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Evaluation of the Effect of Premolar Extraction on Hard and Soft Tissue Profile Changes

Premolar Çekiminin Sert ve Yumuşak Doku Profili Değişiklikleri Üzerindeki Etkisinin Değerlendirilmesi

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ABSTRACT

Objectıve: To evaluate the hard and soft tissue profile changes in pre- and post-treatment cephalometric films in patients over 16 years of age who underwent maxillary two or four premolar tooth extraction. Materials and Methods: Cephalometric radiographs of 68 patients who completed orthodontic treatment were analyzed. Measurements were made on the records of 40 patients who had four first premolars extracted and 28 patients who had two upper premolars extracted. Pre-treatment (T1) and post-treatment (T2) values were compared. The Shapiro-Wilk test was used to evaluate the normal distribution of the data, and paired t-test and independent t-test were used for pre-treatment and post-treatment comparisons. The significance level was taken as $p<0.05$. Results: In the four premolar extraction group, the distances of the upper and lower incisors to the E-plane and lip thickness and lip length increased numerically but were not found to be statistically significant ($p>0.05$). The lower lip thickness increased in the two premolar extraction group ($p<0.05$). In the independent comparison of the parameters between the groups, there was no difference in the nasolabial angle between the two groups at T1, but it increased statistically at T2. The SNA angle decreased numerically in the four premolar extraction group, but increased in the two premolar extraction group. The nasolabial angle increased significantly in both groups. Conclusion: In both extraction groups, minimal profile change was achieved with lip retraction resulting from incisor retraction. Extraction treatment can be considered in cases where the lips are desired to move backward.

Keywords: *Aesthetics, Premolar extraction, Profile change*

ÖZ

Amaç: Maksiller iki veya dört premolar diş çekimi yapılmış 16 yaş üzeri hastalarda tedavi öncesi ve sonrası sefalometrik filmlerde sert ve yumuşak doku profil değişikliklerini değerlendirmektir. Gereç ve Yöntem: Ortodontik tedavisi tamamlanmış toplam 68 hastanın sefalometrik radyografileri analiz edilmiştir. Ölçümler dört birinci premolar dişi çekilmiş 40 hasta ile üst iki premolar dişi çekilmiş 28 hastanın kayıtları üzerinden yapılmıştır. Tedavi öncesi (T1) ve tedavi sonrası (T2) değerleri karşılaştırılmıştır. Verilerin normal dağılımını değerlendirmek için Shapiro-Wilk testi, tedavi öncesi ve sonrası karşılaştırmalar için paired samples t-test ve independent samples t-test kullanılmıştır. Anlamlılık düzeyi $p<0,05$ alınmıştır. Bulgular: Dört premolar çekimli grupta, üst ve alt keser dişlerin E-düzlemine olan uzaklıkları ve dudak kalınlığı ile dudak uzunluğu sayısal olarak artmış ancak istatistiksel olarak anlamlı bulunmamıştır ($p>0,05$). İki premolar çekimli grupta alt dudak kalınlığı artmıştır ($p<0,05$). Parametrelerin gruplar arası bağımsız karşılaştırılmasında nazolabial açıda iki grup arasında T1 de fark yokken T2 de istatistiksel olarak artmıştır. SNA açısı, dört premolar çekimli grupta sayısal olarak azalırken iki premolar çekimli grupta artmıştır. Her iki grupta da nazolabial açı anlamlı düzeyde artmıştır. Sonuç: Her iki çekim grubunda da kesici diş retraksiyonu sonucunda ortaya çıkan dudak retraksiyonu ile minimal düzeyde profil değişikliği elde edilmiştir. Çekimli tedavi, dudakların geriye hareketinin istendiği vakalarda değerlendirilebilir.

Anahtar Kelimeler: *Estetik, Premolar çekimi, Profil değişimi*

INTRODUCTION

Orthodontics aims to treat incompatibilities between the teeth and the facial skeleton. The main goals of orthodontic treatment are to achieve optimal functional occlusion and to achieve a harmonious facial aesthetics and make these results permanent. Past studies and clinical observations have shown that a balance between the teeth and the perioral muscles is required to ensure the stability of orthodontic treatment. The soft tissues of the face have a significant impact on facial aesthetics, speech and other physiologic functions. Therefore, it is accepted that the successful results of orthodontic treatment are closely related to the changes occurring in the soft tissues of the face (1,2). , Although there is a general consensus that orthodontic treatment can affect the soft tissue profile, there is still no consensus on the extent to which soft tissues respond to position changes in the teeth and alveolar structure (3).

In the treatment of many malocclusions for orthodontic treatment, tooth extraction may be planned for different reasons. This planning varies depending on the type of occlusion, function and tooth morphology (4). Regarding the effect of orthodontic treatment with premolar extraction on soft tissues, it has been reported that tooth extraction may result in a retracted profile (5). While some studies have shown that the selection of extraction or non-extraction treatment does not cause profile changes in the medium and long term, others have reported a gradual flattening of the facial profile in growing patients who received both extraction and non-extraction treatment, suggesting that this is due to maturational changes rather than extraction (2,6).

It is clear that the behavior of soft tissues is still unpredictable. In our study, we aimed to evaluate the hard and soft tissue profile changes before and after treatment on cephalometric films of patients aged 16 years and older who underwent maxillary two premolar or four premolar tooth extraction.

MATERIAL and METHOD

This retrospective study was conducted on routine orthodontic treatment records of patients who came to Süleyman Demirel University Department of Orthodontics for treatment. After the patients were informed about the treatment, informed consent forms were obtained before starting the treatment. The power analysis of the study was performed with the G*Power program. A minimum sample size of n = 15 individuals was determined for both groups with 90% power and alpha = 0.05 (7).

In the study, lateral cephalometric radiographs of a total of 68 individuals (18 males, 50 females) whose orthodontic treatment was completed were analyzed. The treatment was carried out retrospectively on the records of 40 patients who had four first premolars extracted and 28 individuals who completed fixed orthodontic treatment by extracting only the upper two first premolars.

The study was conducted after obtaining the necessary ethical approval from Suleyman Demirel University Ethics Committee (Decision No: 27).

The inclusion criteria were as follows; completion of permanent dentition, absence of congenital tooth deficiency and orthodontic treatment completed by extraction of premolars (individuals with teeth numbered 14-24 and premolars numbered 14,24,34,44). Individuals with systemic disorders and regular medication use were not included in the study. The genders and orthodontic malocclusion distributions of the individuals we evaluated are shown in Table 1.

Cephalometric radiographs taken before (T1) and after (T2) orthodontic treatment were evaluated and measured using the WebCeph (A.I. Web Based Orthodontic and Orthognatic Platform, Gyeonggi, South Korea) software program. All parameters evaluated in the study and their definitions are shown in Table 2 and Figure 1. Radiographs were drawn and digitized by two researchers (E.A. and A.D.A.). After two weeks, 20% of the measurements were repeated and the

method error was determined as 0.1 mm. As shown in Figure 1, cephalometric planes were drawn and soft and hard tissue measurements were made. All patients were treated with the MBT system including a 0.22 sloth bracket system and acceptable results were obtained at the end of treatment. Statistical Package fort he Social Sciences (SPSS, Version 29.0, IBM, Armonk, USA) software was used to calculate the statistical analysis of the measured data. As a result, it was determined that the data was normally distributed. The homogeneity of the variances was confirmed with Levene's Test.

Since the obtained measurement values showed parametric properties, 'paired samples t-test' was performed for pre-treatment and post-treatment comparisons. 'Independent samples t-test' was used for independent comparison of the two groups. A value of $p<0.05$ was considered significant.

RESULTS

In our study, cephalometric records of a total of 68 individuals were evaluated. The skeletal malocclusion classification of the premolar extraction samples is shown in Table 3. Four premolar extractions were planned significantly higher in individuals with skeletal class I and two premolar extractions were planned significantly higher in individuals with skeletal class II malocclusion ($p<0.05$). In the group where four premolars were extracted, the distance of the upper incisor to the E-plane and the distance of the lower incisor to the E-plane were numerically increased but not statistically significant. Lip thickness and lip length also increased numerically, but no statistically significant difference was obtained ($p>0.05$). In the group with two premolar extractions, lower lip thickness increased significantly ($p<0.05$). When other measurements were examined, it was not found to be statistically significant (Table 4). In the independent comparison of the parameters between the groups, there was no difference in nasolabial angle between the two groups at T1, but it increased statistically significantly at T2. The increase was more pronounced in the group with two premolar extractions. The differences between SNB and ANB values were statistically significant between the two groups at T1 and T2. The SNA angle decreased numerically in the four premolar extraction group and increased in the two premolar extraction group. Statistically significant differences were observed in IMPA angle between the two groups at T1 and T2. In the four premolar extraction group, the lower incisors were retrusive and retroclined, so the IMPA angle decreased numerically, whereas in the two premolar extraction group, no numerical change was observed (Table 5). Among the skeletal measurement values of the four premolar extraction group, the nasolabial angle increased significantly. IMPA angle, one of the dental measurement parameters, decreased significantly. In the group with two premolar extractions, the nasolabial angle increased significantly, while the ANB angle decreased significantly. No significant difference was found in other measurement values (Table 6).

Table 1. Gender and malocclusion distributions of individuals in the groups

		Skeletal malocclusion n(%)			*Total*	*p*
		Class I	Class II	Class III		
Gender	E	10(32.3)	5(15.6)	3(60.0)	18(26.5)	0,069
	K	21(67.7)	27(84.4)	2(40.0)	50(73.5)	
Total		31	32	5	68	

n: individual, %: percentage, *p<0.05

Table 2. Definitions and norms of cephalometric measurements

Cephalometric measurements	*Definition*	*Standard value*
Upper lip to E-plane	The distance of the most anterior point of the upper lip to the E plane (E plane: The line passing through the pronasale and pogonion)	-6 ± 2 mm

Lower lip to E-plane	The distance of the most anterior point of the lower lip to the E plane (E plane: The line passing through the pronasale and pogonion)	-2 ± 2 mm
Upper vermillion thickness	The distance from the most labial surface of the upper incisor tooth to the vermilion line of the lip	13 ± 1 mm
Lower vermillion thickness	The distance from the most labial surface of the lower incisor tooth to the vermilion line of the lip	13 ± 1 mm
Upper lip length	Distance between subnasal and lowest point of upper lip vermilion	23 ± 3 mm
Lower lip length	Distance between the soft tissue menton and the highest point of the lower lip vermilion	48 ± 4 mm
U1 to UOP	The angle formed by the long axis of the maxillary incisor and the upper occlusal plane	55º ± 4º
L1 to LOP	The angle formed by the long axis of the mandibular incisor and the lower occlusal plane	66º ± 5º
Nasolabial angle	Subnasal, angle formed by the columella and anterior part of the upper lip	102º ± 8º
IMPA	The angle formed between the axis of the lower incisor tooth and the mandibular plane (Go-Me)	90º ± 3º
SNA angle	The angle formed between the SN line passing through the sella and nasion points and the NA line passing through the nasion and A points	82º ± 2º
SNB angle	The angle formed between the SN line passing through the sella and nasion points and the NB line passing through the nasion and B points	80º ± 2º
ANB angle	The angle formed between the lines NA and NB	2º ± 2º

Table 3. Distribution of premolar extraction samples according to skeletal malocclusion classification

		Premolar extraction sample n (%)			p
		14,24,34,44	14,24	Total	
Skeletal malocclusion	Class I	23 (57.5)	8 (28.6)	31 (45.6)	0.002
	Class II	12 (30.0)	20 (71.4)	32 (47.1)	
	Class III	5 (12.5)	0 (0.0)	5 (7.4)	
Total		40	28	68	

n: individual, %: percentage, *p<0.05

Table 4. Soft tissue changes in extraction groups

			Time				
Treatment		Variables	T1	SD	T2	SD	p
14,24,34,44 extraction	U1 to UOP	Upper lip E-plane	-4.12	5,4	-4,32	5,7	0,103
		Upper vermillion thickness	4,66	0,85	4,73	0,95	0,311
		Upper lip lenght	2,72	0,44	2,77	0,32	0,209
	L1 to LOP	Lower lip E plane	-2,10	0,9	-2,82	0,10	0,375
		Lower vermillion thickness	4,90	0,94	5,11	0,97	0,106
		Lower lip lenght	1,47	0,15	1,49	0,18	0,141
14,24 extraction	U1 to UOP	Upper lip E plane	-2,72	2,21	-3,46	3,21	0,079

	Upper vermillion thickness	5,01	0,99	5,02	0,85	0,468
	Upper lip lenght	2,85	0,40	3,00	0,46	0,006
L1 to LOP	Lower lip E plane	-2,57	1,69	-3,01	1,89	0,085
	Lower vermillion thickness	4,24	0,56	4,81	0,59	0,000*
	Lower lip lenght	1,50	0,47	1,36	0,14	0,086

S.D.: Standart Deviation, *p<0,05.

Table 5. Comparison of skeletal and dental measurement values (T1-T2) of 2 and 4 premolar extraction samples*

			T1		*T2*	
Variables	Premolar extraction sample	n	Mean±SD	p	Mean±SD	p
Nazolabial angle	14,24,34,44	40	97,21±10,64	0,147	100,52±10,89	0,003*
	14.24	28	99,99±10,72		107,93±9,98	
IMPA	14,24,34,44	40	95,71±7,52	0,018*	92,49±8,02	0,000*
	14.24	28	99,29±5,50		99,08±5,80	
SNA angle	14,24,34,44	40	80,71±3,54	0,133	80,57±3,79	0,366
	14.24	28	79,63±3,27		80,37±4,26	
SNB angle	14,24,34,44	40	77,61±4,00	0,001*	77,75±4,00	0,002*
	14.24	28	74,59±3,20		74,69±4,64	
ANB angle	14,24,34,44	40	2,96±2,36	0,000*	2,93±2,13	0,000*
	14.24	28	5,67±2,19		5,04±2,26	

Table 6. premolar çekimli örneklerin iskeletsel ve dişsel ölçüm değerlerinin kendi içinde T1-T2 karşılaştırılması

Premolar extraction sample	*Variables*	*T1±SD*	*T2±SD*	*p*
14,24,34,44 (n=40)	Nasolabial_angle	97,21±10,64	100,52±10,89	0,009*
	IMPA	95,71±7,52	92,49±8,02	0,001*
	SNA angle	80,71±3,54	80,57±3,79	0,297
	SNB angle	77,61±4,00	77,75±4,00	0,254
	ANB angle	2,96±2,36	2,93±2,13	0,439
14.24 (n=28)	Nasolabial_angle	99,99±10,72	107,93±9,98	0,000*
	IMPA	99,29±5,50	99,08±5,80	0,429
	SNA angle	79,63±3,27	80,37±4,26	0,053
	SNB angle	74,59±3,20	74,69±4,64	0,389
	ANB angle	5,67±2,19	5,04±2,26	0,031*

n: individual, S.D.: Standart Deviation, *p<0.05, dependent samples t-test

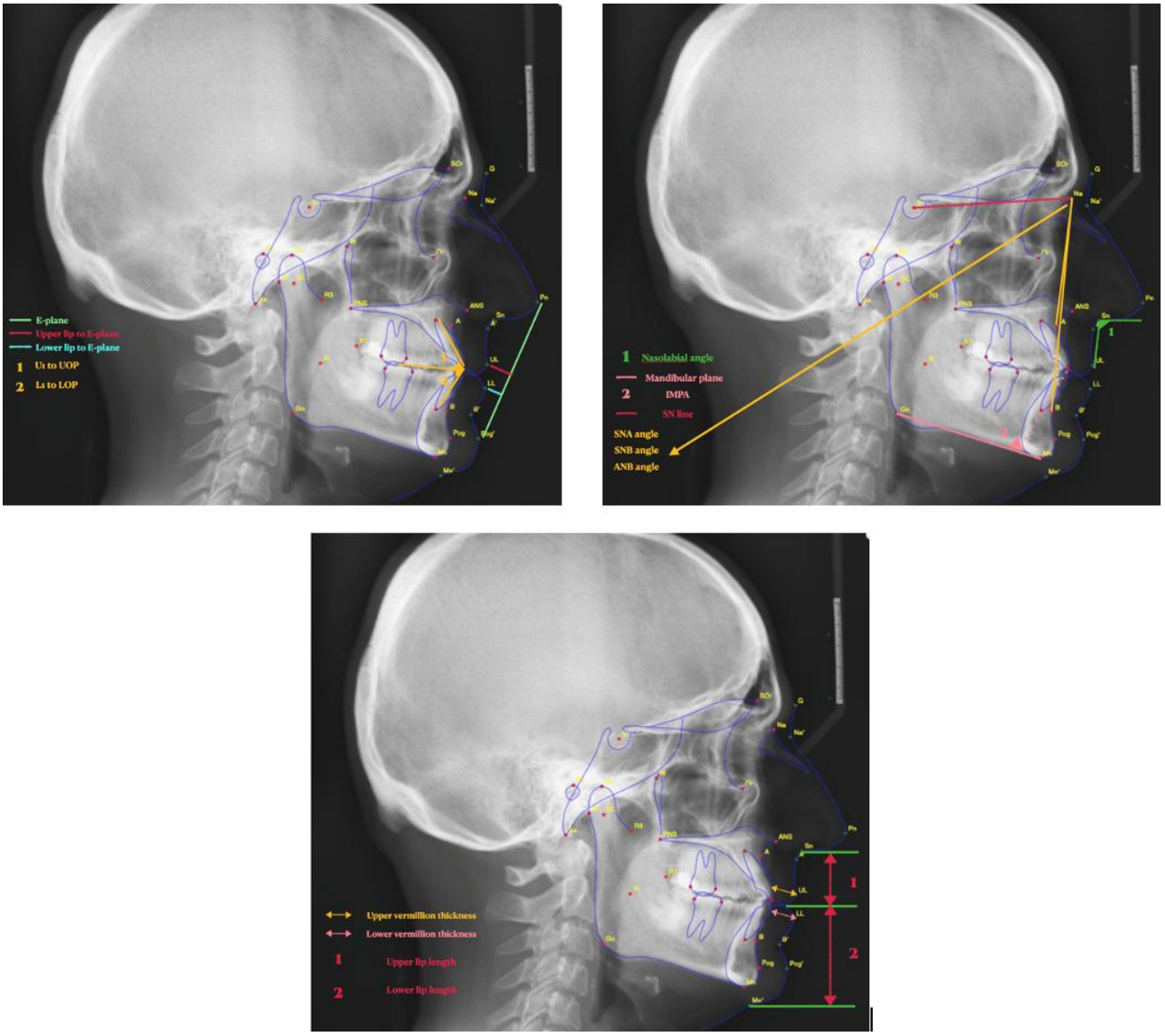

Figure 1. Parameters measured in the study

DISCUSSION

Soft tissue changes and skeletal values may be difficult to predict after treatment with tooth extraction. However, it is stated that in the presence of appropriate indications, treatment with tooth extraction provides better aesthetic results than treatment without extraction (8). Therefore, our study aimed to identify clinical features that would help orthodontists and clinicians to predict profile changes after extraction. In our study, 5 angular measurements and 8 length measurements were used to evaluate the correlation between incisor retraction and lip positions Cephalometric radiographs are an important clinical tool used to measure the size and proportions of the skull. This examination is very important for treatment planning and evaluation of the results (9). In addition, lateral cephalometric radiographs provide information about skeletal structure, dental structure, soft tissue morphology and the relationships between them in the sagittal plane. In this study, cephalometric radiographs taken at the beginning and end of treatment were analyzed. Individual variations that can be observed during changes that occur with growth and development are effective in the evaluation of the soft tissue profile. The radiographs used in this study were selected from individuals who had completed their growth and development. Thus, it is aimed to prevent the effects of growth and development.

In many studies in the literature, it has been reported that premolars are the most frequently extracted teeth during orthodontic treatment. In one study, it was reported that the first premolars were preferred with 59% and the second premolars followed with 13% (10). The decision on which

premolars to extract in treatment is based on a number of factors. Indications for first premolar extraction include anterior crowding, increased overjet and protrusion, increased overbite and serial extraction treatment. Creekmore stated that he prefers extraction of the first premolars in Class II division 2 patients whose growth and development is complete and that this approach is advantageous in cases with deep bite. Dewel, on the other hand, stated that extraction of the first premolars in serial extraction cases may allow the canines to erupt more easily and settle into the extraction cavity (11,12). Indications for second premolar extraction include posterior crowding, anterior open bite and Class III camouflage treatment. Second premolar extraction provides an advantage in the correction of anterior open bite and an increase in overbite in the anterior region is obtained by reducing the posterior vertical dimension (13).

The patients included in our study generally consisted of individuals with class I and class II malocclusion. Premolar extraction treatment is less frequently planned in patients with class III malocclusion. Of the patients treated with four premolar extractions, 57.5% had Class I malocclusion. Upper two premolar extraction was preferred in 71.4% of patients with Class II malocclusion. Adult patients presenting for orthodontic treatment are usually women and it has been reported that women give more importance to the appearance of their dental structures in terms of aesthetics (14). The results of our archival records show that female patients frequently apply for orthodontic treatment.

It has been reported that incisor retraction leads to changes in lip location in cases treated with tooth extraction (15,16). Ricketts, in his study examining the effect of incisor retraction on lip retraction, reported that 1 mm thickening of the upper lip occurred as a result of 3 mm incisor retraction (17). However, individual differences such as soft tissue thickness, lip tension, lip morphology and the amount of dental crowding should be taken into consideration (18). In a recent study, it was shown that lip vermillion thickness and lip morphology were differentially affected by incisor retraction in thin and thick-lipped individuals; the mean incisor/lip retraction ratio was 61% and 98% for the upper and lower lip, respectively, in thin-lipped individuals, whereas these ratios were 17% and 44% in thick-lipped individuals (19). Therefore, it can be said that incisor recession leads to more pronounced changes in lip vermilion thickness in thin-lipped individuals. In a different study, it was reported that the relationship between incisor retraction and lip movement was not significant in individuals with thick lips, while a stronger relationship was found in individuals with thin lips (20). However, some studies have found that lip thickness was significantly reduced or that there was no relationship between incisor retraction and lip thickness (21,17). In our study, although there was no significant difference between upper and lower lip thickness in the four premolar extraction group in the pre- and post-extraction periods, it was observed that the values increased numerically. In the maxillary two premolar extraction group, the lower lip thickness increased significantly. Protrusion and proclination of the lower incisors may have caused an increase in lip thickness.

It can be said that we obtained findings compatible with the results of Ricketts' study (17). Our data showed a positive correlation between incisor retroclination and lip thickness change in both extraction groups, and a numerical increase in vermilion thickness was observed. The unequal number of patients in the extraction groups or racial differences may have caused statistical differences.

In a study evaluating skeletal changes, no statistically significant change was observed in SNA, SNB and ANB angles after extraction of the upper two premolars. However, a significant decrease was found only in the ANB angle in the four premolar extraction group (22). In our study, the ANB angle decreased by 0.6 degrees in the upper two premolar extraction group, and this change was statistically significant. The differences observed in the number of patients and overjet severity may cause differences between the results. In the same study, it was reported that the IMPA angle increased in the upper two premolar extraction group and decreased significantly in the four premolar extraction group (22). Our study similarly reveals that the IMPA angle decreased

significantly in the four premolar extraction group, whereas the increase was not found to be statistically significant in the two premolar extraction group, with a numerical difference of 0.1 degrees observed.

The nasolabial angle also increased in the two-extraction group. Consistent with our study, other studies have also reported an increase in nasolabial angle after extraction (23,24). However, another study reported that no change in nasolabial angle was observed after extraction (25).
With proper planning and an effective treatment approach, extraction of the upper two or four premolars can result in aesthetically acceptable results and no significant changes in the soft tissue profile.

This study was conducted on Caucasians only, but the effects of racial differences on lip protrusion and thickness should be taken into account. The numbers of male and female subjects were not balanced. In accordance with the ALARA (As Low As Reasonably Achievable) principle, CBCT records could not be obtained from the patients and measurements were made with two-dimensional cephalometric images. In addition, although the soft tissue profile can be affected by body weight, the body mass index (BMI) of the patients was not recorded during the treatment process.

CONCLUSION

In both extraction groups, minimal profile change can be achieved with incisor retraction and the resulting lip retraction. Extraction treatment may be considered in cases where lip retraction is desired. In addition, it should not be ignored that due to individual differences, the same results cannot be obtained from every individual.

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