

LIP MORPHOLOGY IN BIMAXILLARY DENTOALVEOLAR PROTRUSION IN CLASS I AND CLASS II ADULTS

¹AMNA SHEIKH, BDS, FCPS II Trainee

²ABIDA IJAZ, BDS, D.ORTH, MCPS, MS, FICD, FPFA

ABSTRACT

The objective of this study was to compare lip morphology in the young adult population of Pakistani origin, having bimaxillary dentoalveolar protrusion on class I and class II skeletal pattern.

This cross sectional comparative study included 100 subjects, 50 with class I skeletal pattern and other 50 with skeletal class II pattern. Age of these subjects ranged from 18-25 years. The sampling included random selection of the subjects. The method comprised skeletal, dental and soft tissue cephalometric analysis made on lateral cephalograms taken in natural head position of the subject. A total of 20 variables were used in the study comprising 6 skeletal, 3 dental and 11 soft tissue variables. Among the skeletal I subjects variables of the sagittal and vertical skeletal analysis showed more or less normal values. Variables of the dental analysis however, determined increased inclinations of the upper and lower incisors and consequent reduction of Frankfurt mandibular incisor angle FMIA. The soft tissue variables showed full profile with greater upper and lower lip vermilion, decreased lip strain, lower lip thickness and deficient upper and lower lip lengths. In skeletal II subjects almost all these variables gave relatively enhanced readings, but difference was not of statistical significance. The study concluded that there is no significant difference in the lip morphology with bimaxillary protrusion on class I and class II skeletal pattern.

Key words: Bimaxillary Protrusion, Dentoalveolar Protrusion, Cephalometric norms or Standards.

INTRODUCTION

Bimaxillary Protrusion or full mouth appearance is an unesthetic condition resulting from protrusive and proclined upper and lower incisors with resultant procumbency of lips, convexity of face and excessive vermilion show of upper and lower lips¹. It is seen commonly in African-American and Asian populations, but it can be seen in almost every ethnic group² Bimaxillary dental protrusion is predominant among black people but is also found among whites³.

Like facial divergence; lip prominence is strongly influenced by racial and ethnic characteristics. Whites of northern European backgrounds often have thin lips, with minimal lip and incisor prominence. Whites of southern European and middle eastern origin normally have more lip and incisor prominence than their northern cousins. Greater degree of lip and incisor prominence normally occur in Orientals and in blacks.

This difference simply means that a degree of lip and incisor prominence normal for many whites would be considered retrusive for many Orientals or blacks. While a lip and tooth position normal for blacks would be excessively protrusive for most whites⁴.

Bimaxillary dentoalveolar protrusion is seen in the facial appearance in three ways. Excessive separation of lips at rest (lip incompetence), Excessive efforts to bring the lips into closure (lips strain), Prominence of lips in profile view all three characteristics must be present to make the diagnosis of dental protrusion and the lip protrusion⁵. The etiology of bimaxillary protrusion is multifactorial and consists of a genetic component as well as environmental factors such as mouth breathing, lip habits and skeletal factors⁶

Saudi adults living in the Western region of Saudi Arabia, also known as Hijaz presenting with ethnic diversity were found to have an increased facial con-

¹ **Correspondence:** Dr Amna Sheikh, 764/1, Block Z, Phase III, Defence Society, Lahore Cantt. Tel: 35723232

² Professor of Orthodontics, Fatima Memorial Medical and Dental College, Shadman, Lahore

vexity, a more convex profile and a steeper mandibular plane. 'In addition, the upper and lower incisors were significantly proclined and more protruded⁷. In another study smaller interincisal angle, smaller nasiolabial and upper and lower lip protrusion, smaller anterior and total cranial base and cranial base angle, larger lower and total of the anterior and posterior facial heights were found⁸.

Similarly in African patients with procumbent upper and lower lips, a deep mentolabial sulcus, excessive vermilion show of the upper and lower lips, excessive lip strain on closure, a convex profile, a long lower facial height and proclined and protruded maxillary and mandibular incisors are reported to be present⁹.

In Orthodontic practice cephalometric radiography is most commonly used to evaluate and analyze soft tissue pattern. The term cephalometry means the scientific measurement of the dimensions of craniofacial complex. Cephalometry allows a direct measurement of the dimensions of the head and face based on skeletal, dental and soft tissue landmarks. A number of cephalometric analyses have been designed and modified from time and on namely Tweed¹⁰, Steiners¹¹, Ricketts¹², Burstone¹³, Holdaway¹⁴ and Witts¹⁵ analyses. Cephalometrics provides data for both population based cross sectional study as well as longitudinal study relating to the same individual. A large variability in lip position can be expected on lateral cephalograms even when patients are instructed to keep their lips relaxed and their teeth in occlusion because of the flexible and mobile lip texture¹⁶.

The lip extension can easily adapt to incisor displacements and become wider or narrower, due to extensive mobility¹⁷.

In the study of racial variations in cephalometric analysis between Whites and Kuwaitis it is reported that the Kuwaitis show more protrusive upper and lower lips and more facial convexity. All the measurements relating the upper and lower incisors to the maxilla and the mandible, respectively showed a significant bimaxillary protrusion¹⁸.

Keating used cephalometrics to determine the morphological features of bimaxillary protrusion in a strictly Caucasian population. It was observed that

bimaxillary protrusion is associated with a shorter posterior cranial base, a longer and more prognathic maxilla, a mild class II skeletal pattern, a smaller upper and posterior facial heights, diverging facial planes and a procumbent soft tissue profile with a low lip line¹⁹.

Lip structure seems to have an influence on lip response to incisor retraction.

To determine the effects of incisor retraction on the profile, several studies have been conducted to quantify and predict the relationship between incisor retraction and lip retraction²⁰⁻²³.

Wisth found that lip response, as a proportion of incisor retraction, decreased as the amount of incisor retraction increased. This seems to indicate that the lips have some inherent support²⁴.

Riveiro²⁵, Quintanilla, Chamosa and Cunqueiro conducted a study on soft tissue profile of a European white population of young adults by means of linear measurements in natural head position such as upper/lower lip length, upper/lower vermilion etc. According to their study no significant difference was found among the values of upper and lower lip vermilion.

Canut²⁶ in 1996 introduced esthetic analysis; He studied the interrelationship of nasal, labial, and chin prominences with regard to the Sn-Sm line (facial esthetic traid) and the depth of the nasiolabial sulcus that he called the nasolabial esthetic sigma and measured between 2 perpendicular lines to the frankfort plane through Sn and Ls.

This article reports on a comparative cross sectional study that was conducted on the subjects presenting with bimaxillary protrusion. The aim of this study was to compare the lip morphology in bimaxillary protrusion on skeletal class I and class II pattern.

METHODOLOGY

This cross sectional comparative study was conducted in the Orthodontic Department of Dental Section of Children Hospital and Institute of Child health, Lahore. The sample consisted of 100 subjects of age range 18-25 years. Out of this sample size, 50 were having class I skeletal pattern and other 50 had class II skeletal pattern.

Inclusion criteria

Age range 18-25 years.

Permanent dentition.

Patients with class I and class II skeletal pattern.

Exclusion criteria

Supernumerary teeth.

Parafunctional habits like mouth breathing, thumb sucking.

Patients with class III skeletal pattern.

DATA COLLECTION PROCEDURE

The sample was collected from the Allied Health Sciences, the Nursing School The Childrens' Hospital and The Institute of Child Health, Lahore. Lateral cephalometric radiographs of the subjects were attained from the Orthosphos plus machine. The each subject was standing in natural head position with relaxed lips and teeth in centric occlusion. The head was positioned in the cephalostat with ear rods. The x-ray source was placed on the right side of the patient at a distance of 5 feet from the midsagittal plane. The subject film distance was 1 foot. Exposure was made at 90 kvp (kilovoltage) and 12 mAs (milliamperes). Each subject was exposed for 1.2 seconds for each radiograph. Tracing sheets were fixed along the whole length of the left side border of the cephalograms with adhesive tape. The lateral Cephalogram of each subject was traced and measured manually by the same operator on 0.003 inch thick and 8 by 10 inch size acetate paper with 3H lead pencil.

Following lateral landmarks were identified on the lateral radiographs.

- 1 Sella (S): the mid point of the pituitary fossa of the sphenoid bone.
- 2 Nasion (N): the point in the midline located at the nasal root.
- 3 Porion (Po): the superior most point on the external auditory meatus.
- 4 Orbitale (Or): the lower most point on the inferior margin of the orbit.

- 5 Point A: is the deepest point on the concavity formed by the anterior maxillary contour of the alveolar process.
- 6 Point B: is the deepest point on the concavity of the anterior surface of the symphysis.
- 7 Menton: The most inferior point on the inferior border of the chin.
- 8 Subnasale (Sn): The point where the upper lip joins the columella.
- 9 Steiner's point (St): The point at $\frac{1}{2}$ of the distance between Pn & Sn.
- 10 Pronasale (Pn): The most prominent point on the tip of the nose.
- 11 Labial superioris (Ls): The point that indicates the mucocutaneous limit of the upper lip.
- 12 Stomion superior (Sts): The most inferior point of the upper lip.
- 13 Stomion inferior (Sti): The most superior point of the lower lip.
- 14 Labial inferioris (Li): The point that indicates the mucocutaneous limit of the lower lip.
- 15 Supramentale (Sm): The deepest point of the inferior sublabial concavity.
- 16 Pogonion (Pog): the most anterior point of the soft tissue chin.

The cephalometric analysis of each of the study sample was prepared at two different occasions. For the purpose of diagnosis, 20 variables were selected both angular and linear from the following different methods, making use of multiple reference lines, in order to prepare a comprehensive cephalometric analysis.

Angular measurement used from Steiner's analysis included sella nasion- point A SNA 80 ± 2 degrees, sella nasion- point B SNB is 78 ± 2 degrees, Point A-nasion- point B ANB 0 ± 2 degrees, Upper incisor to SN plane 102 ± 2 degrees, Sella nasion to mandibular plane, norm used for SN-MP 32 ± 4 degrees. Steiner's (S) Line (0 ± 2 mm).

The E plane from Ricketts analysis intersects the most prominent points on the tip of the nose and the chin. It is used to assess soft tissue balance between the lips and the profile. The mean distance of the lower lip from the E plane is approximately -2 ± 2 mm and of upper lip is -3 ± 2 mm.

The angular measurements taken from Tweed triangle were incisor mandibular plane angle IMPA ($90^\circ \pm 5^\circ$), Frankfort mandibular plane angle FMA ($25^\circ \pm 5^\circ$) and Frankfort mandibular incisor angle FMIA $65^\circ \pm 5^\circ$.

Witt's Method used in this study included perpendiculars from point A and point B to the functional occlusal plane (used as reference plane) and the linear difference between these points was measured. In a well proportioned face BO is 1mm ahead of point A in the male where as both these projections fall on the same point in the female.

Measurements taken from Holdaway analysis were; the upper lip thickness mean value is 15 ± 2 mm. upper lip strain 15mm.

Burstone carried out an exhaustive esthetic analysis of the facial profile. Within the linear parameters, he defined the position of the upper (Ls) and lower (Li) lips regarding the Sn-Pg line, the nasal length (measured perpendicular to the palatal plane), the length of the upper lip from subnasale to stomion superior (Sn-Sto) and lower lip from stomion inferior to menton (Sto-Me), and the interlabial gap (Sto^s-Sto^i), Upper lip length: Sn-Ss, mean is 18 ± 1.5 mm, lower lip length: Si-Sm, mean is 23 ± 1.5 mm, lower lip thickness: mean is 19 ± 2 mm, upper lip vermilion: Ls-Ss, mean is 8.5 ± 1.5 mm, lower lip vermilion: Si-Li, mean is 10.2 ± 1.6 mm.

DATA ANALYSIS PROCEDURE

The study included five angular and one linear measurements for skeletal analysis namely SNA, SNB, ANB, Witts value, SNM, FMA, three angular measurements for dental analysis namely UI-SN, IMPA, FMIA and eleven linear measurements for soft tissue analysis namely Lower lip to E line, Upper lip to E line, Upper lip to S line, Lower lip to S line, Upper lip length / thickness, Upper lip strain, Lower lip length / thickness, Upper lip vermilion, and Lower lip vermilion. The results were analysed by using the SPSS 10.0.

Descriptive analysis was used for finding the norms, mean and standard deviations.

The mean and norms were then subjected to independent t test for significant differences between the mean values.

RESULTS

The study sample consisted of 100 (hundred) subjects which were divided into two groups.

Group 1 consisted of 50 (fifty) subjects having bimaxillary protrusion with class I skeletal pattern. Group 2 consisted of 50 (fifty) subjects having bimaxillary dentoalveolar protrusion with class II skeletal pattern.

For the same age range the angular measurements of skeletal analysis, dental analysis and linear measurements of soft tissue analysis of class I skeletal pattern were compared with the angular measurements of skeletal analysis, dental analysis and linear measurements of soft tissue analysis of class II skeletal pattern and the difference was analysed using t- test. P-value less than 0.05 were considered level of significance, $P < 0.01$ a highly significant and $P < 0.001$ as statistically very highly significant.

For subjects with class I skeletal pattern, the mean SNA was 82.870 (SD 3.612), mean SNB was 79.670 (SD 3.582), mean ANB was 3.200 (SD 1.049), mean AO-BO distance was 2.600 (SD 1.956), mean SNM was 31.640 (SD 6.170), mean FMA was 25.660 (SD 7.000) shown in Table 1.

For dental analysis, the mean UI to SN was 115.120 (SD 5.501), mean IMPA was 102.700 (SD 3.400), mean FMIA was 55.500 (SD 5.493) shown in Table 2.

Similarly linear measurements for soft tissue analysis of subjects with class I skeletal pattern, the mean lower lip to E line was 0.9300 (SD 3.067), mean upper lip to E line was -1.620 (SD 2.594), mean Upper lip to S line was 1.350 (SD 2.343), mean Lower lip to S line was 2.600 (SD 2.969), mean upper lip length was 21.260 (SD 2.238), mean upper lip thickness was 15.320 (SD 2.084), mean upper lip strain was 11.120 (SD 2.228), mean lower lip length was 16.180 (SD 2.876), mean lower lip thickness was 12.380 (SD 1.523), mean upper lip vermilion was 10.520 (SD 1.693), and mean lower lip vermilion was 11.780 (SD 1.798) as shown in Table 3.

TABLE 1: A COMPARATIVE SKELETAL ANALYSIS OF SUBJECTS WITH CLASS I AND CLASS II SKELETAL PATTERN

Variable name	Mean values	SD	t-value	P-value	Significance
Mean SNA(class I skeletal pattern) (degrees)	82.8700	3.61235	-2.538	0.013	Significant
Mean SNA(in class II skeletal pattern) (degrees)	84.7000	3.59847			
Mean SNB(class I skeletal pattern) (degrees)	79.6700	3.58228	3.841	0.000	Very Highly Significant
Mean SNB (class II skeletal pattern) (degrees)	77.1400	2.97616			
Mean ANB(class I skeletal pattern) (degrees)	3.2000	1.04978	-13.494	0.000	Very Highly Significant
Mean ANB(class II skeletal pattern) (degrees)	7.4800	1.98196			
Mean Witt's value (class I skeletal pattern) (mm)	2.6000	1.95615	-6.908	0.000	VeryHighly Significant
Mean Witt's value (class II skeletal pattern) (mm)	6.2300	3.15939			
Mean SNM (class I skeletal pattern) (degrees)	31.6400	6.17024	-3.050	0.003	Highly Significant
Mean SNM(class II skeletal pattern) (degrees)	35.0200	4.82971			
Mean FMA (class I skeletal pattern) (degrees)	25.6600	7.00032	-2.312	0.023	Significant
Mean FMA(class II skeletal pattern) (degrees)	28.5800	5.54790			

TABLE 2: A COMPARATIVE DENTAL ANALYSIS OF SUBJECTS WITH CLASS I AND CLASS II SKELETAL PATTERN (DEGREES)

Variable name	Mean values	SD	t-value	P-value	Significance
Mean UI to SN (class I skeletal pattern) (degrees)	115.1200	5.50191	0.359	0.720	Not Significant
Mean UI to SN (class II skeletal pattern) (degrees)	114.7347	5.15904			
Mean IMPA(class I skeletal pattern) (degrees)	102.7000	3.40018	-1.091	0.278	Not Significant
Mean IMPA(class II skeletal pattern) (degrees)	103.4694	3.61768			
Mean FMIA (class I skeletal pattern) (degrees)	55.5000	5.49304	3.011	0.003	Highly Significant
Mean FMIA(class II skeletal pattern) (degrees)	51.8163	6.63850			

TABLE 3: A COMPARATIVE SOFT TISSUE ANALYSIS OF SUBJECTS WITH CLASS I AND CLASS II SKELETAL PATTERN (MM)

Variables name	Mean values	SD	t-Value	P-Value	Significance
Mean L..lip to E line(class I skeletal pattern)	0.9300	3.06729	-3.948	0.000	Very Highly Significant
Mean L..lip to E line(class II skeletal pattern)	3.6100	3.69264			
Mean U..lip to E line(class I skeletal pattern)	-1.6200	2.59426	-4.677	0.000	Very Highly Significant
Mean U..lip to E (class II skeletal pattern)	0.9700	2.93364			
Mean U..lip to S line(class I skeletal pattern)	1.3500	2.34358	-4.081	0.000	Very Highly Significant
Mean U..lip to S line(class II skeletal pattern)	3.6500	3.22340			
Mean L..lip to S line(class I skeletal pattern)	2.6000	2.96923	-3.425	0.001	Highly Significant
Mean L..lip to S line(class II skeletal pattern)	4.8600	3.59994			
Mean U..lip length (class I skeletal pattern)	21.2600	2.23890	-0.274	0.784	Not Significant
Mean U..lip length(class II skeletal pattern)	21.4200	3.46463			
Mean U..lip thickness(class I skeletal pattern)	15.3200	2.08434	1.642	0.104	Not Significant
Mean U..lip thickness(class II skeletal pattern)	14.5000	2.85178			
Mean U..lip strain (class I skeletal pattern)	11.1200	2.22821	0.567	0.572	Not Significant
Mean U..lip strain(class II skeletal pattern)	10.7200	4.45861			
Mean L..lip length(class I skeletal pattern)	16.1800	2.87629	1.112	0.269	Not Significant
Mean L..lip length(class II skeletal pattern)	15.5600	2.69663			
Mean L..lip thickness(class I skeletal pattern)	12.3800	1.52382	-1.114	0.268	Not Significant
Mean L..lip thickness(class II skeletal pattern)	12.7600	1.86875			
Mean U..lip Verm(class I skeletal pattern)	10.5200	1.69320	-1.653	0.102	Not Significant
Mean U..lip Verm(class II skeletal pattern)	11.1100	1.87162			
Mean L..lipVerm(class I skeletal pattern)	11.7800	1.79898	-0.497	0.620	Not Significant
Mean L..lipVerm(class II skeletal pattern)	11.9500	1.61703			

For subjects with class II skeletal pattern, the mean SNA was 84.700(SD 3.598), mean SNB was 77.140(SD 2.976), mean ANB was 7.480(SD 1.981), mean AO-BO distance was 6.230(SD 3.159), mean SNM was 35.020(SD 4.829), mean FMA was 28.580(SD 5.547) shown in Table 1.

Angular measurements for dental analysis of subjects with class II skeletal pattern were as follows, the mean UI to SN was 114.7347(SD 5.159), mean IMPA was 103.4694(SD 3.617), mean FMIA was 51.8163 (SD 6.638) shown in Table 2.

Similarly linear measurements for soft tissue analysis of subjects with class II skeletal pattern, the mean lower lip to E line was 3.610(SD 3.692), mean upper lip to E line was

0.9700(SD 2.933), mean Upper lip to S line was 3.650(SD 3.223), mean Lower lip to S line was 4.860(SD 3.599), mean upper lip length was 21.420(SD 3.464), mean upper lip thickness was 14.500(SD 2.851), mean upper lip strain was 10.720(SD 4.458), mean lower lip length was 15.560(SD 2.696), mean lower lip thickness was 12.760(SD 1.868), mean upper lip vermilion was 11.110(SD 1.871), and mean lower lip vermilion was 11.950(SD 1.617) as shown in Table 3.

DISCUSSION

The material for this study consisted of 100 lateral cephalograms. There were 50 subjects with skeletal class I pattern and 50 subjects with skeletal class II pattern in the study sample. The mean age of the whole sample was 18-25 years.

The purpose of this study was to compare the effects of lip morphology in the development of bimaxillary protrusion on skeletal class I and class II pattern. The study was based on cephalometric radiography. The purpose of cephalometry is to interpret geometric expression of cranial anatomy.

Among four variables of the skeletal sagittal analysis three elements were found statistically very highly significant with ($P < 0.001$). The findings of Bills² and Farrow¹ match the result of our study. Statistically significant difference was found in the value of (SNA) sella nasion maxillary apical base angle (P -value 0.013) amongst the class I and class II skeletal pattern. These findings were unlike the description of Cowson³, Bloom²⁰

and Mingchu²⁷. Statistically, very highly significant difference (P -value 0.000) however was found among the values of sella nasion mandibular apical base angle (SNB), maxillary apical base nasion mandibular apical base angle (ANB) and Witts value (AO-BO distance) like the findings of other researcher such as Hassan⁷, Fujita²⁸ and Riveiro²⁵.

Among the vertical analysis, statistically significant difference was found in the values of frankfort mandibular plane angle (FMA) (P -value 0.023) and highly significant difference in sella nasion mandibular plane angle (SNM) (P -value 0.003) These results supports the findings of Proffit⁵ and Ming²⁹.

Describing individual elements of the vertical analysis amongst this sample, SN-Mand plane angle gave more or less standard value (Mean 31.6400, SD 6.17024) in class I skeletal pattern where as for class II skeletal pattern an optimum angle was seen (Mean 35.02, SD 4.82). Frankfort mandibular plane angle (FMA) standard value (Mean 25.6600, SD 7.000) of class I skeletal pattern and for class II skeletal pattern (Mean 28.58, SD 5.547). In fact the mean values of ANB angle and AO-BO distance were higher in the class II skeletal pattern than the class I skeletal pattern, but the difference was statistically not significant. These results coincide with the findings of Hillesund¹⁶ and Saelens¹⁷.

A total of three elements were used to analyse dental relations. No statistically significant difference was found among the values of upper incisor to SN plane (P -value 0.720) and incisor mandibular plane angle (P -value 0.278). Statistically, highly significant difference (P -value 0.003) was however found in the value of Frankfort mandibular incisor angle (FMIA). These results coincides with those of Langberg⁹, Bukhary⁸ and Mingchu²⁷. The mean values of upper incisor to sella nasion plane angle and Frankfort mandibular incisor angle (FMIA) were slightly higher in class I skeletal pattern, but the difference was not statistically significant.

On, the basis of the result, again it can be concluded that no apparent difference was found between class I and class II skeletal pattern.

Out of the 11 variables of the soft tissue analysis, no statistically significant difference was found among the

seven variables namely upper lip length (P-value 0.784), upper lip thickness (P-value 0.104), upper lip strain (P-value 0.572), lower lip length (P-value 0.269), lower lip thickness (P-value 0.268), upper lip vermilion (P-value 0.102), and lower lip vermilion (P-value 0.620).

These findings coincide with those of Burstone¹³, Riveiro²⁵, Wisth²⁴ and Ming²⁹. Statistically, very highly significant difference (P-value 0.000) was found among the values of lower lip to Esthetic line, upper lip to E line, upper lip to Steiner's line, lower lip to S line (P-value 0.001) similar to the findings of Keating¹⁹. The mean values of upper lip to E line, upper lip to S line, and lower lip to S line were slightly higher in class II skeletal pattern, but the difference did not achieve statistical significance.

These findings in all the three analysis contradict the hypothesis that there is a difference in the lip morphology in subjects having bimaxillary protrusion on class I and class II skeletal pattern.

CONCLUSIONS

On the basis of the results attained, it can be concluded that no significant difference was found in the lip morphology in subjects having bimaxillary dentoalveolar protrusion on class I and class II skeletal pattern.

REFERENCES

- Farrow AL, Zarrinnia K, Aziz K. Bimaxillary protrusion in Black Americans- an esthetic evaluation and the treatment considerations. *Am J Orthod Dentofacial Orthop* 1993; 104: 240-50.
- Bills DA, Handelman CS, BeGole EA. Bimaxillary dentoalveolar protrusion: Traits and orthodontic correction. *Angle Orthod* 2004; 75: 333-9.
- Cowson RA, Odell EW, Sporter SH. *Soft tissue diseases. Oral Pathology and Oral Medicine*. 7th ed. London: Elsevier Science Limited; 2002; 178-9.
- Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States. *Int J Adult Orthod Orthognathic Surg* 1998; 13: 297-306.
- Proffit WR. Forty year review of extraction frequencies at a university of orthodontic clinic. *Angle Orthod* 1994; 64: 407-14.
- Moyers, Hertzberg. Bottle feeding and malocclusion. *Am J Orthod* 1988; 149-52.
- Hassan AH. Cephalometric norms for Saudi adults living in the Western region of Saudi Arabia. *Angle Orthod* 2004; 76:109-13.
- Bukhary MT, Namankani EA. A cephalometric comparisons of dentofacial features between Saudi and British school boys. *J Pak Dent Asso* 2001; 10: 199-206.
- Langberg BJ, Todd A. Treatment of a class 1 malocclusion with severe . bimaxillary protrusion. *Am J orthod Dentofacial orthop* 2004; 126: 739-46.
- Tweed CH. The Frankfort mandibular incisor angle (FMIA) in orthodontic diagnosis, treatment planning and prognosis. *Angle Orthod* 1959; 24: 121-69.
- Steiner C. The use of Cephalometrics as an aid to planning and assessing Orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1960; 461: 721-35.
- Ricketts RM. Esthetic environment and the law of lip relation. *Am J Orthod Dentofacial Orthop* 1968; 54: 272-89.
- Burstone CJ. Lip posture and its significance in treatment planning. *Am J Orthod* 1967; 53: 262-84.
- Holdaway RA. A soft tissue Cephalometric analysis and its use in orthodontic treatment planning part 1. *Am J Orthod Dentofacial Orthop* 1983; 84: 1-28.
- WITTS Jacobson A. The "Wits" appraisal of jaw disharmony. *Am J Orthod* 1975; 67: 125-38.
- Hillesund E, Fjeld D, Zachrisson BU. Reliability of soft tissue profile in cephalometrics. *Am J Orthod* 1978; 74: 537-50.
- Saelens NA, De Smit A. Therapeutic changes in extraction versus non extraction Orthodontic treatment. *Eur J Orthod* 1988; 20: 225-36.
- Behbehani F, Hicks P, Beeman C. Racial variations in cephalometric analysis between Saudis and Kuwaitis. *Angle Orthod* 2006; 76: 408-11.
- Keating PJ. Bimaxillary Protrusion in the Caucasian: a cephalometric study of the morphological features. *Br J Orthod* 1985; 12: 1930-201.
- Bloom LA. Perioral profile changes in orthodontic treatment. *Am J Orthod* 1961; 47: 371.
- Garner LD. Soft tissue changes concurrent with orthodontic tooth movement. *Am J Orthod* 1974; 66: 357-77.
- Roos N. Soft tissue changes in class 2 treatment. *Am J Orthod* 1977; 72: 165-75.
- Rain MD, Nanda R. Soft tissue changes associated with maxillary incisor retraction. *Am J Orthod* 1982; 81: 481-8.
- Ballard CF. Some bases for etiology and diagnosis in Orthodontics. *Dent Record* 1990; 68: 133-45.
- Wisth PJ. Soft tissue response to upper incisor retraction in boys. *Br J Orthod* 1974; 1: 199-204.
- Riveiro PF, Quintanilla SD, Chamosa ES, Cunqueiro MS. Linear photogrammetric analysis of the soft tissue facial profile. *Am J Orthod Dentofacial Orthop* 2002; 122: 59-66.
- Canut J. Un analisis estetico dentofacial. *Rev Esp Ortod* 1996; 26: 13-30.
- Mingchu Y, Hsunchen RP, Morres DE, Chinko EW. Surgical Approach to the patient with Bimaxillary Protrusion. *Clin Plast Surg* 2007; 34: 535-46.
- Fujita K, Haraguchi S, Kawasaki K, Takada K. Autotransplantation of premolar tooth in a case of dental bimaxillary protrusion with multiple missing permanent premolars. *Jap Orthod society J* 2007; 66: 149-54.
- Ming Y, Bergeron, Ray CY. Bimaxillary Protrusion. An Overview of the Surgical Orthodontic Treatment. *Clin Plast Surg* 2009; 23: 32-9.