ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 01, pp.45723-45729, January, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

CASE STUDY

CEPHALOMETRIC COMPARISON OF SOFT TISSUE CHANGES AFTER EXTRACTION AND NON-EXTRACTION ORTHODONTIC TREATMENT

***Swati S. Pakolu, Amruta O.Kamble and Rajkiran P.Lokhande**

Department of Orthodontics & Dentofacial Orthopedics, YCMM & RDF's Dental College and Hospital, Ahmednagar, Maharashtra, India

ARTICLE INFO

Article History:
Received 27th October, 2016
Received in revised form
15th November, 2016
Accepted 12th December, 2016
Published online 31st January, 2017

Key words:

Cephalometric soft tissue changes,
Extraction cases,
Non-extraction cases.

ABSTRACT

Objective: To compare changes occurring in the soft tissue profile with orthodontic treatment after extraction and non-extraction cases, and to determine soft tissue parameters that show significant correlations to understand the factors influencing the response to tooth movement.

Methodology: Pre- and post-treatment lateral cephalographs of 16 subjects were assessed. For half of the patients (n=8), treatment included the extraction of 4 premolars, whereas the other half(n=8) were treated by the non-extraction approach.Soft tissue changes by treatment were analyzed and compared between both groups using the independent sample t-test to assess the degree of change with orthodontic treatment. Mean and S.D values before and after extraction and non-extraction treatment were also evaluated.

Nasolabial angle, Labiomental angle, H angle, Lip chin submental angle, upper and lower sulcus depth to H line as well as upper and lower lip to E line were evaluated for study.

Results: Although the premolar extraction group showed greater soft tissue changes with treatment, post-treatment comparisons showed that both extraction and non-extraction groups finished within the almost same soft tissue parameters.

Conclusion: The effects of the two types of orthodontic treatment (i.e. extraction and non-extraction) on the facial soft tissues were very similar, indicating that treatment, involving the extraction of premolars, does not have a detrimental effect on facial aesthetics provided the decision to extract is on sound basis.

Citation: Swati S. Pakolu, Amruta O.Kamble and Rajkiran P.Lokhande, 2017. "Cephalometric comparison of soft tissue changes after extraction and non-extraction orthodontic treatment", *International Journal of Current Research*, 9, (01), 45723-45729.

INTRODUCTION

Evaluating facial profiles and facial balance is a continuous learning process for orthodontists and the effects of orthodontic treatment on the facial profile with or without the extraction of teeth have greatly concerned (Ilken Kocadereli, 2002). Now a day's one of the major reasons patients seek orthodontic treatment is to improve their facial appearance (Dimitrios Konstantonisa, 2012). Success in orthodontic practice is closely related to observable enhancement in the esthetic outcome(s) of the treatment, and therefore evaluating facial profile is of prime importance. Several authors hold a strongly negative view of extraction treatment because they believe that such therapies produce dished-in profiles, flatten the face and make the lips more retrusive thus giving the individual an older appearance (Jay Bowman and Lysle E. Johnston, 2000; Nelson and Russell, 1986; Kusnoto and Kusnoto, 2001; Leonardi *et al*., 2010). Dr. Edward Angle, believed that the dental arches should be expanded to include all the teeth and that an ideal balance and harmony of the face can only occur if all of the teeth are maintained in the ideal occlusion (Angle, 1907). Unlike Angle, Calvin Case stated that expanding the dental arches and ignoring extraction would not guarantee long term stability (Calvin, 1920). While Angle insisted that patients who maintain their full complement of teeth will have superior occlusion and therefore esthetics, Tweed recognized through cephalometrics the impossibility of attaining balance and facial harmony when orthodontically treating all patients without extraction. Tweed noticed that in some cases of non-extraction treatment that the teeth and the therefore covering soft tissue became too protrusive and were not esthetic (Tweed, 1953). Additionally, other authors including students of Angle later verified the therapeutic advantages of extraction therapies (Begg, 1954; Tweed, 1996; Looi and Mills, 1986). It was recognized that between the hard tissue profile and the soft tissue profile, the soft tissue profile was of greater importance when considering esthetics (Burstone, 1959). It had also been recognized by this time the nose, lips, and chin play a dominant role in facial esthetics (Ricketts, 1968). These three structures define the soft tissue facial profile and are important to consider when studying the face. The nose and chin were found

****Corresponding author: Swati S. Pakolu,***
Department of Orthodontics & Dentofacial Orthopedics, &YCMM & RDF's Dental College and Hospital, Ahmednagar, Maharashtra, India

to be, in most cases, independent of orthodontic treatment and affected solely by growth while it was found the lips could be modified with orthodontics (Burstone, 1959; Burstone, 1958; Subtelny, 1961). So the aim of the present study is to compare soft tissue morphology changes by cephalometric measurements before and after orthodontic treatment in extraction and non-extraction cases. This study will also help to evaluate that patients treated with extraction of premolars will improve or harm the esthetics of the soft tissue profile.

MATERIALS AND METHODS

- This in vitro study was carried out in the department of Orthodontics and Dentofacial Orthopedics, YCMM & RDF's Dental College, Ahmednagar. The Available records of the patient who visited Department of orthodontics for treatment purpose were used for the study. This Study consisted of 16 pre-treatment lateral cephalograms of 9 to 26 year old individuals who had never undergone orthodontic treatment. The cephalometric data of 16 patients from which half of the patients (n=8) were treated by extraction of 4 premolars, whereas the other half (n=8) were treated by the non-extraction approach.(Fig 7 and 8)
- All patients were having class 1 malocclusion.
- In the non-extraction group, crowding was 3.18±2.18mm in the maxilla and 3.15±1.86 in the mandible. In the extraction group, crowding was 7.20±2.44mm in the maxilla and 5.35±2.50mm in the mandible. (Ilken Kocadereli, 2002)
- Patients having missing teeth were excluded from the study.
- For evaluation of cephalometric soft tissue changes following parameters were measured:

1) Nasolabial angle (Ilken Kocadereli, 2002; Alexander Jacobson, 1985) (Fig.1): It is line Formed by the intersection of a line originating at Sn(Subnasal), tangent to the lower border of the nose, and a line from Sn to Ls (Labrale superior). Average value: 90 º to 110º. This angle is influenced by columella of nose as well as position of upper lip.

2) Labiomental angle (Ilken Kocadereli, 2002; Alexander Jacobson, 1985) (Fig.2): It is formed by intersection of line traced between Li (Labrale inferior) and Si (Sulcus inferior), and line traced between Si and Pog'(Soft tissue pogonion).Average value: 110 º –130 º. Excessively proclined lower incisor teeth, a prominent chin may lead to an acute labiomental angle.

3) Lip chin submental angle (Alexander Jacobson, 1985) (Fig.3): Average 90 º –110º. This angle is obtuse in case of mandibular retrognathia, excessive lower lip protrusion.

4) E-line (esthetic plane) (Ricketts, 1957) (Fig.4): Drawn from tip of the nose to soft tissue pognion. Normally the upper lip is about 4 mm behind the reference and the lower lip lies 2 mm behind it.

5) H line (harmony line) and h angle (Holdaway, 1983) (Fig.5): Harmony line (H-line) proposed by Holdaway, is formed by a line from soft tissue pog' touching the upper lip bisecting the nose. H angle (°) Formed by intersection of soft tissue (N'-Pog') line and harmony (H) line.

6) Upper and lower Sulcus depth (Alexander Jacobson, 1985) (Fig.6): It is measured from H-line to upper and lower sulcus depth. Mean value, 5mm for both upper and lower sulcus depth.

Statistical analysis

- All the parameters were measured and analyzed by using pre-treatment and post treatment cephalometric records of patients.
- Mean, Standard deviation, difference between pre-treatment and post-treatment values of all 8 variables were calculated for both extraction and non-extraction groups before and after treatment.
- T-test were performed to test the significance of difference (P value) between the change values.

Fig.1 Nasolabial angle

Fig.2.Labiomental angle

Fig.3 Lip Chin Submental angle

Fig.4. E Line (Esthetic Plane)

Fig.5 H Line & H angle

Fig.6.Upper & lower sulcus Depth to H line

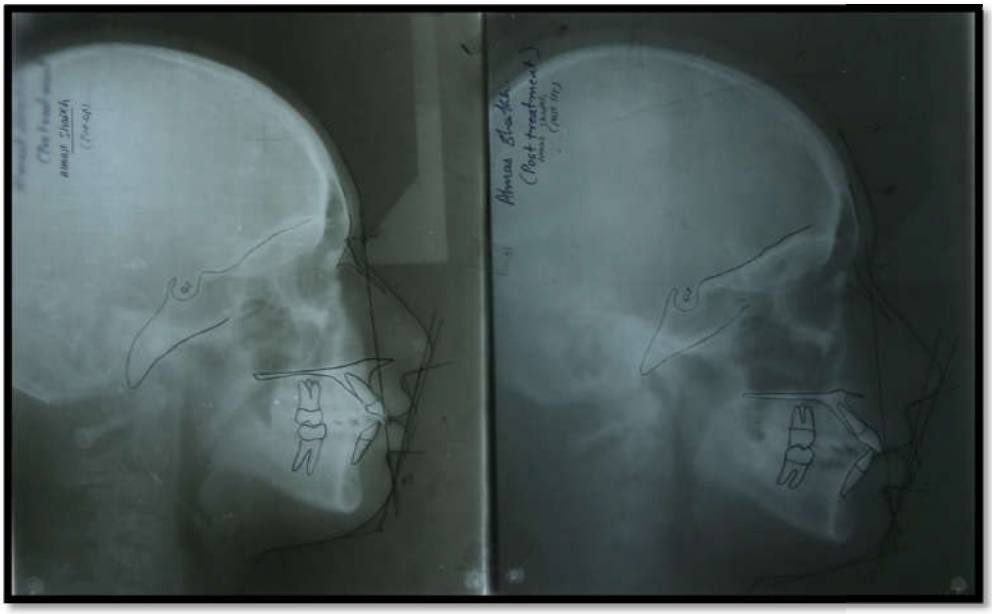

Fig.7. Extraction Pre-treatment &Post-treatment

Fig.8. Non Extraction Pre treatment & Post treatment

Table 1. Nasolabial angle

SR. No.	Extraction			Non-Extreaction		
	Before	After	Difference	Before	After	Difference
1	95	109	-14	88	86	2
2	88	88	0	84	109	-25
3	98	99	-1	110	110	0
4	98	110	-12	105	105	0
5	120	100	20	88	100	-12
6	100	101	-1	110	110	0
7	90	90	0	100	100	0
8	74	110	-36	90	95	-5
MEAN=	95.375	100.875	-5.5	96.875	101.875	-5
SD=	12.99382	8.626165	16.01785	10.62931	8.442029	9.242758
P value		0.1819			0.08492	

Table 2. Labiomental angle

SR. No.	Extraction			non-extreaction		
	Before	After	Difference	Before	After	Difference
1	100	112	-12	99	104	-5
2	90	120	-30	121	122	-1
3	52	72	-20	93	97	-4
4	119	110	9	107	109	-2
5	80	70	10	113	80	33
6	75	75	0	129	128	1
7	98	100	-2	85	83	2
8	90	110	-20	102	100	2
MEAN=	88	96.125	-8.125	106.125	102.875	3.25
SD=	19.79177	20.46905	14.64277	14.535	16.889	12.3027
P value		0.08			0.239	

Table 3. H angle

SR. No.	Extraction			non-extreaction		
	Before	After	Difference	Before	After	Difference
1	33	26	6	16	18	-2
2	22	18	2	26	27	-1
3	20	17	3	34	20	14
4	19	13	4	13	10	3
5	19	20	-3	21	18	3
6	18	20	-2	20	19	1
7	22	17	5	17	12	5
8	23	16	6	22	18	4
MEAN=	22	18.375	3.625	21.125	17.75	3.375
SD=	4.869732	3.814914	3.461523	6.556077	5.147815	4.926242
P value		0.034			0.046	

Table 4. Lip-Chin submental angle

SR.No.	Extraction			Non-extraction		
	Before	After	Difference	Before	After	Difference
1	140	128	12	126	127	-1
2	134	120	14	140	145	-5
3	131	120	11	134	128	6
4	117	100	17	100	101	-1
5	127	125	2	119	130	-11
6	126	124	2	125	116	9
7	124	123	1	123	113	10
8	113	122	-9	115	120	-5
MEAN=	126.5	120.25	6.25	122.75	122.5	0.25
SD=	8.766821	8.598173	8.680849	12.13908	13.16923	7.459414
P value		0.040			0.463	

The mean decrease in extraction case was 1±1.19 and in non-extraction case was by 1.125±1.24.

Table 5. Upper sulcus depth to h line

SR.No	Extraction			Non-extraction		
	Before	After	Difference	Before	After	Difference
1	14	12	2	8	8	0
2	7	6	1	12	12	0
3	8	8	0	10	9	1
4	7	4	3	5	4	1
5	6	6	0	6	5	1
6	8	8	0	11	11	0
7	10	8	2	7	4	3
8	9	9	0	12	9	3
MEAN=	8.625	7.625	1	8.875	7.75	1.125
SD=	2.503569	2.386719	1.195229	2.748376	3.105295	1.246423
P value		0.024			0.018	

Table 6. Lower sulcus depth to H line

SR.No	Extraction			Non-extraction		
	Before	After	Difference	Before	After	Difference
1	6	5	1	5	5	0
2	5	3	2	5	5	0
3	4	6	-2	6	6	0
4	3	4	-1	7	5	2
5	4	5	-1	5	6	-1
6	7	9	-2	6	6	0
7	5	5	0	6	5	1
8	6	6	0	8	6	2
MEAN=	5	5.375	-0.375	6	5.5	0.5
SD=	1.309307	1.767767	1.407886	1.069045	0.534522	1.069045
P value		0.237			0.113	

E line to upper and lower lip in extraction cases

Table 7. Extraction cases

SR.No	ULIP	ULIP	Difference	LLIP	LLIP	Difference
	Before	After		Before	After	
1	5	2	-3	7	3	-4
2	-2	-4	-2	2	2	0
3	0	-3	-3	3	0	-3
4	-1	-3	-2	1	-1	-2
5	0	-2	-2	5	0	-5
6	-2	-2	0	7	5	-2
7	-2	-4	-2	3	1	-2
8	0	-3	-3	0	-1	-1
MEAN=	-0.25	-2.375	-2.125	3.5	1.125	-2.375
SD=	2.3145502494	1.9226098334	0.991031209	2.6186146828	2.1001700611	1.5979898087
P value=		0.00025			0.00200	

E line to upper lip and lower lip in Non-extraction cases

Table 8. Non-extraction

SR.No	ULIP	ULIP	Difference	LLIP	LLIP	Difference
	Before	After		Before	After	
1	-4	-4	0	2	0	2
2	6	3	3	4	3	1
3	3	1	2	2	1	1
4	-3	-5	2	-6	-4	-2
5	-2	-3	1	1	2	-1
6	1	0	1	1	1	0
7	3	-4	7	2	-2	4
8	1	1	0	3	2	1
MEAN=	0.625	-1.375	2	1.125	0.375	0.75
SD=	3.4200041771	2.9730936269	2.1213203436	3.0443155459	2.3260942126	1.7139136501
P value=		0.02066			0.1424	

RESULTS

1) Nasolabial angle: Nasolabial angle in extraction and non-extraction cases is Non-significantly increasing. The mean increase difference in extraction case was 5.5±16.0º and in non-extraction case was 5±9.24º. (Table 1)

2) Labiomental angle: Labiomental angle is non-significantly increasing in extraction cases and non-significantly decreasing in non-extraction cases. The mean increased difference in extraction group was 8.12±14.64 and mean decrease in non-extraction group was 3.25±12.3. (Table.2)

3) H angle: Value of H angle are significantly decreasing in both extraction and non-extraction cases. Mean decrease in H angle value is more in extraction cases i.e. 3.6±3.46 as compared to non-extraction cases which is 3.37±4.92.(Table.3)

4) Lip chin submental angle: Is significantly decreasing in Extraction cases by 6.25±8.68º In non-extraction this angle is decreasing in negligible manner by only 0.25±7.4º (Table 4).

5) Upper sulcus depth to H line: It is significantly decreasing in both extraction and non-extraction cases (Table 5).

6) Lower sulcus depth to H line: In extraction cases non-significantly increasing by 0.375±1.40mm and in non-extraction cases it is non-significantly decreasing by 0.5±1.06mm (Table 6).

DISCUSSION

1) Nasolabial angle (Table 1): In the present study the nasolabial angle was increased in extraction group by mean of 5.5±16.01º and in non-ex group by 5±9.24º. The mean increase in nasolabial value was more in extraction cases. According to Fitzgerald *et al*. (1992) the mean value of the angle in a sample of 104 young white adults with well-balanced faces was 114º ± 10º. Several studies of pleasing profiles indicate a range of 90º to 120º for the parameter (Serpil HAZAR *et al*., 2004). In this study the mean of nasolabial angle before extraction was 95.3±12.9 º which became 100.87±8.62 º and in non-extraction

cases before treatment the value was 96.87±10.62º which became 101.87±8.44º the change was within normal range of nasolabial angle. However, Freitas *et al*. (1999) observed an increase of the nasolabial angle in cases treated with extraction of four premolars in a proportion of increase of nasolabial angle in 1.49° for each millimeter of retraction on upper teeth which also was confirmed by Talass *et al*. (1987). Scott Conley and Jernigan (2006) also found statistically significant alterations of the nasolabial angle which had an increase of 6.38°. According to Dimitrios *et al*. (Ilken Kocadereli, 2002) the nasiolabial angle had a statistically significant ($p<0.05$) increase of 5.34 within the extraction group and a decrease of -0.24 within the non- extraction Group Extraction of four bicuspids was noted to increase the nasolabial angle 5.2° by Drobocky and Smith (Drobocky and Smith, 1989). Therefore, extraction of teeth in a borderline patient with a nasolabial angle greater than the normative values should be avoided (Dhiman and Maheshwari, 2015). In the study done by Amirabadi *et al*. (2014) Nasolabial angle increased 5.44° and the mean amount for all the patients was 114.65º.

2) Labiomental angle (Table 2): De Smit and Dermaut (1984) reported that a flattening of the mental fold lead to a more drastic loss of esthetics than a deepening. The study of Verma *et al*[29] showed non-significant increase of 4.92±12.94º in extraction cases and showed non-significant increase of 1.43±3.92º. In this present study extraction group showed decrease in mean difference by 8.125±14.64º and non-extraction groups showed non-significant increase in labiomental angle by 3.25±12.30º mean difference. The Average value of labiomental angle is110-130º. In extraction cases value of labiomental angle before and after treatment were 88±19.79º and 96.125±20.46º respectively and In non-extraction group the mean changes before and after treatment were 106.12±14.53º and 102.8±16.88º respectively which were within normal range.

3) H angle (Table 3): The mean value of H angle is of 7-15º. The value of H angle is Decreasing by mean of 3.625±3.46 º in extraction cases and by mean of 3.37±3.92 º in non-extraction cases in the present study. H angle in the present study are shifting towards normal range. Similar results were obtained in the study of Tian-Min Xu *et al*. (2006) which showed mean decrease of -1.5±2.3 º in extraction group and mean decrease by -0.7±3.9º in non-extraction group. In extraction cases value of H angle before and after treatment were 22±4.86º and 18.37±3.81º respectively and In non-extraction group the mean changes before and after treatment were 21.12±6.55º and 17.75±5.14 º respectively which seems to be changing towards normal range value.

4) Lip chin submental angle (Table 4): In the present study Lip chin submental angle (mean 90-110 degree) decreasing by Mean of 6.25±8.68º in extraction cases and by 0.25±7.45º in non-extraction cases. The angle will be obtuse in patients with microgenia, excessive submental adipose tissue, and protrusive lower incisors, whereas it will be acute in Class III cases and patients with macrogenia. In extraction cases value of Lip chin submental angle before and after treatment were 126.5±8.76º and 120.25±8.59º respectively and In non-extraction group the mean changes before and after treatment were 122.75±12.13º and 122.5±13.16º respectively which seems to be changing towards normal range value.

6) H line to upper and lower sulcus depth (Table 5 and 6): In this present study the upper sulcus depth to H line and lower sulcus depth to H line mean values in both extraction and non-extraction fell within the pleasing normal range, as measured by the Holdaway (1983) H-line. Statistically significant decrease in mean value of H line to upper sulcus depth by 1±1.19mm in extraction case and by 1.125±1.24 mm in non-extraction case was noticed. Upper sulcus depth is significantly decreasing in both extraction and non extraction cases. The reason behind less decreased sulcus depth in extraction cases as compared to non-extraction cases is might be the simultaneous more retraction of upper lip. There is statistically non-significant increase in mean value of H line to lower sulcus depth by negligibly small value of 0.375±1.4mm in extraction case and non-significant decrease by 0.5±1.06 mm in non-extraction case. According to study of S.Hazar *et al* [21] findings showed that the sulcus inferior to the H line tended to deepen and the lower lip became retruded to the H line in the extraction group whereas the non-extraction group showed almost no change. Study done by Kesar *et al*. (2009) showed significant increase in inferior sulcus depth to H line in extraction case by 1.35±1.13 and Non-significant increase in inferior sulcus depth to H line in non-extraction case by 1.45±0.5

7) Upper lip and lower lip to E line (Table 7 and 8): In the present study in extraction cases the mean value of upper lip before treatment was -0.25, here -ve value indicates upper lip was behind E line, which shifted to -2.375 mm behind E line after treatment which indicates retraction of upper lip by-2.125±0.99 mm in extraction cases. The mean of lower lip in extraction cases was +3.5mm ahead of E line which shifted to 1.125 ahead of E line after treatment showing retaction of lower lip to E line by mean difference of -2.3±1.59mm. In non-extraction cases of this study upper lip before treatment was +0.625mm ahead of E line which later shifted to-1.375mm behind E line i.e retraction of upper lip to E line was by mean difference of 2±2.12. In non-extraction cases lower lip was 1.125mm ahead of E line before treatment which shifted to 0.375mm ahead of E line i.e. retraction of lower lip noticed by 0.75±1.71. This results of present study are matching with results of Finnoy *et al*. (1987) Who found mean changes of (-) 3.3 mm for the upper lip to the E line and (-) 2.5 mm for the lower lip to the E line in extraction cases. According to Battagel (1990), these changes were (-) 4.4 mm for the upper lip to the E line and (-) 2.3 mm for the lower lip to the E line in extraction cases.

Conclusion

From the present study it was concluded that non-extraction patients have less soft tissue changes as compared to patients undergoing extraction t/t approach. But the common belief that extraction therapy negatively affects the profile was not confirmed by present finding as all pre-operative and post-operative measurement fell within the pleasing normal ranges. The important conclusion off overall study is that: The upper and lower lips were more retrusive in extraction groups as compared to non-extraction groups, on which parameters like H angle, lip chin submental angle, Nasiolabial angle and labiomental angle are dependent.

REFERENCES

Alexander Jacobson. Radiographic cephalometry:from basic to videoimaging, 1985.

Amirabadi GE, Mirzaie M, Kushki SM, Olyaee P. 2014. Cephalometric evaluation of soft tissue changes after

extraction of upper first premolars in class II div 1 patients. *J ClinExp Dent*, 6(5):e539-45).

Angle EH. 1907. Malocclusion of the teeth. SS White Dental Mfg Co, Philadelphia.

Battagel JM. 1990. The relationship between hard and soft tissue changes following treatment of Class II division 1 malocclusions using Edgewise and Frankel appliance techniques. *Eur J Orthod*., 12: 154-65.

Begg PR. 1954. Stone age manÕ s dentition. *Am J Orthod Dentofac Orthop.,* 40: 298-312.

Burstone C. 1958. The integumental profile. *Am J Orthod*., 44:1–25.

Burstone C. 1959. Integumental contour and extension patterns. *Angle Orthod*., 9:93–104.

Calvin SC. 1920. The principles of retention in orthodontia. Am J Orthod Dentofac Orthop Nov: 3-34.

Comparison of extraction versus nonextraction orthodontic treatment outcomes for borderline Chinese patients. Tian-Min Xu, Yan Liu, Min-Zhi Yang and Wei Huang *Am J Orthod Dentofacial Orthop.,* 2006;129:672-7.

De Smit A. and Dermaut L. 1984. Soft-tissue profile preferences. *Am J Orthod.*, 86:67–73.

Dhiman S. and Maheshwari S. 2015. A dilemma in orthodontics: Extractions in borderline cases. *J Adv Clin Res Insights*, 2:36-39.

Dimitrios Konstantonisa, 2012. The impact of extraction vs nonextraction treatment on soft tissue changes in Class I borderline malocclusions. *Angle Orthod*., 82:209–217.

Drobocky OB. and Smith RJ. 1989. Changes in facial profile during orthodontic treatment with extraction of four first premolars. *Am J Orthod Dentofacial Orthop*., 95:220-30.

Elif idil Kesar *et al*. 2009. Changes in Soft-tissue Profile After Extraction and Non-extraction Openbite Treatment. Hacettepe Diş Hekimliği Fakültesi DergisiCilt: 33, Sayı: 1, Sayfa: 21-30.

Finnoy JP. and Wisth PJ. 1987. Changes in soft tissue profile during and after orthodontic treatment. *Eur J Orthod*., 9: 68-78.

Fitzgerald JP, Nanda RS, Currier GF. 1992. Evaluation of nasolabial angle. *Am J Orthod Dentofac Orthop*., 102: 328-34.

Freitas MR, Henriques JFC, Pinzan A, Janson GRP, Siqueira VCV. 1999. Estudo longitudinal das alterações do ângulonaso-labial, emjovens com Classe II, 1ª divisão, que se submeteram ao tratamento ortodôntico corretivo. *Ortodontia*., 32(1):8-16.

Holdaway RA. 1983. A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Part I. *Am J Orthod*., Jul;84:1–28.

Ilken Kocadereli, 2002. Changes in soft tissue profile after orthodontic treatment with and without extractions. *Am J Orthod Dentofacial Orthop*., 122:67-72.

Jay Bowman, S., Lysle E. Johnston, 2000. The Esthetic Impact of Extraction and Nonextraction Treatments on Caucasian Patients. *Angle Orthod*., 70:3–10.

Kusnoto J. and Kusnoto H. 2001. The effect anterior tooth retraction on lip position of orthodontically treated adult Indonesians. *Am J Orthod Dentofacial Orthop*., 120;304-7.

Leonardi R, Annunziata A, Licciardello V, Barbato E. 2010. Soft tissue changes following the extraction of premolars in non-growing patients with bimaxillary protrusion. A systematic review. *Angle Orthod*., 80:211-6.

Looi LK. and Mills JRE. 1986. The effect of two contrasting forms of orthodontic treatment on facial profile. *Am J Orthod Dentofac Orthop.,* 89: 507-517.

Nelson RT. and Russell DM. 1986. Facial soft tissue profile changes in the North American Black with four first bicuspid extractions. *J Md State Dental Assoc*., 29;24-30.

Ricketts RM. 1957. Planning treatment on the basis of the facial pattern and an estimate of its growth. *Angle Orthod*., 27:14-37.

Ricketts RM. 1968. Esthetics, environment, and the law of lip relation. *Am J Orthod*., Apr;54:272–89.

Scott Conley R. and Jernigan C. 2006. Soft tissue changes after upper premolar extraction in Class II camouflage therapy. *Angle Orthod*., 76(1):59-65.

Serpil HAZAR Sercan AKYALIN, Hayal BOYACIOÚLU. 2004. Soft Tissue Profile Changes in Anatolian Turkish Girls and Boys Following Orthodontic Treatment With and Without Extractions. *Turk J Med Sci*., 34;171-178.

Sneha Lata Verma, V.P Sharma, Pradeep Tandon, Gyan P.Singh, Kiran Sachan, 2013. Comparison of esthetic outcome after extraction or non-extraction orthodontic treatment in class 2 div 1 malocclusion patients. *Contemporary clinical dentistry*, Apr-jun Vol:4(2).

Subtelny J. 1961. The soft tissue profile, growth, and treatment changes. *Angle Orthod*., 31:105–22.

Talass MF, Talass L, Baker RC. 1987. Soft-tissue profile changes resulting from retraction of maxillary incisors. Am *J Orthod Dentofacial Orthop*., 91(5):385-94.

Tweed C. 1953. Evolutionary trends in orthodontics, past, present, and future. *Am J Orthod*., 39:81–108

Tweed CH. 1996. Clinical Orthodontics. Mosby, St Louis, pp 31-82.

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