



MORPHOLOGICAL FEATURES OF BIMAXILLARY PROTRUSION IN THE BENGALI POPULATION

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ABSTRACT

Bimaxillary protrusion is a common orthodontic problem seen in day to day practice. Bi maxillary protrusion may be dental or alveolar. So different pattern of bimaxillary protrusion exists in different populations. In this study different skeletal, dental and soft tissue parameters were measured by the use of cephalometric radiograph and study model and these values are compared with the caucasian population for staderization. Results were represented statistically.

Key Words:

Bimaxillary protrusion, Dental protrusion, Gonial angle, Saddle angle, Articular angle.

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INTRODUCTION

The relationship in between malocclusion and facial form has been a focus of orthodontics since the early 20th century. Improvement in facial aesthetics and functional occlusion are the main objectives of orthodontic treatment (Bishara et al 1990). The term 'Bimaxillary protrusion' was first used as early as 1897 by Dr Calvin C case. He describes bimaxillary protrusion as a condition in which the entire dentures of both jaws are protruded in relation to the mandible and other bones of the skull and states that this deformity is always aggravated by receding chin. He speculates the possible influence of heredity in this condition.

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In 1943 Samuel (Samuel 1943)² uses the term 'bimaxillary protraction' which is synonymous in protrusion. He divided protraction in to two group i) dental protraction when the teeth are not in perpendicular or upright position because the crowns are tipped anteriorly and ii) pure alveolar protraction, when the teeth may or may not be in an upright position but there is more or less prominence of the alveolar process and the lips are correspondingly prominent. Bimaxillary protrusion is observed mainly in African-American (Fonseca³ and Klein 1978⁴; Rosa and Arvystas, 1978; Keating 1985; Farrow et al, 1993⁶) and Asian (Lamberton et al, 1980; Lew 1989; Tan 1996⁹) populations but it can be seen in almost every ethnic group. Hovell (1966) states that bimaxillary protrusions are independent and usually a considerable degree of association exists in between basal prognathism and dentoalveolar proclination). In bimaxillary protrusion molars are usually in class I relationship and the incisors show a relatively normal overbite and overjet (Tulley, 1970; Graber, 1972; Posen, 1972).

Keating (1985) used cephalometrics to determine the morphological features of bimaxillary Protrusion in strictly Caucasian population. The goals of orthodontic treatment of bimaxillary protrusion include the retraction and retroclination of maxillary and mandibular incisors with are effectively decrease in soft tissue procumbency and convexity. This is most commonly achieved by the extraction of four first premolars followed by the retraction of the anterior teeth using maximum anchorage mechanics. These are totally contradictory findings over the study in three different population makes it clear that its quite necessary to study the features of bimaxillary protrusion in the Bengali population that can arguably differ from the other similar studies in a different population. So, the purpose of this study is to find correlation in between the skeletal feature and the dento-alveolar pattern in the Bengali population. Radiographic land marks are identified from which skeletal, dental and soft tissue areas will be under the study and evaluation will be made according to statistical method. The collected data will be analysed to see whether there is any difference between the morphological features of the experimental group and then that of standard Caucasian population. Since there is no established norm for the bimaxillary Bengali population is available.

Aims and Objectives

Specific: Find out the skeletal features of the bi-maxillary protrusion in the Bengali population.

General: Morphological features of the Bengali population including the dental and soft tissue evaluation as well as comparisons with the Caucasian norms.

MATERIALS AND METHODS

The samples for this study consisted of 50 (25 male and 25 female) Bengalis of both sexes ranging in age from 12 to 18 years. The sample was selected from the patients attending to the Department of Orthodontics in Dr R Ahmed dental college and hospital, 114, A. J. C. Bose Road, Kolkata-700014. Study period was one and half years (Approximate). The selections of samples were done on the basis of following inclusion or exclusion criteria:

-) All the subjects were healthy, Bengali origin and born and brought up in West Bengal.
-) All the subjects were age group 12-18 years.
-) All the subjects were selected only in permanent dentition where wisdom teeth may or may not present.
-) All the subjects were without any previous history of orthodontic treatment and no surgical intervention done to correct the deformity.
-) The subjects having no congenital defects and no history of disease which could have affect cranio-facial growth and development
-) All the subjects were without clinically visible dental caries, attrition or dental anomalies.
-) The periodontal condition of all the subjects were good.
-) Minimum crowding or spacing.

The data used in this study were derived from standard lateral cephalometric radiographs and dental study models.

Nineteen skeletal and seven dental and six soft tissue parameters were digitised and computed. The error of the method was calculated by retracing and redigitizing. This error is essentially that of landmark identification.

Skeletal parameters:

1. **N-S-Ar** (The saddle angle):-The angle formed by joining these three points provides a parameter for assessment of the relationship between anterior and posterolateral cranial bases.

2. **S-Ar-Go (Articular angle/ The joint angle)**:The articular angle is a constructed angle between the upper and lower parts of the posterior contours of the facial skeleton.

3. **Ar-Go-Me (Gonial angle/ the jaw angle)**: The angle formed by tangents to the body of the mandibular posterior border of the ramus. It expresses the form of mandible and also gives information on mandibular growth direction.

4. **Ar-Go-N (Upper gonial angle)**: The angle formed by posterior border of the ramus and line connecting nasion to gonion.

5. **N-Go-Me (Lower gonial angle)**: The angle formed by tangents to the body of the mandible and line connecting nasion to gonion.

6. **S-N-A (Anteroposterior position of maxilla/ Maxillary basal prognathism)**: The angle S-N-A expresses the sagittal relationship of the anterior limit of the maxillary apical base (Lundstrom's term for the junction of alveolar and basal bone) to the anterior cranial base.

7. **S-N-B (Anteroposterior position of Mandibular/ Mandibular basal prognathism)**: The angle S-N-B expresses the sagittal relationship between the anterior extent of the mandibular apical base and anterior cranial base.

8. **SN-MP**: Angle is formed in between S-N plane to mandibular plane Or anterior cranial base to mandibular planes .

9. **Mx-MP/Pal-MP** : Angle between palatal and mandibular plane/ Maxillary to mandibular plane angle.

10. **N-A-Pog (Down's angle of skeletal convexity)**: The angle of convexity is formed by intersection of line N-point A to point A-pogonion. This angle measures the degree of the maxillary basal arch at Its anterior limit (point A) relative to the total facial profile (nasion-pogonion).

11. **N-S (Anteroposterior extent of the anterior cranial base Anterior cranial base length)** : Line joining sella point and nasion. The correlation of this criterion with the length of the jaw bases enable the assessment of the proportional averages of these bases.

12. **S-Ar (Extent of the lateral cranial base/ Posterior cranial base length)**: Line joining sella point and Articulare. The magnitude of posterior cranial base length depends on Posterior face height and the position of fossa.

13. **N-Ar (Total cranial base length)**: Total cranial base length measured form Nasion to Articulare.

14. **Co-ANS (Maxillary length)**: The maxillary unit length is measured from the posterior border of the mandibular condyle to the anterior nasal spine.

15. **Co-Pog (Mandibular length)**: The mandibular length is measured from the posterior border of the mandibular condyle to the anterior point of the chin.

16. **S-Go (Posterior facial height):** The measurement of posterior face height is linear assessment sella to gonion.

17. **N-Me (Anterior facial height):** The measurement of anterior face height is linear assessment nasion to menton.

18. **UFH (Upper facial height) :** Upper facial height is measured from nasion to Anterior nasal spine in vertically.

19. **LFH (Lower facial height) :** Upper facial height is measured from anterior nasal spine to menton in vertically.

Dental factors:

1. **SN-U1 (Axial inclination of upper incisor):**The posterior angle between the long axis of upper incisors and SN line is measured.

2. **MP-LI (Axial inclination of lower incisor):** The posterior angle between the long axis of lower incisors and mandibular plane.

3. **UI-LI (Interincisal angle):** The interincisal angle is established by passing a line through the incisal edge and the apex of the root of the maxillary and mandibular central incisors.

4. **U1-NA(linear):** It is a linear measurement between the labial surface Of upper central incisor and the line joining Nasion to point A.

5. **U1-NA (angle) :** It is the angle formed by the intersection of the long axis of the upper central incisor and the line joining Nasion to point A.

6. **L1-NB (linear):** It is a linear distance between the labial surface of lower central incisor and the line joining Nasion to point B

7. **L1-NB (angle):** It is the angle formed between the N-B plane and the long axis of the lower central incisor.

Soft tissue parameters

1. **UL -E line (Ricketts) :** Upper lip to E line is measured from the most prominent outline of the upper lip to E line.

2. **LL- E line (Ricketts) :** Lower lip to E line is measured from the most prominent outline of the lower lip to E line.

3. **LL - H line (Linear -Holdaway) :** The lower lip to H-line is measured from The` most prominent outline of the lower lip.

4. **Nasolabial angle :** Angle is formed by the intersection of the upper lip and the Nasal columella at subnasal.

5. **H-line angle (Holdaway):** The H-line angle is the angle formed between the H-line and the soft-tissue nasion-pogonion line (N'-Pog').

6. **Labiomental angle:** Angle formed by the intersection of the lower lip and the Chin measured at soft tissue B point.

STUDY MODEL

Five parameter were measured in study model.

1. **Anterior arch width:** The anterior arch width of upper arch measured from the distal pit of one upper first premolar to the distal pit of the opposite upper first premolar. In case of lower arch it measured in between buccal interproximal embrasure of mandibular first and second premolar.

2. **Posterior arch width:** Posterior arch width of upper arch is measured in between the central fossa of first molars. In lower arch it measured in between middle buccal cusp tips of lower molars.

3. **Overbite:** The overjet is the horizontal distance between the upper and lower incisors in occlusion, measured at the tip of the upper incisor.

4. **Overjet:** The overbite is the vertical distance between the tips of the upper and lower incisors in occlusion.

5. **Molar relation:** According to Angle, the maxillary first permanent molar is the key to occlusion. He considered these teeth as fixed anatomical points within the jaws. Based on the relation of the lower first permanent molar to the upper first permanent molar, he classified malocclusions in to three main classes designated by the Roman numerals I,II,III.

Statistical Analysis was performed with help of Epi Info (TM) 3.5.3. EPI INFO is a trademark of the Centers for Disease Control and Prevention (CDC). Descriptive statistical analysis was performed to prepare different frequency tables and to calculate the means with corresponding standard errors. t-test was used to compare the means. $p < 0.05$ was taken to be statistically significant.

RESULTS

The collected data was statistically analyzed for evaluation of Bengali bimaxillary features. Skeletal, dental, soft-tissue and study model measurements of the bimaxillary population of the west Bengal state was taken and an attempt was made to compare with that of the Caucasian standard norms as it was shown in the Table I,II,III, & IV and the figures 1,2,3,4,5&6.

Table -I: Mean (mean \pm s.d.) of skeletal parameters

| | Bengali Population Mean \pm s.d. (n=50) | Caucasian Population Mean \pm s.d. | p-value |
|---------------------------------|---|---|---------|
| Parameters measure in degree | | | |
| N-S-Ar | 127.06 \pm 3.00 | 123.00 \pm 3.27 | <0.01** |
| S-Ar-Go | 142.78 \pm 2.21 | 143.00 \pm 6.01 | >0.05 |
| Ar-Go-Me | 129.73 \pm 1.79 | 128.00 \pm 7.12 | >0.05 |
| Ar-Go-N | 53.29 \pm 1.29 | 52.00 \pm 1.97 | >0.05 |
| N-Go-Me | 76.44 \pm 1.60 | 73.00 \pm 1.77 | <0.01** |
| S-N-A | 82.1 \pm 1.76 | 81.00 \pm 1.54 | <0.05* |
| S-N-B | 80.24 \pm 1.66 | 79.00 \pm 1.23 | <0.05* |
| SN-MP | 36.18 \pm 1.51 | 35.00 \pm 1.11 | <0.05* |
| Mx-MP/Pal-MP | 27.39 \pm 1.48 | 25.00 \pm 1.77 | <0.01** |
| N-A-Pog | 6.64 \pm 1.25 | 1.50 \pm 0.89 | <0.01** |
| Parameters measure in mm | | | |
| N-S | 71.09 \pm 1.60 | 71.00 \pm 1.23 | >0.05 |
| S-Ar | 33.09 \pm 1.68 | 34.09 \pm 1.27 | <0.05* |
| N-Ar | 95.06 \pm 1.85 | 95.11 \pm 1.01 | >0.05 |
| Co-ANS | 95.30 \pm 2.64 | 93.78 \pm 1.19 | <0.05* |
| Co-Pog | 114.70 \pm 4.45 | 114.02 \pm 2.07 | >0.05 |
| S-Go | 72.91 \pm 2.79 | 74.13 \pm 1.89 | <0.05* |
| N-Me | 117.48 \pm 3.74 | 117.91 \pm 3.71 | >0.05 |
| UFH | 51.82 \pm 2.34 | 51.93 \pm 2.39 | >0.05 |
| LFH | 65.42 \pm 3.49 | 65.51 \pm 3.34 | >0.05 |

<0.01** - Significant at 1% level of significance

<0.05* - Significant at 5% level of significance

>0.05 - Not significant

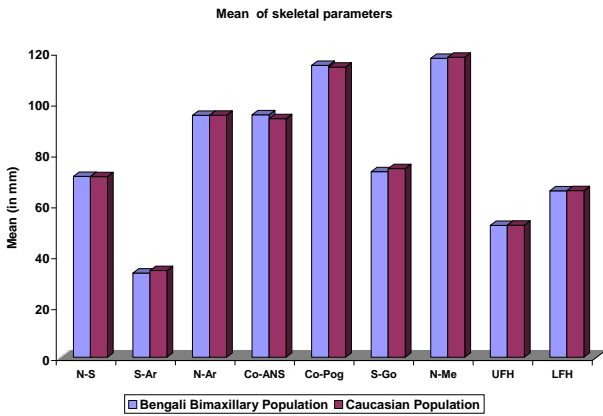
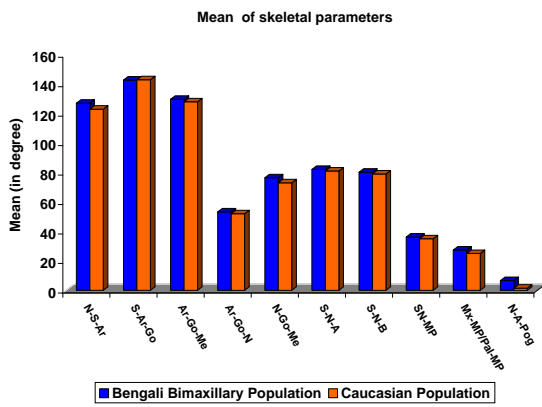


Table 2. Mean (mean ± s.d) of dental parameters

| | Bengali Population Mean ± s.d. (n=50) | Caucasian Population Mean ± s.d. | p-value |
|----------------|--|-------------------------------------|---------|
| SN-U1 (angle) | 115.82±6.36 | 102.00±6.12 | <0.01** |
| MP-L1 (angle) | 100.48±5.19 | 93.00±2.23 | <0.01** |
| U1-L1 (angle) | 107.82±7.19 | 134.00±6.68 | <0.01** |
| U1-NA (linear) | 7.39±1.97 | 4.00±2.26 | <0.01** |
| U1-NA (angle) | 32.21±4.77 | 22.00±3.24 | <0.01** |
| L1-NB (linear) | 8.48±1.67 | 4.00±1.82 | <0.01** |
| L1-NB (angle) | 34.12±4.68 | 25.00±4.72 | <0.01* |

<0.01** - Significant at 1% level of significance

Skeletal factors

- The cranial base- This study showed saddle angle of bimaxillary Bengali population significantly larger than that of the Caucasian standard norms. Posterior cranial base length was significantly shorter by 1mm in Bengali sample. Articular angle was decrease but was not significant.
- The maxilla-The maxilla was found to be more prognathic in the Bengali bimaxillary sample with an S-N-A angle of 82.1° versus 81° for the Caucasian. The maxillary length in bimaxillary group of the Bengali bimaxillary sample was significantly longer by 1.52 mm.
- The mandible- The mandible was found to be more prognathic in the Bengali bimaxillary sample with an S-N-B angle of 80.24° verses 79° for the Caucasian. The mandibular length in bimaxillary group was not significantly larger or smaller.
- The facial heights and facial plane angle - The angle in between anterior cranial cranial base to the mandibular plane was greater 36.18° versus 35° in the Bengali bimaxillary group. Inter maxillary planes angle is

significantly greater in Bengali population. Posterior facial height was smaller in this study group. Anterior facial height was larger 117.91° versus 117.48° but not significant in Bengali bimaxillary Population.

Dental factor

- Position of incisor-Only the position of the most prominent incisors have been studied. The Bengali bimaxillary group showed an increased protrusion of about 3.39 mm for the maxillary incisors and 4.48 mm for the mandibular incisors. Upper incisor to N-A (angle) and lower incisor to N-B (angle) both were significantly larger in Bengali bimaxillary sample than the Caucasian standard norms.
- Incisor axis: The mean interincisal angle in the Bengali bimaxillary protrusion group was 107.82° while the Caucasian norms being 134°. In the study group, the upper incisor’s axial inclination to the SN plane 115.82° versus 102°. The lower incisor axial inclination to the MP plane 100.48° versus 93° in Caucasian population. All these differences were highly significant.

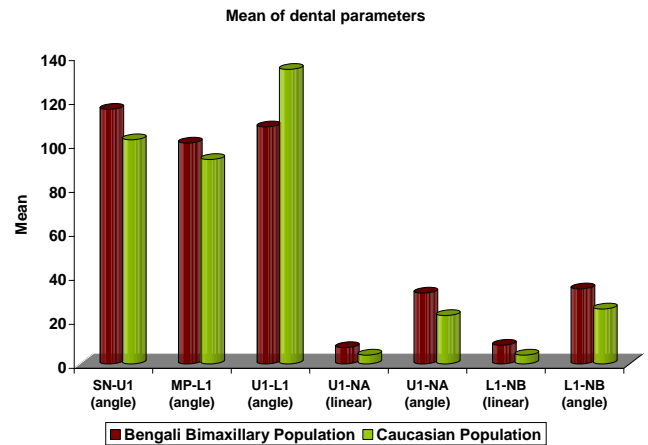
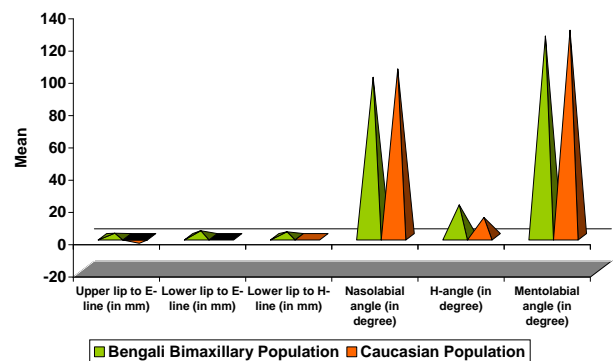


Table 3. Mean (mean ± s.d) of soft tissue parameters

| | Bengali Population Mean ± s.d. (n=50) | Caucasian Population Mean ± s.d. | p-value |
|-------------------------------|--|-------------------------------------|---------|
| Upper lip to E-line (in mm) | 2.20±1.19 | -4.00±2.13 | <0.01** |
| Lower lip to E-line (in mm) | 3.75±2.20 | -2.00±2.29 | <0.01** |
| Lower lip to H-line (in mm) | 3.09±1.41 | 0.00±0.00 | <0.01** |
| Nasolabial angle(in degree) | 98.88±10.06 | 104.00±9.87 | <0.01** |
| H-angle(in degree) | 19.79±2.91 | 12.00±3.27 | <0.01** |
| Mentolabial angle (in degree) | 124.42±8.19 | 128.00±7.77 | <0.01** |

<0.01** - Significant at 1% level of significance



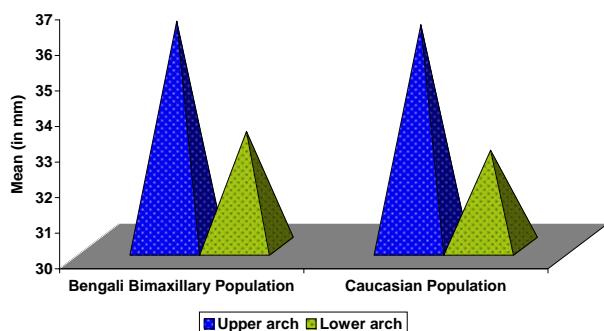
Soft tissue factor

Only the profile relationships of the soft tissues have been investigated. Prominence of the lips was measured by the Holdaway angle. This angle reflects the prominence of the upper and lower lips to the underlying skeletal framework while excluding the nose. The Bengali bimaxillary protrusion sample had an H angle of 19.79° against 12° of normal the Caucasian standard a highly significant difference. Rickeets soft analysis, upper lip to E line showed upper lip protrusive by 2.20 mm versus -4.00 mm of the Caucasian and lower lip to E line showed lower lip protrusive by 3.75mm versus -2.00 mm in the Caucasian . Nasolabial angle and labiomental angle were significantly smaller in Bengali bimaxillary sample than the Caucasian norms.

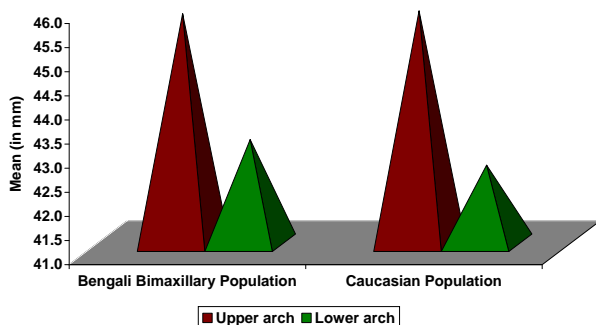
Study model: In this study Bengali bimaxillary sample showed both the over jet and over bite both were smaller than the Caucasian standard norms Anterior and posterior arch width were not significant in Bengali bimaxillary sample.

| | Bengali Population Mean ± s.d. (n=50) | Caucasian Population Mean ± s.d. | p-value |
|---------------------------------|--|-------------------------------------|---------|
| Anterior arch width (in mm) | | | |
| Upper arch | 36.33±1.45 | 36.23±1.77 | >0.05 |
| Lower arch | 33.23±2.15 | 32.70±2.19 | >0.05 |
| Posterior arch width (in mm) | | | |
| Upper arch | 45.75±1.33 | 45.81±1.92 | >0.05 |
| Lower arch | 43.14±2.01 | 42.61±2.27 | >0.05 |
| Overjet | 1.97±0.85 | 3.01±2.01 | >0.05 |
| Overbite | 1.57±0.79 | 2.09±0.81 | >0.05 |

Study model analysis Anterior arch width



Study model analysis Posterior arch width



DISCUSSION

This study was the first to observe Bengali patients with bimaxillary protrusion to determine their morphological skeletal features as well as dental and soft tissue cephalometric characteristics. All measurement were compared with the Caucasian standard norms. These values were used for comparison purpose because they best represent the ethnic variability of this sample. Table I showed the cephalometric skeletal characteristics present in the patients with bimaxillary protrusion in Bengali sample. In this study showed saddle angle of Bengali population significantly larger than the Caucasian standard norms. Posterior cranial base length was significantly shorter by 1mm and articular angle was decrease but not significant. Keating (1985) reported that the Caucasian sample with bimaxillary protrusion, Posterior cranial base was (S-Ar) significantly shorter by 1.86 mm in the bimaxillary group. The saddle angle was larger but not significantly revealed. Maxilla was found to be more prognathic in the bimaxillary group with an S-N-A angle of 82.45° verses 81.2° and maxillary length was significantly longer by 1.8 mm than controls groups(the Caucasian standard norms). He found the angle of the anterior cranial base to mandibular planes angle and maxillary plane to the mandibular plane (27.1° verses 25.3°) were greater in the Caucasian bimaxillary group.

The posterior facial height was smaller in the bimaxillary group, with the ratio of the total posterior facial height to the anterior height being 62.5 verses 64.2 in the control groups. The bimaxillary group showed an increased protrusion of about 5 mm for the maxillary incisors and 3.7 mm for the mandibular incisor. The mean interincisal angle for the bimaxillary protrusion groups was 115.3° with the controls being 135.7° and the upper incisor's axial inclination 118.2° verses 106.9° and the lower incisor axial inclination 97.7° verses 89.3°. All these dental parameter were highly significant. P.J.Keating investigated the prominence of the lips by the Holdaway angle. The bimaxillary protrusion group had an 'H'angle of 15.9°against 11.5° for the controls-a highly significant difference. In this present study the Bengali bimaxillary protrusion sample had an H angle of 19.79°. Lamberton et al (1980) Richard A Drummond (1968), Dr. Deepesh Agrawal (2012), Hassan, A H (2006), Jong-Ryoul Kim et al. (2002) Emad Hussen et al (2007), KENZA Lahlou et al. (2010) also did similar studies which correlated with the present study.

SUMMARY AND CONCLUSION

Bimaxillary protrusion in Bengali population is shown to exhibit some definitive skeletal, dental and soft tissue feature. Saddle angle of bimaxillary Bengali population significantly larger than that of the Caucasian standard norms. Posterior cranial base length was shorter than the Caucasian. Lower gonial was significantly increased but upper gonial was not significantly changed in the study group. Prognathic maxilla was found as a prominent feature in the Bengali bimaxillary sample. The mandible was found also prognathic but length of the mandible was similar to the Caucasian. Anterior cranial base to the mandibular plane was greater the Bengali bimaxillary group. Posterior facial height was smaller but anterior facial height not significantly different in Bengali bimaxillary Population. Inter maxillary planes angle is significantly greater in Bengal population. Associated with the

maxillary prognathism, it was found an increased dentoalveolar proclination which was complemented by a similar situation in the mandible. The lower incisor in the Bengali bimaxillary sample was considerably more procumbent in relation to the mandibular plane and maxillary incisors were more procumbent in relation to the anterior cranial base length. In normal the Caucasian standard, both upper and lower lips were behind the E line but in Bengali bimaxillary groups both upper and lower were found ahead of the E line. Bengali bimaxillary protrusion sample had significantly higher an H angle normal the Caucasian standard. Nasolabial angle and labiomental angle were significantly smaller in Bengali bimaxillary sample than the Caucasian norms. This result was another indication of the soft tissue procumbency in bimaxillary group. Study model analysis showed no significant difference in anterior and posterior arch width but over jet and over bite both were reduced in bimaxillary Bengali bimaxillary sample. Most of the skeletal, dental and soft tissue features found in this study associated with bimaxillary protrusion were similar to those of other ethnic groups exhibiting the same dentofacial morphology.

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