UPPER LIP STRAIN IN BIMAXILLARY PROCLINATION

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ABSTRACT

The purpose of this study was to determine the upper lip by Holdaway's method in individuals with bimaxillary proclination and to find out correlations of skeletal convexity at point A & maxillary incisor inclination with upper lip inclination and upper lip strain. Lateral cephalograms of 100 patients (50 males and 50 females) exhibiting bimaxillary dental proclination were exposed in closed lip position. Cephalometric radiographs were traced manually and the database was developed in SPSS 10.0 for windows. The results showed a significant positive correlation with upper lip strain measured by Holdaway's method. Holdaway's method reveals lip strain in the sample. No statistical significant correlations of skeletal convexity at point A and maxillary incisor inclination with upper lip inclination were found. A-FP distance revealed a significant negative correlation with upper lip strain recorded by Holdaway's method. I-FH and I-SN plane angles are significantly positively correlated with upper lip inclination and upper lip strain measured by Holdaway's method.

Key words: *Bimaxillary dental proclination, Convexity, Lip strain, Holdaway method*

INTRODUCTION

Lip strain or the interlabial gap is the distance between the inferior border of upper lip and upper border of lower lip, ranging between 2 ± 2mm[1]. Peck and Peck concluded that the maxillary sulcus contour and mandibular sulcus contour are gently curved and can indicate lip strain[2]. The population having bimaxillary dental proclination shows different lip morphology and lip tension than normal esthetic group. Bills et al showed that patients with bimaxillary protrusion demonstrated increased procumbency of lips, a decreased nasolabial angle, and thin and elongated upper and lower anterior alveoli.[3] The soft tissue response during the treatment especially the lips shows different variations regarding lip morphology and strain during hard tissue change. Thin lips follow the incisors movement while the thick lips may not respond in the same way[4]. Oliver demonstrated a significant correlation between incisors change and vermillion border changes in subject with high lip strain but insignificant in subject with low lip strain[5].

Pretreatment soft tissue morphology and lip strain may be of help in predicting the soft tissue response to treatment. Very little work has been reported in the orthodontic literature regarding the lip strain in subjects having bimaxillary proclination in our region.

METHODOLOGY

100 patients (50 males and 50 females) of bimaxillary dental proclination were recruited in this study. The consent was taken and the patients were informed for the amount of radiation exposure related to cephalometric radiography. The selection criteria for the sample were:

15 - 25 years of age.

Bimaxillary dental proclination.

No previous or active orthodontic treatment.

Mandibular plan angle in the range of 25 – 35.

Lateral cephalometric radiographs of the patients were exposed in centric occlusion with relaxed lip and closed lip position. The cephalometric radiographs of patients were traced manually on acetate papers. Each radiograph of the patient was traced at the same sitting to minimize tracing errors.

Following skeletal measurements were taken:

<SNA, <SNB, <ANB, <SN-MP, A-FP

Following dental parameters were used to determine the dental inclination:

<UI-SN, UI-FH, <IMPA, <IIA.

Following soft tissue parameters were used:

Basic upper lip thickness in close position (BULT-C), Vermilion upper lip thickness in closed lip position

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(VULT-C), Lip strain by Holdaway method (LS-HO), Z angle, Nasolabial angle (NLA),Upper lip inclination (ULI). Nasal inclination (NI).

The upper lip strain was calculated by Holdaway method:

a. Basic upper lip thickness in the closed lip position (BULT-C): A linear distance measured in mm from point K to point M (fig 1).

b. Vermilion upper lip thickness in the closed lip position (VULT-C): A linear distance measured in mm from Incision anterius (Ia) to the Labrale superius (Ls).

The difference of a and b measurements in mm is the lip strain by Holdaway's method.

The database of study sample measurements was developed in SPSS version 10 for the Windows. The arithmetic mean, range and standard deviation for all the concerned variables were determined using the above-mentioned software with the help of SPSS processor.

Fifty (50) cephalograms were randomly selected and retraced after two weeks of first tracing by the same operator and were compared to the first tracing of the same cephalograms. Paired t-test was applied to find any method error. Pearson's correlation test was applied to determine the correlation of Skeletal Convexity at Point A and Upper Incisor Inclination with Upper Lip Inclination and Upper Lip Strain.

Lip Strain (mm) = a – b

Fig 1

TABLE 1: SKELETAL CHARACTERISTICS OF THE SAMPLE (IN DEGREES)

S. No.	Cephalometric Parameter	Minimum	Maximum	Mean	Standard deviation
1	SNA	76	92	83.58	3.48
2	SNB	69	85	77.49	3.59
3	ANB	0	12	6.09	2.36
4	FMA	-2	10	5.36	2,84
5	SN-MP	29	43	35.34	4.08

n=100

TABLE 2: DENTAL CHARACTERISTICS OF THE SAMPLE (IN DEGREES)

S. No.	Cephalometric Parameter	Minimum	Maximum	Mean	Standard deviation
1	IMPA	97	114	104.78	5.30
2	IIA	84	120	105.64	7.41
3	I-FH	113	147	123.82	7.52
4	I-SN	108	148	118.41	8.34

n=100

TABLE 3: SOFT TISSUE LINEAR MEASUREMENTS OF THE SAMPLE (IN MM)

S. No.	Cephalometric Parameter	Minimum	Maximum	Mean	Standard deviation
1	BULT-C	11	20	15.34	1.97
2	VULT-C	5	14	10.33	1.81
3	LS-HO	2.0	10.0	5.013	1.854

n=100

TABLE 4: SOFT TISSUE ANGULAR MEASUREMENTS OF THE SAMPLE (IN DEGREES)

S. No.	Cephalometric Parameter	Minimum	Maximum	Mean	Standard deviation
1	**Z angle**	55	79	66.64	5.31
2	**NLA**	69	115	91.91	9.19
3	**ULI**	57	89	73.97	7.33
4	**NI**	3	38	18.31	7.64

n=100

TABLE 5: PEARSON'S CORRELATIONS OF SKELETAL CONVEXITY AT POINT A AND UPPER INCISOR INCLINATION WITH UPPER LIP INCLINATION AND UPPER LIP STRAIN

	Upper Lip Inclination	Lip Strain by Holdaway Method
A - FP	-0.033	-0.336**
I-FH	-0.058	0.439**
I-SN	0.035	0.446**

n=100, **p<0.01

TABLE.6: PEARSON'S CORRELATIONS OF SKELETAL CONVEXITY AT POINT A AND UPPER INCISOR INCLINATION WITH BASIC UPPER LIP THICKNESS & VERMILION UPPER LIP THICKNESS IN RELAXED AND CLOSED LIPS

	BULT-C	VULT-C
A - FP	-0.463**	-0.159
I-FH	0.363**	-0.054
I-SN	0.478**	0.062

n=100, **P< 0.01

RESULTS

The mean age of the sample was 20 ± 3.2 years, with a range of 15.2 to 25.0 years.

The mean value of the SNA angle was 83.58° ± 3.48°, that of SNB angle was 77.49° ±3.59° and that of ANB angle was 6.09° ± 2.36°. This means that sagittaly the sample was class II due to mild mandibular deficiency.

The mean value of the A to facial plane (A-FP) was 5.36° ± 2.84°. As far as the vertical pattern of the sample is concerned the mean SN-MP angle was 35.34° ± 4.08° showing the normal mandibular plane inclination (Table 1).

The mean value of the I-FH angle was 123.82° ± 7.52° and that of I-SN angle was 118.41° ± 8.34°. The mean IIA of the sample was 105.64 ± 7.41. All these show bimaxillary protrusion, which was one of the selection criteria of the sample (Table-2).

The mean values of BULT-C and VULT-C were 15.34mm ± 1.97mm and 10.33mm ± 1.81mm respectively (Table-3).

The mean value of LS-HO in the sample was 5.013mm ± 1.854mm and that of LS-CC was 3.237mm ± 1.445mm, both showing lip strain (Table-3).

The mean value of the Z angle was 66.64° ± 5.31°, that of NLA angle was 91.91° ± 9.19° and that of ULI angle was 73.97° ± 7.33°. These readings show lip protrusion. The mean value of NI angle was 18.31° ± 7.64° which was within the normal range (Table 4).

There were no statistical significant correlations of skeletal convexity at point A and maxillary incisor inclination with upper lip inclination as evaluated by Pearson's correlations of A to facial plane (A-FP), I-FH angle and I-SN angle with upper lip inclination (ULI) (Table 5).

A to facial plane (A-FP) showed a significant negative correlation ($r=-0.336$, $p<0.01$) with upper lip strain recorded by Holdaway's method As far as the maxillary incisor inclination is concerned, both I-FH and I-SN angles were significantly positively correlated ($r=0.379$, $p<0.01$) with upper lip strain measured by Holdaway's method (Table 5)

Table 6 indicate that A to facial plane shows significant negative correlation with the mean value of basic upper lip thickness in closed lip ceph (BULT-C) but does not have any significant correlation with vermilion upper lip thickness in closed lip cephalometric radiograph (VULT- C).

DISCUSSION

The present study was carried out on lateral Cephalometric radiographs of 100 patients (50 males and 50 females). The purpose of the study was to determine the lip strain in a Pakistani population sample having bimaxillary dental proclination and to find out correlation of upper incisor inclination to the upper lip strain.

Average age of the whole sample was 20 ± 3.2 years with a range of 15.0 to 25.0 years. The entire sample had bimaxillary dental protrusion, mandibular plane angle ranging 25 to 35.

The mean value of the SNA angle of the sample was 83.58° ± 3.48°. The ANB angle mean value of the sample was 6.09° ± 2.36°. So sagittaly the sample was skeletal class II due to mild mandibular deficiency.

The mean value of SNA angle in the present study is slightly larger and SNB angle is less than those presented by Steiner[6] for the Caucasian population. The differences in SNA and SNB angle between Pakistani bimaxillary protrusion sample and Steiner Caucasian sample of class I are related to the protruded apical base of maxilla and retruded apical base of mandible in our sample. The mean value of the measurement ANB is more (6.09° ± 2.36°) as compared to American Caucasian norms (2° ± 2°).

Tajik[7] studied 38 class I subjects for cephalometric norms of Pakistani population. He derived the mean values of SNA (81.25° ± 3.45°), SNB (78.97° ± 3.56°) and ANB (2.28° ± 2.29°). In our study the SNA angle and ANB were larger but the SNB angle mean value was slightly less than his norms, which indicate that the bimaxillary dental protrusion sample of Pakistani population has class II skeletal pattern due to mandibular deficiency.

The mean value of convexity of point A, a measure of maxillary skeletal apical base was 5.36mm ± 2.84mm in the sample.

As a comparison with the Ricketts[8] norms of skeletal I white population, our mean values of skeletal convexity at point A are larger which indicate the relative maxillary protrusion in bimaxillary population of Pakistan.

Similarly Tajik[7] calculated the mean value (1.19mm ± 2.72mm) of skeletal convexity of point A in class I sample of Pakistani group and found a slightly larger value which is contrary to our findings.

As far as the vertical pattern is concerned, the mean value of SN-MP angle was 35.35° ± 4.08°. As compared to mandibular plane angles values of Steiner[5] (SN-GoGn=32°) of class I American population, our sample SN-GoGn is within the normal range.

Tajik[7] found out the mean value of SN-MP angle was 30.13° ± 5.30° in a group of class I Pakistani population. His mean SN-MP values are less than the mean values of our study which show that the bimaxillary dental protrusion sample has greater mandibular plane inclination than skeletal class I Pakistani sample.

The mean value of the UI-SN angle was 118.41° ± 8.34°. The mean IIA of the sample was 105.64 ± 7.41. All these values show bimaxillary protrusion, which was one of the selection criteria of the sample (Table 2).

According to Down's[9] Caucasian analysis, the mean value of IIA is 135.40° ± 5.80° which is much larger than our measurement. The normal value of IIA (131°) as calculated by Steiner[5] is also greater than our calculation. Tweed[10] mean value of IMPA is 90°, which is again

less than the measurement. All these support the bimaxillary dental proclination in our sample.

SOFT TISSUE ANGULAR MEASUREMENTS

The mean value of the Z angle was 66.64° ± 5.31°, that of NLA angle was 91.91° ± 9.19° and that of ULI angle was 73.97° ± 7.33°. These readings show lip protrusion. The mean value of NI angle was 18.31° ± 7.64° which was within the normal range (Table 4).

Merrifield[11] found the mean value of Z angle (78° ± 5°) in a study of 40 normal faces (30 females and 10 males) of class I occlusion collected by Tweed[10]. His Z angle value is greater than our value, which may be attributed to protruded lips in our sample.

Tajik[7] also found larger value of Z angle in females (75.61° ± 9.47°) than males (72.73° ± 8.27°), similar to our finding although the difference was statistically insignificant. Moreover his Z angle value was larger in both sexes than that of our sample supporting lip protrusion in our sample.

The nasolabial angle is an important consideration in treatment planning for patients with dentofacial deformities. The range of this parameter is between 90° to 112° degrees for Caucasian as found in various studies. So the nasolabial angle in our sample (91.91° ± 9.19°) was towards the starting range of the measurement as quoted in the above studies pointing towards lip protrusion tendency in our bimax sample.

Fitzgerald et al[12] studied 104 young white adults, 80 men and 24 women. All exhibited class I occlusions with good facial balance. Their mean value for nasolabial angle was 114° ± 10° and for upper lip inclination was 98° ± 5°. Both of which are larger as compared to the values of our sample thereby showing protrusive lips in bimaxillary proclination sample of Pakistani population as compared to class I Caucasians. However the nasal inclination angle (18° ± 7°) value of whites coincides with our findings showing the similar nasal profile both in class I white individuals and bimaxillary protruded subjects of Pakistani population.

CORRELATIONS

There were no statistical significant correlations of skeletal convexity at point A and maxillary incisor inclination with upper lip inclination as evaluated by Pearson's correlations of A to facial plane, I-FH and I-SN with upper lip inclination. This is contrary to the finding of Sexby and Freer[13] who were of the view that lip position may be affected by incisor position and skeletal convexity at point A.

A to facial plane (A-FP) showed a significant negative correlation ($r=-0.336$, $p<0.01$) with upper lip strain recorded by Holdaway's[4] method.

As far as the maxillary incisor inclination is concerned, both I-FH and I-SN were significantly positively correlated ($r=0.379$, $p<0.01$) with upper lip strain measured by Holdaway's[4] method.

In order to clarify the above points, further correlations as shown in Table 6 were calculated and it was found that A to facial plane shows significant negative correlation with basic upper lip thickness in closed lip ceph (BULT-C) but does not have any significant correlation with vermilion upper lip thickness in closed lip ceph (VULT-C). It means that with the forward movement of point A, the basic upper lip thickness will be decreased while a very minute non-significant change will occur in vermilion lip thickness. That is why lip strain recorded by Holdaway[4] method decreases with the increase of skeletal convexity at point A. It is clear from Tables 5 and 6 that with the increase in incisor inclination, Holdaway[4] lip strain increases because the basic upper lip thickness increases in closed lip cephalograms and vermilion lip thickness does not change with the change of incisor inclination.

CONCLUSIONS

The soft tissue analysis shows both upper and lower lip protrusion in the sample.

The soft tissue parameters, which are within the normal range, included the nasal inclination, basic upper lip thickness and vermilion upper lip thickness.

Holdaway's method reveals lip strain in the sample. No statistical significant correlations of skeletal convexity at point A and maxillary incisor inclination with upper lip inclination were found. Point A to facial plane distance was in significant negative correlation with upper lip strain recorded by Holdaway's method. I-FH and I-SN plane angles are significantly positively correlated with upper lip strain measured by Holdaway's method.

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