

Soft Tissue Cephalometric Norms for Orthognathic Surgery in South Indian Population

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Abstract

Background and Aim: Orthodontic treatment is aimed at achieving good facial aesthetic and occlusion. Proportioned soft tissue contours form an integral part of orthodontic treatment. It is important to establish standard cephalometric norms for various population groups. The present study was aimed to establish soft tissue norms (for Orthognathic surgery) for South Indian population and to compare the values with that of Caucasian standards.

Materials and methods: 50 South Indian subjects comprising of 25 males and 25 females in the age group of 18-30 years were selected based on inclusion and exclusion criteria who were subjected to lateral cephalometric radiographic analysis. Soft tissue parameters were analysed in the study group and compared with the Caucasian group based on Burstone and Legan analysis.

Results: South Indian population showed increased lower face protrusion, lower lip protrusion, upper lip protrusion and deep mentolabial sulcus in both males and females when compared to Caucasian population. An increased lower face-throat angle was seen in South Indian males. Diverse results were also seen in some other soft tissue parameters.

Conclusion and clinical significance: The current study shows that certain soft tissue cephalometric parameters in South Indian population are significantly different from the Caucasian population in both males and females. The differences in both racial groups are clearly evident in the study and can thus be of utmost clinical importance while planning out orthognathic surgery.

Keywords: cephalometric norms, orthognathic surgery, soft tissue analysis

Introduction

Facial esthetics has been studied by artists and philosophers. A good facial harmony requires proportioned soft tissues contours with underlying balanced skeletal and dental structures. Facial characteristic of an individual also depends upon racial,

ethnic background, heredity and domain location. Aim of an orthodontic treatment is to achieve good facial esthetics and occlusion. Fixed orthodontic treatment along with orthognathic surgery is one method of treatment used to correct severe skeletal dysplasia. Such cases require accurate diagnosis and treatment planning.¹⁻²

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Cephalometric norms are used as a guide by a clinician during orthodontic diagnosis and treatment planning.³ In the past, studies have mainly concentrated on the hard tissue relationship and these studies have identified several linear and angular norms. In recent years, orthodontics has seen a shift in paradigm where soft tissue esthetics is being primarily considered.⁴ Soft

tissue facial features of an individual are mainly studied clinically by taking morphometric measurement and also by cephalometry. Several authors noticed the variation in the facial morphology in different ethnic groups.⁴ Most of the studies are done in Caucasian population and these norms may be inappropriate to apply for the different ethnic and racial groups.⁵

Burstone and Legan developed soft tissue cephalometric analysis for orthognathic surgery (COGS) at the University of Connecticut in the year 1989 and it is most commonly used by orthodontists and maxillofacial surgeons.^{2,6,7} This analysis was done on white subjects of European American ancestry. Different ethnic and racial groups have been previously studied for cephalometric norms which have been established in many studies.⁸⁻¹² Therefore, it is important to develop norms for various population groups with a standard method. Thus the present study was conducted with following objectives:

1. To establish Soft tissue norms (for Orthognathic surgery) for South Indian population
2. To compare the values with that of Caucasian standards.

Methodology

The study was conducted on 50 South Indian individuals comprising of 25 males and 25 females with age ranging from 18 to 30 years who were visiting the outpatient department of the institution.

The subjects included in the study were with class I molar relationship with minimal or no crowding of teeth, straight facial profile and all teeth anterior to second molar being present. The subjects with gross facial asymmetry, history of trauma or previous orthodontic treatment, history of previous maxillofacial or plastic surgery and significant medical history were excluded from the study. Ethical clearance was obtained from the institutional ethical committee (Cert.no:ABSM/EC/27/2009). Informed consent was obtained from all the subjects.

All subjects were subjected to Lateral cephalometric radiographic analyses with natural head position; teeth in maximum intercuspation and lip at rest using standardized technique.

Standardization of the cephalometric technique armamentarium:

Standardized 8" x 10" Kodak lateral radiographic head films with intensifying screen were used for each subject on PLANMECA 2002 CC PROLINE advanced panoramic and cephalometric equipment. The X-ray source to subject distance was kept at a constant distance of 5 feet. The film was kept at a constant distance of 16 cms away from the midsagittal plane of the subject oriented in Natural Head Position. A rectangular mirror was hung on the wall facing the cephalostat at a distance of 5 feet from subject and at a height of 6 feet from the ground.

Lateral cephalograms of both male and female groups were analysed. Landmarks used for the soft tissue analysis have been described in Fig. 1. The paramaters used in the analysis have been shown in Fig. 2, 3, 4, 5.

Statistical Analysis

The data obtained was subjected to statistical analysis using Statistical Package for Social Sciences (Windows version 17.0, SPSS Inc., Chicago, Illinois, USA). Mean and standard deviation were determined for male and female group. The mean and standard deviation of each group were subjected to Student's t-test for comparison with the normal values obtained by Burstone and Legan² where p value ≤ 0.05 was considered to be statistically significant.

Result

The mean and standard deviation obtained in both male and female groups was tabulated (table 1). Soft tissue parameters in male and female groups of South Indian population were compared with Caucasian male and female groups.

Statistically highly significant difference was found on comparing South Indian male subjects with Caucasian males with respect to the following parameters; lower face protrusion [12.14 ± 4.00], lower face-throat angle [105.92 ± 7.03], upper lip protrusion [3.98 ± 1.08], lower lip protrusion and mentolabial sulcus [5.26 ± 1.65] (table 2). On comparing South Indian female subjects with Caucasian females, the soft tissue parameters which were found to have statistically highly significant difference were lower face protrusion [3.54 ± 3.782],

upper lip protrusion [3.74 ± 1.370], lower lip protrusion [3.62 ± 1.494], lower lip length [42.72 ± 3.323], mento labial sulcus [4.5400 ± 1.567] and inter labial gap [1.7600 ± 1.164] (table 3).

Table 1: Orthognathnic Cephalometric Analysis Measurement Of Soft Tissue For South Indian Male And Female

Measurement	Mean (Male)	Standard deviation	Mean (Female)	Standard deviation
Facial form				
Facial Convexity angle (Gn-Sn-Pg')	12.1400	4.00916	11.2200	3.73073
Mid face protrusion (G-Sn)	7.0600	2.74363	7.1200	2.37294
Lower face protrusion (G-Pg')	3.3600	3.41113	3.5400	3.78297
Lower face – Throat Angle (Sn-Gn'-C)	105.9200	7.03515	102.7800	8.90234
Lower Vertical Height – DepthRatio (Sn-Gn'/C-Gn')	1.2984	.16237	1.2616	.21195
Soft tissue chin tickness (Pg-Pg')	11.7240	3.68220	12.4200	2.48613
Lip Position and Form				
Naso – Labial Angle (Cm-Sn-Ls)	104.9200	9.35824	104.0000	7.28583
Upper lip protrusion (Ls to {Sn-Pg'})	3.9800	1.08474	3.7400	1.37022
Upper Incisor disply (stms-I)	2.3200	1.26557	2.6400	1.03602
Lower lip protrusion (Li to {Sn-Pg'})	3.4600	1.44280	3.6200	1.49499
Upper lip length (Sn-Stms)	21.0000	3.84057	20.5600	4.78783
Lower lip length(Stms-Me')	45.4800	3.51331	42.7200	3.32315
Mento labial sulcus (Si to {Li-Pg'})	5.2600	1.65278	4.5400	1.56738
Inter Labial Gap (Stms-Stmi)	1.9000	1.08012	1.7600	1.16476

Table 2: Comparison Of Orthognathic Cephalometric Analysis Measurement Of Soft Tissue Between South Indian Male And Caucasian Male

Measurement	SOUTH INDIAN MALE		CAUCASIAN MALE		t-value	p-value
	Mean (Male)	Standard deviation	Mean (Male)	Standard deviation		
Facial form						
Facial Convexity angle(G-Sn-Pg')	12.1400	4.00916	12.0000	4.00000	.9850	0.912
Mid face protrusion (G-Sn)	7.0600	2.74363	6.0000	4.00000	1.093	0.279
Lower face protrusion(G-Pg')	3.3600	3.41113	.0000	4.00000	3.196	0.0025h.sig
Lower face – Throat Angle(Sn-Gn'-C)	105.920	7.03515	100.0000	7.00000	2.982	0.004 h-sig
Lower Vertical Height – DepthRatio (Sn-Gn'/C-Gn')	1.2984	.16237	1.2000	.21195	1.841	0.071
Soft tissue chin tickness (Pg-Pg')	11.7240	3.68220	12.0000	2.00000	.3290	0.746
Lip Position and Form						
Naso – Labial Angle (Cm-Sn-Ls)	104.920	9.35824	102.0000	8.00000	1.187	0.241
Upper lip protrusion (Ls to {Sn-Pg'})	3.9800	1.08474	3.0000	1.00000	3.322	0.0017 h sig
Upper Incisor disply (stms-I)	2.3200	1.26557	2.0000	2.00000	.6750	0.502
Lower lip protrusion (Li to {Sn-Pg'})	3.4600	1.44280	2.0000	2.00000	2.960	0.0048 h sig
Upper lip length (Sn-Stms)	21.0000	3.84057	22.0000	2.00000	1.154	0.254
Lower lip length (Stms-Me')	45.4800	3.51331	44.0000	2.00000	1.832	0.074
Mento labial sulcus (Si to {Li-Pg'})	5.2600	1.65278	4.0000	2.00000	2.428	0.019 sig
Inter Labial Gap (Stms-Stmi)	1.9000	1.08012	2.0000	2.00000	.2190	0.828

TABLE 3: Comparison of Orthognathic Cephalometric Analysis Measurement Of Soft Tissue Between South Indian Female And Caucasian Female

Measurement	SOUTH INDIAN FEMALE		CAUCASIAN FEMALE		t-value	p-value
	Mean (Female)	Standard deviation	Mean (Female)	Standard deviation		
Facial form						
Facial Convexity angle (G-Sn-Pg')	11.2200	3.73073	12.0000	4.00000	.784	.512
Mid face protrusion (G-Sn)	7.1200	2.37294	6.0000	3.00000	1.54	.129
Lower face protrusion (G-Pg')	3.5400	3.78297	.0000	4.00000	5.34	0.001 vhs
Lower face – Throat Angle(Sn-Gn'-C)	102.7800	8.90234	100.0000	7.00000	.437	.676
Lower Vertical Height – Depth Ratio (Sn-Gn'/C-Gn')	1.2616	.21195	1.2	.16237	0.067	.912
Soft tissue chin tickness (Pg-Pg')	12.4200	2.48613	11.7240	3.68220	0.128	.786
Lip Position and Form						
Naso – Labial Angle (Cm-Sn-Ls)	104.0000	7.28583	102.0	8.0	1.453	.135
Upper lip protrusion (Ls to {Sn-Pg'})	3.7400	1.37022	3.00	1.00	.118	.834
Upper Incisor displ (stms-I)	2.6400	1.03602	2. 00	2.00	1.422	.142
Lower lip protrusion (Li to {Sn-Pg'})	3.6200	1.49499	2.00	1.00	4.512	0.001 vhs
Upper lip length (Sn-Stms)	20.5600	4.78783	20.00	2.00	1.122	.267
Lower lip length (Stms-Me')	42.7200	3.32315	40.00	2.00	3.6	0.001 vhs
Mento labial sulcus (Si to {Li-Pg'})	4.5400	1.56738	4.00	2.0	1.582	.123
Inter Labial Gap (Stms-Stmi)	1.7600	1.16476	2.00	2.0	.442	.728

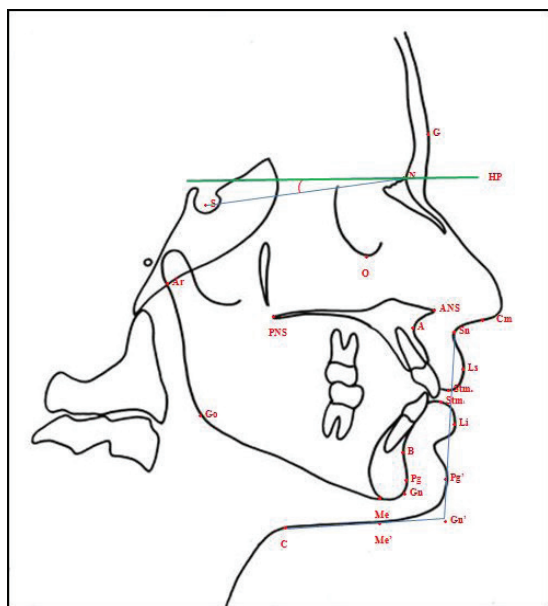


Fig 1: Soft tissue Landmarks: Glabella (G), Columella point (Cm), Subnasale (Sn), Labrale superius (Ls), Stomion superius (Stm_s), Stomion inferius (Stm_i), Labrale inferius (Li), Mentolabial sulcus (Si), Soft tissue pogonion (Pg'), Soft tissue gnathion (Gn'), Soft tissue menton (Ms), Subnasale (Sn), Cervical point (C)

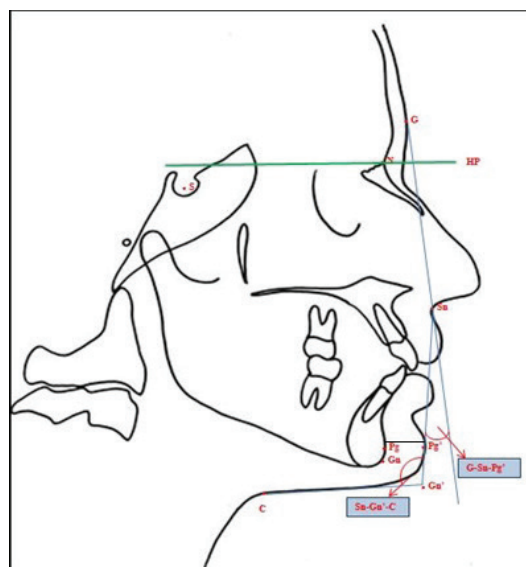


Fig. 3: Facial convexity angle (G-Sn-Pg) and Lower face throat angle (Sn-Gn'-C)

Soft tissue Chin thickness (Pg-Pg') and Lower face height depth ratio (Sn-Gn'/C-Gn')

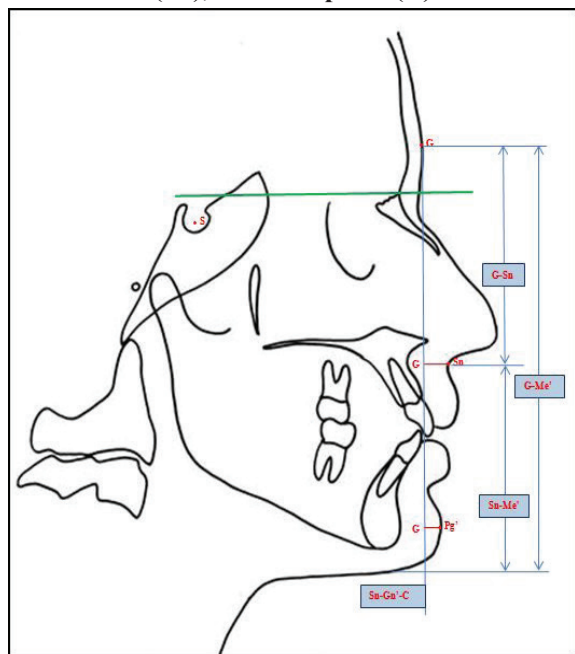


Fig. 2: Facial form linear and angular measurements

FACIAL FORM: Mid face protrusion (G-Sn), Lower face protrusion(G-Pg')

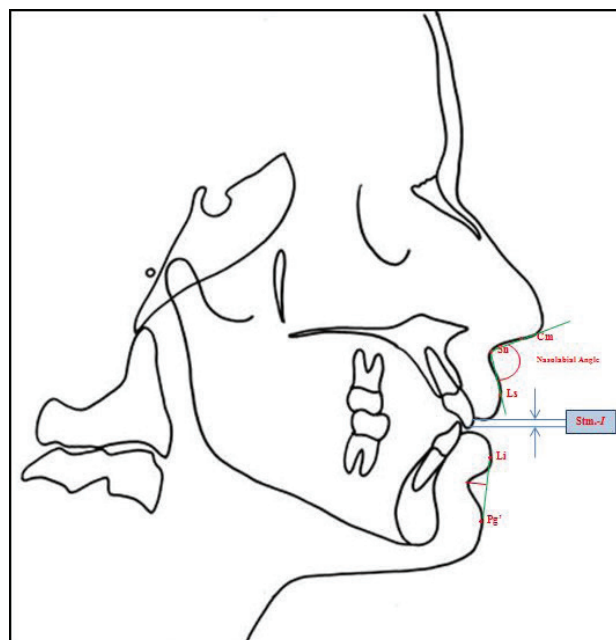


Fig.4: Lip position and Form linear and angular measurements

LIP POSITION AND FORM: Nasiolabial angle (Cm-Sn-Ls), Upper incisor display (Stm_s-I), Inter labial gap (Stm_s-Stm_i), Mento labial sulcus(Si to {Li-Pg'})

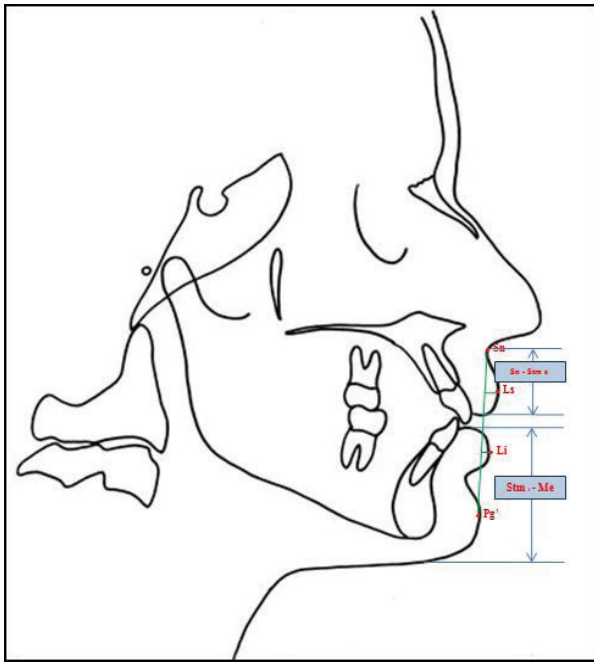


Fig.5: Lip position and Form - Linear Measurements

LIP POSITION AND FORM: Upper lip length (Sn-Stm_s), Lower lip length (Stm_s-Me'), Upper lip protrusion (Ls to {Sn-Pg'}), Lower lip protrusion (Li to {Sn-Pg'})

Discussion

Achieving an ideal soft tissue facial profile is the primary goal of the orthodontic treatment. Soft tissue profile of an individual depends on underlying maxillary and mandibular jaw position. It is achieved by only orthodontic treatment or growth modulation procedures or surgical orthodontic treatment in severe skeletal deformity cases. It involves execution of proper diagnosis and treatment planning.¹³

Soft tissue cephalometric norms play an important role in diagnosis and treatment planning of orthognathic surgical cases. Legan and Burstones' soft tissue analysis is most commonly used for orthognathic and cosmetic surgical cases. These norms are established on European-American population. Various studies have been conducted on different ethnic groups like Ukrainian, Iraqi, Iranian and Japanese population.¹⁴⁻¹⁷ Also studies done with various other cephalometric analysis on the Indian population have shown varied results when compared with that of the Caucasian population.¹⁸⁻²⁰ In India, Caucasian standards are widely used for orthognathic surgery as cephalometric norms for different ethnic groups are not available. The present

cephalometric study presents norms developed for the soft tissue cephalometric analysis for orthognathic surgery for South Indian population.

Most of the patients presenting for orthognathic surgery are young adults. In this study the sample was limited to young adults with a mean age of 21 years as cephalometric norms of children and adults with advanced age may undergo changes.^{17,19, 21, 22}

Facial form describes the overall horizontal soft tissue profile. In our study Facial Convexity angle (Gn-Sn-Pg') was found to be more in South Indian males than Caucasian males which indicates a convex profile in South Indian male group. This was in accordance with studies conducted by Jain P et al¹⁹, Al-Gunaid T et al²³ and Hamid M et al.²⁴ Facial Convexity angle (Gn-Sn-Pg') was found to be less in South Indian females than the Caucasian females.

Mid face protrusion (G-Sn) was found to be more in both South Indian males and females than Caucasians with the reading statistically not significant. This was similar to study conducted by Flynn TR et al.²⁵ Studies were conducted by Flynn TR et al²⁵ and Alcaide RE et al¹⁷ where Lower face protrusion (G-Pg') was found to be more in study groups than Caucasians with the values being statistically highly significant. Similar results were also obtained in our study.

Lower face – Throat Angle (Sn-Gn'-C) was found to be more in both South Indian males and females than Caucasians which was statistically significant in males. This is similar to the study done by Jain P et al¹⁹ and Hamid M et al.²⁴ The results signify that this parameter should be considered during the correction of anteroposterior dysplasia especially chin reduction procedures.

Variations in results were obtained in relation to Lower Vertical Height – Depth Ratio (Sn-Gn'/C-Gn') and soft tissue chin thickness between the study group and Caucasian group but were statistically not significant.

In lip position and form relations; Upper lip protrusion (Ls to {Sn-Pg'}) and Lower lip protrusion (Li to {Sn-Pg'}) both were found to be more in South Indian males and females than Caucasians. This was

similar to the study done by Flynn TR et al,²⁵ Uysal et al,²⁶ and Erbay et al.¹⁰ Statistically highly significant results were obtained with respect to Mento labial sulcus (Si to {Li-Pg'}) which was found to be more in South Indian males and females than Caucasians. This was similar to the studies done by Flynn TR et al²⁵, Rafael E Alcaide et al¹⁷, Hamid M et al²⁴ and Celebi AA et al.²⁷

Varied results were obtained in relation to Upper Incisor displ (stm_s-I), Upper lip length (Sn-Stm_s), Lower lip length (Stm_s-Me') and Inter Labial Gap (Stm_s-Stm_i) which were statistically non-significant when South Indian group was compared with Caucasian group.

Conclusion

The present study has derived normal soft tissue cephalometric (COGS) values for South Indian male and female population. There was increased Facial convexity, Mid-face and Lower face protrusion with more obtuse Lower face throat angle in South Indian subjects. Upper and Lower lip protrusion, Upper and Lower lip length was found to be more along with deep Mento-labial sulcus in South Indian subjects. Differences in both racial groups was clearly evident in the study and hence the soft tissue cephalometric parameters studied can be used as a standard and be helpful in planning out orthognathic surgery.

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