacial and soft tissue changes to Class II Division 1 cases treated with and without extractions. *Am J Orthod Dentofacial Orthop.* 1995;107:28–37.
 14. Young T, Smith R. Effects of orthodontics on the facial profile: a comparison of change during nonextraction and four premolar extraction treatment. *Am J Orthod Dentofacial Orthop.* 1993;103:452–458.
 15. Nguyen DD, Turley PK. Changes in the Caucasian male facial profile as depicted in fashion magazines during the twentieth century. *Am J Orthod Dentofacial Orthop.* 1998;114:208–217.
 16. Scott CR, Goonewardene MS, Murray K. Influence of lips on the perception of malocclusion. *Am J Orthod Dentofacial Orthop.* 2006;130:152–162.
 17. Burstone CJ. Lip posture and its significance in treatment planning. *Am J Orthod.* 1967;53:262–284.
 18. Altuğ-Ataç AT, Bolatoğlu H, Toygar-Memikoğlu U. Facial soft tissue profile following bimaxillary orthognathic surgery. *Angle Orthod.* 2008;78:50–57.
 19. Oliver BM. The influence of lip thickness and strain on upper lip response to incisor retraction. *Am J Orthod.* 1982;82:141–148.
 20. Vogt W. The Forsus Fatigue Resistant Device. *J Clin Orthod.* 2006;40:368–377.
 21. Pecora NG, Baccetti T, McNamara JA Jr. The aging craniofacial complex: a longitudinal cephalometric study from late adolescence to late adulthood. *Am J Orthod Dentofacial Orthop.* 2008;134:496–505.
 22. Nanda RS, Meng H, Kapila S, Goorhuis J. Growth changes in the soft tissue facial profile. *Angle Orthod.* 1990;60:177–190.
 23. Bishara SE, Hession TJ, Peterson LC. Longitudinal soft-tissue profile changes: a study of three analyses. *Am J Orthod.* 1985;88:209–223.
 24. Hodges A, Rossouw PE, Campbell PM, Boley JC, Alexander RA, et al. Prediction of lip response to four first premolar extractions in white female adolescents and adults. *Angle Orthod.* 2009;79:413–421.
 25. Behrents RG. *Growth in the Aging Craniofacial Skeleton*. Monograph #17, Craniofacial Growth Series. Ann Arbor, Mich: Center for Human Growth and Development, University of Michigan; 1985:54–67.
 26. Kocadereli I. Changes in soft tissue profile after orthodontic treatment with and without extractions. *Am J Orthod Dentofacial Orthop.* 2002;122:67–72.
 27. Hazar S, Akyalçın S, Boyacıoğlu H. Soft tissue profile changes in Anatolian Turkish girls and boys following orthodontic treatment with and without extractions. *Turk J Med Sci.* 2004;34:171–178.
 28. Lew K. Profile changes following orthodontic treatment of bimaxillary protrusion in adults with the Begg appliance. *Eur J Orthod.* 1989;11:375–381.
 29. Diels RM, Kalra V, Deloach N Jr, Powers M, Nelson SS. Changes in soft tissue profile of African-Americans following extraction treatment. *Angle Orthod.* 1995;65:285–292.
 30. Caplan MJ, Shivapuja PK. The effect of premolar extractions on the soft tissue profile in adult African American females. *Angle Orthod.* 1997;67:129–136.
 31. Kusnoto J, Kusnoto H. The effect of anterior tooth retraction on lip position orthodontically treated adult Indonesians. *Am J Orthod Dentofacial Orthop.* 2001;120:304–307.
 32. Roos N. Soft-tissue profile changes in Class II treatment. *Am J Orthod.* 1977;72:165–174.
 33. Le TN, Sameshima GT, Grubb JE, Sinclair PM. The role of computerized video imaging in predicting adult extraction treatment outcomes. *Angle Orthod.* 1998;68:391–400.
 34. Holdaway RA. A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Part I. *Am J Orthod.* 1983;84:1–27.
 35. Oliver BM. The influence of lip thickness and strain on upper lip response to incisor retraction. *Am J Orthod.* 1982;82:141–148.