International Journal of Dental Sciences and Research, 2014, Vol. 2, No. 4, 80-86
Available online at http://pubs.sciepub.com/ijdsr/2/4/3

DOI:10.12691/ijdsr-2-4-3

"Are We Similar to Caucasians" – Orthognathic Surgery for North Indians

ANKUR MITTAL[1,*], RITESH GARG[2], SUNIL KUMAR GUPTA[2]

[1]Maxillofacial Surgery, DJ Dental College, Modinagar, India
[2]Department of Oral and Maxillofacial Surgery, DJ Dental College, Modinagar, India
*Corresponding author: drankur2007@gmail.com

Received January 27, 2014; Revised April 29, 2014; Accepted June 29, 2014

Abstract *Primary aim - To* establish the cephalometric standards for hard and soft tissues of the facial skeleton for north Indian population. *Methods* – The sample comprised of lateral cephalograms taken in natural head position of 100 participants (50 men, 50 women). The cephalograms were traced, analyzed and interpreted using the landmarks and values given by Burstone's analysis for hard tissue and Legan & Burstone analysis for soft tissue respectively. The student's *t* test, standard deviation and mean deviation were calculated to compare between the groups. *Results* – Statistically significant results were found in various parameters between intra and inter group comparison. *Conclusion* – The results obtained of the north Indian population can be used as cephalometric norms for orthognathic surgery.

Keywords: *orthognathic surgery, north Indians, burstone and legan*

Cite This Article: ANKUR MITTAL, RITESH GARG, and SUNIL KUMAR GUPTA, ""Are We Similar to Caucasians" – Orthognathic Surgery for North Indians." *International Journal of Dental Sciences and Research*, vol. 2, no. 4 (2014): 80-86. doi: 10.12691/ijdsr-2-4-3.

1. Introduction

*T*he specialty of oral and maxillofacial surgery has expanded its boundaries to a great extent in the last few decades. The subspecialty of orthognathic surgery which deals with the correction of disproportion of the facial skeleton has been at the forefront of this expansion and this has brought about dramatic changes in the lives of many patients. To get the proportions correct, various aids have been used, with cephalometric analysis being one of the main tools.

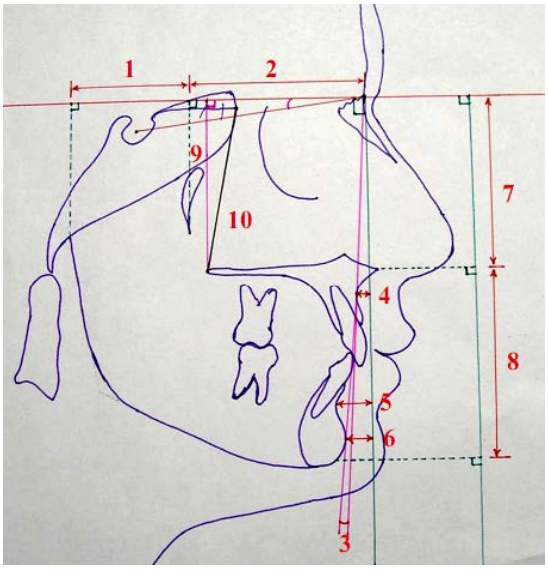
Two of the most accepted analysis norms have been the ones proposed by Burstone et al [1] and Legan & Burstone [2] for hard tissues and soft tissues respectively. The problem facing the maxillofacial surgeon in India has been that these analyses are basically for the Caucasian population. Norms for the Indian population have also been put forth but again these have been mainly for the south Indian population [3]. So we decided to conduct a study to establish the cephalometric norms for ethnic north Indian population utilizing the widely accepted analyses given by Burstone et al[1] and Legan & Burstone [2].

2. Material and Methods

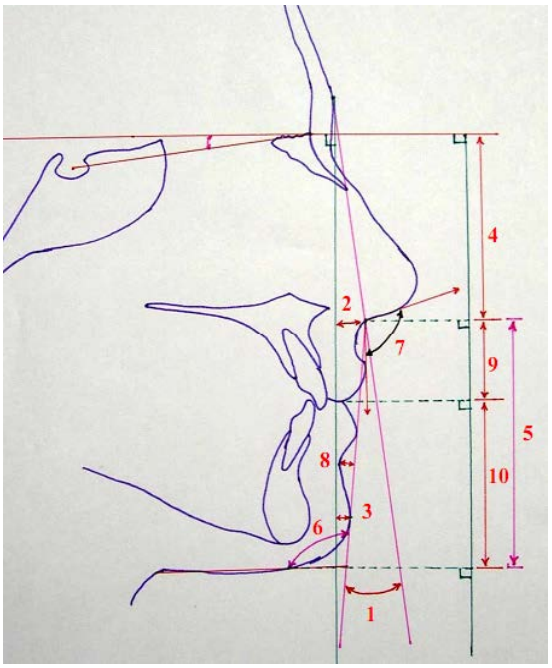
A total of 100 subjects (50 males & 50 females) were enrolled for the study consecutively who met inclusion and exclusion criteria. Lateral cephalogram was taken in normal head position with the teeth in the maximum intercuspation and lips in repose.

All radiographs were traced on 0.008 matte acetate sheets by a single individual & reviewed twice with another investigator for accurate landmark identification. The cephalometric landmarks identification and analysis was done according to definitions used by Burstone et al[1] & Legan & Burstone [2] in their articles.

Written consent was obtained from all the subjects and the study received ethical clearance from the institution's (*DJCDS&R*) ethical board.



Hard tissue analysis, where 1(Ar-PTM), 2(PTM-N), 3(N-A-Pg (angle)), 4(N-A(II HP)), 5 (N-B (II HP)), 6 (N-Pg), 7(N-ANS), 8(ANS-Gn), 9 (PNS-N), 10 (E-PNS)



Soft tissue Analysis, where 1(G-Sn-Pg), 2(G-Sn(II HP)),3(G-Pg'(II HP)), 4(G-Sn), 5(Sn-Me'), 6(Sn-Gn'-C), 7 (Cm-Sn-Ls), 8 (Si to (Li-Pg')), 9 (Sn-Stms(Perp HP)), 10 (Stmi-Me'(Perp HP))

2.1. Inclusion Criteria

1. Person native to north India.
2. Age group 18-25 years.
3. Class I occlusion with well balanced facial profile.
4. Full complement of permanent teeth with proper intercuspation.
5. Absence of remarkably large overjet and overbite.
6. Presence of only negligible crowding, rotations and spacing of the teeth.

2.2. Exclusion Criteria

1. Person with major dental and skeletal discrepancy.
2. History of trauma in maxillofacial region
3. History of orthodontic treatment, orthognathic or plastic surgery in the maxillofacial region.

3. Results

3.1. Statistically Analysis

Various angular and linear measurements for hard and soft tissue tissues in both males and females are tabulated. All readings obtained were subjected to statistical analysis for calculating mean and standard deviation (SD) for both hard and soft tissues using the following formulae

t- test

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S.E.(\bar{x}_1 - \bar{x}_2)}$$

Wherein,

$$S.E.(\bar{x}_1 - \bar{x}_2) = \sqrt{\frac{1}{n1} + \frac{1}{n2}}$$

S = Combined standard deviation = $\sqrt{\frac{(n1-1)s1^2 + (n2-1)s2^2}{(n1+n2-2)}}$

x_1 = Mean of the first sample
x_2 = Mean of the second sample
n1 = Sample size of the first sample
n2 = Sample size of the second sample
s1 = Standard deviation of the first sample
s1 = Standard deviation of the second sample
(n1 + n2 – 2) = Degree of freedom

The mean values with standard deviation of hard and soft tissue of north Indian male and female respectively are tabulated in Table 1 & Table 2.

On comparison with Caucasian result obtained from Burstone's hard tissue and Legan & Burstone's soft tissue analysis with significant and highly significant are tabulated in Table 3, Table 4 & Table 5.

Table 1. HARD TISSUE ANALYSIS – NORTH INDIAN (MALE & FEMALE)

S.NO	VARIABLES	OBSERVED MEAN VALUE			
		MALE	SD	FEMALE	SD
	CRANIAL BASE				
1	Ar – Ptm (II HP)	**38.53**	3.16	**35.69**	2.84
2	Ptm – N (II HP)	**53.94**	4.12	**51.10**	3.88
	HORIZONTAL SKELETAL				
3	N –A – Pg (angle)	**5.96**	4.32	**6.98**	7.19
4	N – A (II HP)	**0.53**	3.56	**-0.46**	4.03
5	N – B (II HP)	**-4.57**	5.63	**-5.33**	7.32
6	N – Pg (II HP)	**-3.79**	5.92	**-4.88**	8.31
	VERTICAL (SKELETAL,DENTAL)				
7	N – ANS (perpendicular HP)	**55.49**	3.43	**52.85**	4.14
8	ANS – Gn (perpendicular HP)	**70.55**	5.94	**66.11**	5.93
9	PNS – N (perpendicular HP)	**56.34**	4.40	**52.12**	2.61
10	MP – HP (angle)	**20.78**	6.09	**24.34**	6.44
11	Upper 1-NF (perpendicular NF)	**29.50**	3.85	**27.77**	2.96
12	Lower 1-MP (perpendicular MP)	**42.22**	5.54	**39.74**	4.04
13	Upper 6-NF (perpendicular NF)	**25.26**	5.10	**22.28**	2.47
14	Lower 6-MP (perpendicular MP)	**34.88**	2.54	**32.15**	2.84
	MAXILLA - MANDIBLE				
15	PNS – ANS (II HP)	**58.33**	3.73	**54.77**	3.56
16	Ar – Go (linear)	**54.96**	4.48	**49.44**	4.50
17	Go – Pg (linear)	**80.86**	4.15	**75.07**	4.16
18	B – Pg (II MP)	**6.53**	1.88	**6.66**	1.81
19	Ar – Go – Gn (angle)	**121.26**	6.23	**125.34**	5.37
	DENTAL				
20	OP Upper (HP angle)	**4.52**	3.21	**6.74**	4.72
21	OP lower (HP angle)	**4.52**	3.21	**6.74**	4.72
22	A – B (II OP)	**-3.38**	2.75	**-2.16**	1.93
23	Upper 1 –NF (angle)	**115.52**	8.79	**113.10**	8.27
24	Lower 1 – MP (angle)	**101.76**	7.34	**98.90**	7.00

2p Value -- <0.05

Table 2. SOFT TISSUE ANALYSIS - NORTH INDIAN (MALE & FEMALE)

S.NO.	VARIABLES		**MALE**	SD	**FEMALE**	SD
	FACIAL FORM					
1	Facial convexity angle	G-Sn-Pg' (angle)	**15.36**	5.52	**13.24**	5.15
2	Maxillary prognathism	G-Sn (II HP)	**8**	4.05	**5.39**	4.62
3	Mandibular prognathism	G-Pg' (II HP)	**0.63**	5.92	**-1.06**	8.35
4	Vertical height ratio	G-Sn/Sn-Me' (Perp. HP)	**1.00**	0.10	**1.06**	0.11
5	Lower face throat angle	Sn-Gn'-C (angle)	**115.96**	12.10	**109.54**	10.52
6	Lower vertical height- depth ratio	Sn- Gn'/C- Gn'	**1.328**	0.32	**1.18**	0.19
	LIP POSITION AND FORM					
7	Nasolabial angle	Cm-Sn-Ls (angle)	**113.74**	11.88	**110.54**	9.58
8	Upper lip protrusion	Ls - (Sn-Pg')	**2.53**	3.40	**2.65**	2.11
9	Lower lip protrusion	Li - (Sn-Pg')	**1.91**	2.97	**2.07**	2.29
10	Mentolabial sulcus	Si - (Li-Pg')	**4.85**	4.47	**5.08**	1.94
11	Vertical lip chin ratio	Sn-Stms/Stmi-Me (Perp. HP)	**0.47**	0.076	**0.45**	0.05
12	Maxillary incisor exposure	Stms-1	**2.87**	2.27	**2.03**	1.58
13	Interlabial gap	Stmi-Stms (Perp. HP)	**0.56**	1.07	**0.31**	0.66

p Value -- <0.05

Table 3. HARD TISSUE ANALYSIS – MALE COMPARSION – CAUCASIANS & NORTH INDIANS

S.NO.	VARIABLES	CAUCASIAN		NORTH INDIAN		p- value
		MEAN	SD	MEAN	SD	
	CRANIAL BASE					
1	Ar – Ptm (II HP)	**37.1**	2.8	**38.53**	3.16	0.13
2	Ptm – N (II HP)	**52.8**	4.1	**53.94**	4.12	0.37
	HORIZONTAL SKELETAL					
3	N –A – Pg (angle)	**3.9**	6.4	**5.96**	4.32	0.16
4	N – A (II HP)	**0.0**	4.1	**0.53**	3.56	0.63
5	N – B (II HP)	**-5.3**	6.7	**-4.57**	5.63	0.68
6	N – Pg (II HP)	**-4.3**	8.5	**-3.79**	5.92	0.8
	VERTICAL (SKELETAL, DENTAL)					
7	N – ANS (perpendicular HP)	**54.7**	3.2	**55.49**	3.43	0.44
8	ANS – Gn (perpendicular HP)	**68.6**	3.8	**70.55**	5.94	0.25
9	PNS – N (perpendicular HP)	**53.9**	1.7	**56.34**	4.40	**0.047**
10	MP – HP (angle)	**23.0**	5.9	**20.78**	6.09	0.23
11	Upper 1 – NF (perpendicular NF)	**30.5**	2.1	**29.50**	3.85	0.36
12	Lower 1 – MP (perpendicular MP)	**45.0**	2.1	**42.22**	5.54	0.07
13	Upper 6 – NF (perpendicular NF)	**26.2**	2.0	**25.26**	5.10	0.5
14	Lower 6 – MP (perpendicular MP)	**35.8**	2.6	**34.88**	2.54	0.24
	MAXILLA – MANDIBLE					
15	PNS – ANS (II HP)	**57.7**	2.5	**58.33**	3.73	0.55
16	Ar – Go (linear)	**52.0**	4.2	**54.96**	4.48	**0.004**
17	Go – Pg (linear)	**83.7**	4.6	**80.86**	4.15	**0.03**
18	B – Pg (II MP)	**8.9**	1.7	**6.53**	1.88	**<0.001**
19	Ar – Go – Gn (angle)	**119.1**	6.5	**121.26**	6.23	0.26
	DENTAL					
20	OP Upper (HP angle)	**6.2**	5.1	**4.52**	3.21	0.14
21	OP lower (HP angle)	**6.2**	5.1	**4.52**	3.21	0.14
22	A – B (II OP)	**-1.1**	2.0	**-3.38**	2.75	**0.005**
23	Upper 1 –NF (angle)	**111**	4.7	**115.52**	8.79	**0.07**
24	Lower 1 – MP (angle)	**95.9**	5.2	**101.76**	7.34	**0.007**

p Value -- <0.05

Table 4. HARD TISSUE ANALYSIS – FEMALE COMPARISON – CAUCASIANS & NORTH INDIANS

S.NO.	VARIABLES	CAUCASIAN		NORTH INDIAN		p- value
		MEAN	SD	MEAN	SD	
	CRANIAL BASE					
1	Ar – Ptm (II HP)	**32.8**	1.9	**35.69**	2.84	**<0.001**
2	Ptm – N (II HP)	**50.9**	3.0	**51.10**	3.88	0.85
	HORIZONTAL SKELETAL					
3	N –A – Pg (angle)	**2.6**	5.1	**6.98**	7.19	**0.03**
4	N – A (II HP)	**-2.0**	3.7	**-0.46**	4.03	0.18
5	N – B (II HP)	**-6.9**	4.3	**-5.33**	7.32	0.42
6	N – Pg (II HP)	**-6.5**	5.1	**-4.88**	8.31	0.46
	VERTICAL (SKELETAL, DENTAL)					
7	N – ANS (perpendicular HP)	**50.0**	2.4	**52.85**	4.14	**0.01**
8	ANS – Gn (perpendicular HP)	**61.3**	3.3	**66.11**	5.93	**0.003**
9	PNS – N (perpendicular HP)	**50.6**	2.2	**52.12**	2.61	**0.04**
10	MP – HP (angle)	**24.2**	5.0	**24.34**	6.44	0.94
11	Upper 1 – NF (perpendicular NF)	**27.5**	1.7	**27.77**	2.96	0.73
12	Lower 1 – MP (perpendicular MP)	**40.8**	1.8	**39.74**	4.04	0.31
13	Upper 6 – NF (perpendicular NF)	**23.0**	1.3	**22.28**	2.47	0.27
14	Lower 6 – MP (perpendicular MP)	**32.1**	1.9	**32.15**	2.84	0.95
	MAXILLA – MANDIBLE					
15	PNS – ANS (II HP)	**52.6**	3.5	**54.77**	3.56	**0.037**
16	Ar – Go (linear)	**46.8**	2.5	**49.44**	4.50	**0.03**
17	Go – Pg (linear)	**74.3**	5.8	**75.07**	4.16	0.56
18	B – Pg (II MP)	**7.2**	1.9	**6.66**	1.81	0.31
19	Ar – Go – Gn (angle)	**122.0**	6.9	**125.34**	5.37	**0.048**
	DENTAL					
20	OP Upper (HP angle)	**7.1**	2.5	**6.74**	4.72	0.77
21	OP lower (HP angle)	**7.1**	2.5	**6.74**	4.72	0.77
22	A – B (II OP)	**-0.4**	2.5	**-2.16**	1.93	**0.004**
23	Upper 1 –NF (angle)	**112.5**	5.3	**113.10**	8.27	0.79
24	Lower 1 – MP (angle)	**95.9**	5.7	**98.90**	7.00	0.12

p Value -- <0.05

Table 5. SOFT TISSUE ANALYSIS – COMBINED (MALE & FEMALE) COMPARISON – CAUCASIANS & NORTH INDIANS

S.NO.	VARIABLES		CAUCASIAN		NORTH INDIAN		p – VALUE
			MEAN	SD	MEAN	SD	
	FACIAL FORM						
1	Facial convexity angle	G-Sn-Pg'(angle)	**12**	4	**14.3**	5.42	**0.016**
2	Maxillary prognathism	G-Sn (II HP)	**6**	3	**6.69**	4.52	0.37
3	Mandibular prognathism	G-Pg' (II HP)	**0**	4	**-0.21**	7.25	0.86
4	Vertical height ratio	G-Sn/Sn-Me' (Perp. HP)	**1**	-	**1.03**	-	-
5	Lower face throat angle	Sn-Gn'-C (angle)	**100**	7	**112.75**	11.73	**<0.001**
6	Lower vertical height- depth ratio	Sn- Gn'/C- Gn'	**1.2**	-	**1.25**	-	-
	LIP POSITION AND FORM						
7	Nasolabial angle	Cm-Sn-Ls (angle)	**102**	8	**112.14**	10.85	**<0.001**
8	Upper lip protrusion	Ls - (Sn-Pg')	**3**	1	**2.59**	2.82	0.37
9	Lower lip protrusion	Li - (Sn-Pg')	**2**	1	**1.99**	2.64	0.98
10	Mentolabial sulcus	Si - (Li-Pg')	**4**	2	**4.97**	3.42	0.1
11	Vertical lip chin ratio	Sn-Stms/Stmi-Me(Per HP)	**0.5**	-	**0.45**	-	-
12	Maxillary incisor exposure	Stms-1	**2.0**	2	**2.45**	1.99	0.23
13	Interlabial gap	Stmi-Stms (Perp. HP)	**2.0**	2	**0.43**	0.89	**<0.001**

p Value -- <0.05

4. Discussion

*T*he improvement in facial aesthetics and functional occlusion are two desirable objectives for the success of various orthognathic surgical procedures. For proper planning and execution of these, various diagnostic procedures are used, cephalometric analysis being the most vital one. Various cephalometric norms for the analysis of hard and soft tissue discrepancies have been

laid down, the Burstone's analysis being the standard one which is based on Caucasians.

A thorough search of literature revealed difference in cephalometric values of dentofacial relationships of various ethnic groups [10,12]. We conducted a study to know if there were any similarities or differences in cephalometric values of north Indian adults with class I occlusion and well balanced facial profile as compared to the values obtained by Burstone et al[1] based on Caucasians. The findings are discussed under hard and soft tissue analyses respectively.

4.1. Hard Tissue Measurements

The total cranial base length (Ar-ptm-N) in north Indian population was similar to the Caucasian population in males but there was statistically significant increase in females. The contributing factor for this was the increase in Ar-ptm. Similar findings were found in south Indian (Karnataka) population [3] and in Egyptians [18]. The horizontal skeletal measurements for north Indian males were similar to Caucasian males but north Indian females had more convex profile compared to their Caucasian counterparts, this being true of Chinese [26], Egyptian [18], Kuwaiti [16] and Saudi [17] female profiles also. Thus north Indian females have marginally prognathic maxillary/mandibular apical base. Though the skeletal norms of north Indian females were protrusive when compared to Caucasians, they were retrusive when compared with Chinese [30], and Afro-American [8] females; however the mean values of the north Indian females were quite similar to Japanese [12].

The vertical skeletal measurements for north Indians of both sexes were increased compared to Caucasians. The contributing factor for the overall increase in length of both males and females was the increase in posterior middle third height, whereas in females there were other contributing factors also, like increase in upper third and lower third vertical facial height. A similar finding was found in the Japanese females also [12].

The maxillo-mandibular relationship of our study group differed much from the Caucasians. Statistically significant differences were found in ramus length, relationship of maxilla and mandible apical base and retrusive chin in both sexes, whereas north Indian females tend to have increased ramal mandibular plane angle and males had short mandibular body length. Increased ramal mandibular plane angles in both sexes were reported in Kuwaitis [16] and Saudis [17] also. The dental relationship showed relatively proclined lower incisors in north Indian males. Similar findings were reported in the Nanda & Nanda's study for north Indian population [9], south Indian (Karnataka) [3], Chinese [30], Egyptian [18], Kuwaiti [28], Japanese [12], Korean [17] and Saudi [27] populations also. This indicates that, while treating north Indian male subjects, a slight protrusion of teeth in comparison with Caucasian standards will be optimum for their features [9].

When the north Indian male profile was correlated with the Caucasian male's, it was evident that the anterior maxilla is seen to be rotated counterclockwise for north Indians which substantiates the fact that for Caucasians an increased anterior facial height does not make the profile displeasing. The north Indian male has a retruded profile as evidenced by decrease in mandibular corpus length, increased ramal length and decreased chin prominence. To mask this the incisors procline, thus providing a pleasing profile.

In north Indian females it was evident that the profile tended towards more convexity (increased N-A-Pg & decrease A-B). An increase in the Ar-Go-Gn angle indicates that the north Indian females have a tendency towards hyperdivergence which is also supported by the fact that the anterior facial height is increased. This increase in facial height (compared to the Caucasian females) seems to sit well with this group.

But overall comparison of the skeletal patterns showed that skeletal morphology of north Indians differ in some parameters compare to Caucasians.

4.2. Soft Tissue Measurements

While planning and assessing the success of orthognathic treatment, soft tissue values are as important as hard tissue values. Therefore, soft tissue values must accurately reflect ideal norms throughout treatment. Soft tissue values of our study group were compared with the Caucasian norms and an inter – gender comparison was also done within this group itself.

The facial convexity angle was found to be greater in our study group, which implies a more convex profile in north Indians than in Caucasians. Our findings were similar to those of P. Jain & JPS Kalra's study involving north Indian population [29] as well as South Indian [26] and Kerala population [15], whereas less convex profile was reported in Japanese [20] and Black populations [16]. We found that north Indian males have more facial convexity than females. When the maxillary and mandibular prognathism values of our study group were compared to those of Caucasians, no statistically significant differences were seen. However, in our study group males had more maxillary prognathism when compared to females. South Indian [26] and Kerala population [15] were also reported to have midfacial prominence, when compared to Caucasians.

The lower face - throat angle was more obtuse compared to Caucasians. Since this angle is critical in treatment planning to correct anteroposterior dysplasias [1], our study suggests that procedures involving chin reduction should be undertaken with caution in north Indian population. The vertical height ratio, lower vertical height depth ratio, upper and lower lip protrusion, etc, were all similar in both our study group as well as the Caucasians. Upper lip protrusion was reported in P. Jain & JPS Kalra's study for north Indian population [29], lower lip protrusion in Kerala population [15] and both upper and lower lip protrusion were reported in South Indian [26], Japanese [20] and Korean [22] populations. When comparison was made gender – wise within the study group, males had more obtuse lower face height depth ratio than females.

Statistically significant difference was found in the nasolabial angle between our study group and the Caucasians. The comparison revealed it to be more obtuse in our study group. Similar findings were reported in Blacks [14], Japanese [20] and Koreans [22]. Obtuse nasolabial angle is suggestive of maxillary retrusion as per available literature but our study contradicts this view as

our study group did not exhibit the latter even though, they had obtuse nasolabial angle. But it is most likely due to the anticlockwise roataion of the maxilla in north Indian males. The interlabial gap of our study group was shorter as compared to Caucasians, with statistical significance. Similar finding was reported in P. Jain & JPS Kalra's study for north Indian population also [29]. No difference was observed in the incisal show of our study group and the Caucasians. However, in our study group males had statistically more incisal show compared to females. Similar finding was reported when south Indian population was compared gender- wise [26].

Intergroup comparison of soft tissue profiles of north Indian males and females clearly indicated that soft tissue convexity (G-Sn-Pg') in males is more in comparison to the female (in compensation to the underlying skeletal base which is more convex in females). This is also supported by the fact that males exhibit a protrusive maxillary soft tissue profile (G-Sn) to give a convex appearance. In addition males also exhibited an increased distance between Stms-1 which shows that males have thick protrusive lips in comparison to females.

Overall, it was found that the soft tissue profiles of north Indians differ to those of the Caucasians.

Even though computerized cephalometric software's are available, we have used manual cephalometric analysis because in manual tracing landmark identification is easier, more accurate and with less variation while duplicating [31].

Some the advantages of this study are:

- More number of subjects were taken as compared to Burstone et al [1] or Legan & Burstone [2] in their respective studies.
- Both hard and soft tissue analyses were done by single examiner.
- Hard and soft tissue analyses were done on the same samples.
- Intra group comparison (male & female) was done for hard and soft tissue analyses.
- In soft tissue analysis separate norms were established for males and females, as compared to Legan & Burstone's [2].

5. Conclusion

A cephalometric study of 100 subjects (50 males & 50 females) from North Indian ethnic population with ideal skeletal and dental relationships, good harmony of the dentofacial structures, and no history of orthodontic treatment was conducted. Standardized lateral cephalograms were taken in natural head position. All cephalograms were traced according to Burstone's Hard tissue analysis [1] & Legan and Burstone's Soft tissue analysis [2], and the hard & soft tissue cephalometric analysis based on natural head position was done. Means, standard deviations, and statistically significances were calculated for all values.

On hard tissue comparison with caucausians, a statistically significant difference was seen in vertical skeletal measurements, ramal length and relationship between maxilla and mandible, whereas in females differences was also seen with cranial base, ramal mandibular plane angle and facial convexity. North Indian males had proclined incisors. On soft tissue comparison with caucausians, a statistically significant difference was seen in soft tissue facial convexity angle, lower face throat angle, nasolabial angle and interlabial gap.

A comparison of our values with the Burstone's Hard tissue analysis [1] & Legan and Burstone's Soft tissue analysis [2] led us toward establishing a different set of cephalometric norms for this ethnic group. As per our findings, before planning orthognathic surgery for north Indian population following some parameter should be considered

- Since north Indian males had increase in lower incisors proclination, pre-surgical orthodontic treatment should be done with caution as this might lead to cortical plate defect because this subset of patients already have proclined lower incisors.
- Literature suggests that relapse rate is higher [32] with either mandibular advancement or setback in hyperdivergence patients and this might have to be taken into consideration while planning surgeries in north Indian females as they exhibit this feature commonly.
- Obtuse nasolabial angle without maxillary – retrusion in north Indians males is most likely to be due to the anticlock-wise rotation of the maxilla. If Lefort I osteotomy with superior repositioning is planned in these patients, partial resection of anterior nasal spine with or without resection of caudal portion of the septum [33], might have to be considered.
- As the north Indian males and females have obtuse soft tissue chin throat angle, mandibular set back surgery should be planned with caution especially if the patient also has a short heavy throat [2].

We are of the opinion that results values that we have obtained can be used as cephalometric norms for orthognathic surgery in north Indian population.

References

[1] Burstone CJ, James RB, Legan H, Murphy GA, Norton LA. Cephalometrics for orthognathic surgery. J Oral Surg 1978; 36(4): 269-277.

[2] Legan HL, Burstone CJ. Soft tissue cephalometric analysis for orthognathic surgery. J Oral Surg1980; 38: 744-751.

[3] Arunkumar KV, Reddy VV, Tauro DP. Establishment of cephalometric norms for the south Indian (Karnataka) population based on Burstone's analysis. J Maxillofac. Oral Surg. 2010 June; 9(2): 127-133.

[4] Angle EH. Classification of malocclusion. Dental Cosmos 1899; 41: 248-264, 350-357.

[5] Broadbent BH. A new X-ray technique & its application to orthodontia. Angle Orthodontist 1931; 1: 45-66.

[6] Hofrath H. Bedeuting der rontgenfern und abstands aufnahme fur die diagnostic der kieferanomalien. Fortschritte der orthodontic 1931; 1: 231-258.

[7] Down William B. Analysis of dentofacial profile. Angle orthodontist Oct 1956: 26(4), 191-212.

[8] Drummond RA. A determination of cephalometric norms for the Negro race. Am J Orthodontics 1968 Sept; 54(9): 670-681.

[9] Nanda R, Nanda RS. Cephalometric study of the dentofacial complex of north Indians. J Indian Dent Assoc 1969; 39(1): 22-28.

[10] Garcia CJ. Cephalometric evaluation of Mexican Americans using the Downs and Steiner analyses. Am J Orthod 1975 July; 68 (1): 67-74.

[11] Scheideman GB, Bell WH, Legan HL, Finn RA, Reisch JS. Cephalometric analysis of dentofacial normals. Am J Orthod 1980 Oct; 78 (4): 404-20.

[12] Engel G, Sploter BM. Cephalometric and visual norms for a Japanese population. Am J Orthod 1981 July: 198; 80 (1): 48-60.
[13] Enlow DH, Pfister C, Richardson E, Kuroda T. An analysis of Black and Caucasian craniofacial patterns. The Angle Orthodontic 1982 Oct; 52(4): 279-287.
[14] Bacon W, Girardin P, Turlot J C. A comparison of cephalometric norms for the African Bantu and a Caucasoid population. European J of Orthodontics 1983; 5: 233-40.
[15] Valiathan A, John KK. Soft tissue cephalometric analysis of adults from Kerala. J of Indian Dent Asso 1984; 56: 419-22.
[16] Connor AM, Moshiri F. Orthognathic surgery norms for American black patients. Am J Orthod 1985 Feb; 87(2): 119-33.
[17] Park I, Bowman D, Klapper L. A cephalometric study of Korean adults. Am J Orthod Dentofacial Orthop 1989 July; 96: 54-59.
[18] Bishara SE, Abdalla EM, Hoppens BJ. Cephalometric comparisons of dentofacial parameters between Egyptian and North American adolescents. Am J Orthod Dentofacial Orthop 1990: May; 97: 413-21.
[19] Arnett GW, Jelic JS, Kim J, Cummings DR, Beress A, Worley M et al. Soft tissue cephalometric analysis: Diagnosis and treatment planning of dentofacial deformity. Am J Orthod Dentofacial Orthop 1999 Sept; 116: 239-253.
[20] Alcalde RE, Jinno T, Orsini MG, Sasaki A, Sugiyama RM, Matsumara T. Soft tissue cephalometric norms in Japanese adults. Am J Orthod Dentofacial Orthop 2000 July; 118: 84-89.
[21] Hamdan AM, Rock WP. Cephalometric norms in an Arabic population. Journal of Orthodontics 2001; 28: 297-300.
[22] Hawang HS, Kim WS, McNamara JA. Ethnic differences in the soft tissue profile of Korean and European- American adults with normal occlusions and well balanced faces. Angle Orthod 2002; 72: 72-80.
[23] Basciitci FA, Uysal T, Buyukerkmen A. Determination of Holdaway soft tissue norms in Anatolian Turkish adults. Am J Orthod Dentofacial Orthop 2003; 123: 395-400.
[24] Johannsdottir B, Thordarson A, Magnusson TE. Craniofacial skeletal and soft tissue morphology in Icelandic adults. European J of Orthodontics 2004; 26(3): 245-50.
[25] Yeong P, Huggare J. Morphology of Singapore Chinese. European J of Orthodontics 2004; 26(6): 605-12.
[26] Kalha AS, Latiff A, Govardhan SN. Soft tissue cephalometric norms in a south Indian ethnic population. Am J Orthod Dentofacial Orthop 2008; 133: 876-881.
[27] Hassan AH. Cephalometric norms for Saudi adults living in the western region of Saudi Arabia. Angle Orthod 2006; 76: 109-113.
[28] Behbehani F, Hicks P, Beeman C, Kluemper T, Rayens MK. Racial variation in cephalometric analysis between Whites and Kuwaitis. Angle Orthod 2006; 76: 406-411.
[29] Jain P, Kalra JPS. Soft tissue cephalometric norms for a north Indian population group using Legan and Burstone analysis. Int J Oral Maxillofac Surg 2010 Sept 1-5.
[30] Cooke MS, Wei SHY. A comparative study of southern Chinese and British Caucasian cephalometric standards. Angle Orthod 1989 June; 59: 2.
[31] Naornova J, Lindman R. A comparison of manual traced images and corresponding scaneed radiographs digitally traced. European Journal of Orthodontics Vol 33, issue 3, june 2011, 247-253.
[32] Eggensperger N, Smolka W, Rahal A and Jizuka T. Skeletal relapse after mandibular advancement and setback in single-jaw surgery. Journal of Oral and Maxillofacial Surgery December 2004, Volume 62, Issue 12, pages 1486-1496.
[33] Pearlman SJ. Surgical treatment of the nasolabial angle in balanced rhinoplasty. Facial Plast Surg 2006; 22: 28-35.