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Dentistry Section

Soft Tissue Treatment Goals for Orthodontic Patients- A Photogrammetric Analysis of Facial Profile for Soft Tissue Norms and Gender Variations in Young Adults, Hyderabad, India

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ABSTRACT

Introduction: An average face is always more aesthetic than an atypical face, so setting soft tissue treatment goals for male and female orthodontic patients required local norms, like average measurements of local aesthetically pleasing profile is more important than adopting universal norms.

Aim: To obtain angular and average measurements of soft-tissue facial profiles for males and females in young adults of Hyderabad, India.

Materials and Methods: The cross-sectional study was conducted at the Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College and Hospital, Hyderabad, India, from the December 2007 to January 2010. The study included 104 aesthetically pleasing individuals between the age group of 16 years to 25 years (42 male and 62 female) selected by Orthodontists and laypersons, facial profile photographs were taken with standardised photographic set up with camera using 100 mm macrolens. Photographs were traced and 12 angular measurements were taken. Descriptive statistical analysis was done using software MATLAB (Matrix Laboratory) mean, maximum, minimum value, standard deviation and confidence intervals were calculated. Student's t-test was done to determine sexual dimorphism, and p-value ≤0.05 was considered statistically significant.

Results: Total of 104 subjects (42 male subjects; mean age: 21.4 years and 62 female subjects; mean age: 19.6 years) were analysed. There was a statistically (p-value <0.05) significant sexual dimorphism in seven of the angular measurements were noted. The nasofrontal (females-141°±4.8°, males-137.86°±5.2°), nasal angle (females -84.4±9°, males-80.7°±6.9°), vertical nasal (males-32.08°±3.3°, females-28.33°±3.636°), nasal dorsal angle (males-180.19°±7.112°, females-174.43°±6.648°), cervico-mental angle (females-98.41°±5.4°, males-95.7°±5.1°), angle of facial convexity (females-173.2°±4.4°, males-169.6°±54.8°), and angle of total facial convexity (females-149°±4.6°, males-144.4°±5.2°), showed sexual dimorphism. In the present study, large variability was observed with the nasolabial (p-value=0.314), and mentolabial (p-value=0.798) angles.

Conclusion: Successful orthodontic treatment is mainly measured by patient appraisal only, this can be obtained by giving the locally more aesthetically pleasing facial profile to the patient, setting soft tissue facial profile treatment goals to native individuals is far more important than following universal norms in the total benefit of the patients.

Keywords: Aesthetically pleasing profiles, Average measurements, Angular measurements, Photographs

INTRODUCTION

A measure of successful orthodontic treatment is the observable enhancement of facial aesthetics, so changes can be made to increase facial attractiveness while maintaining familial and ethnic characteristics that make a person unique. Aesthetics or facial attractiveness may change from one race to another race, Indians look prettier to Indians than other country people and vice-versa, so there is a need for standardised norms for each ethnic group [1]. There are no similar studies over Telugu speaking people, and this justifies the need for the present study. Attractiveness is subjective, making it objective that is quantifying through measurements is the novelty of the present study. Holdaway RA stated that "if we quantify the soft tissue features which contribute to or detract from that 'physical attractiveness stereotype', better treatment goals can be set which has been ingrained into our culture" [2].

The soft tissue drape, made up of adipose and connective tissue, does not always distribute over underlying hard tissue structure in a uniform and orderly manner, earlier it was assumed that the face will be in balance if, skeletal and cephalometric norms were established but this does not ensure facial aesthetics [3].

The quality of facial aesthetic benefits from the harmonised dental and skeletal relationship, but it does not entirely depend on them, most clinicians can relate to an ideal or beautiful face, but there are so many variations of these hypothetical norms as there are those of individuals. Ideal concepts of beauty differ not only based on race and sex but also from one individual to another. The evaluation of facial aesthetic is subjective for a layperson and includes factors such as balance and harmony of the constituent parts, symmetry and proportions, colour and hairstyle [4]. The introduction of cephalometric radiography in orthodontic diagnosis changed the speciality attention from the external facial soft tissue factors to internal skeletal factors, this should be eliminated, and the decision-making process should be structured on both external and internal factors [5].

Study of Nanda RS and Ghosh J, showed that strict adherence to the skeletal tissue norms does not always gives facial balance and harmony and long-term retention [5]. The main goal of the present study is to draw orthodontists' attention to the importance of soft tissue treatment over skeletal factors. The patient's pleasing appearance was directly related to position and locations of the lips, nose, and chin. The traditional concepts in orthodontic diagnosis, have erred in focusing excessively on the use of the dental and skeletal structures of the craniofacial complex. Corrected malocclusions with acceptable long term retention may not necessarily achieve overall facial balance and harmony. It has already been shown that adhering to the so-called dental norms did not provide a greater advantage in long-term retention [6].

This study was an attempt to determine and express quantitatively, the soft tissue relationships of pleasing and harmonious facial profiles of Telugu speaking people as localised soft tissue norms are more apt to particular population instead of following universal norms. The present diagnosis and treatment planning in this particular population was designed to establish the standard soft tissue photogrammetric norms taken in natural head position with all subjects in well balance and harmony of facial structures without dento-facial deformities.

MATERIALS AND METHODS

A cross-sectional study was done at the Department of Orthodontics and Dentofacial Orthopaedics, Government Dental College and Hospital, Hyderabad, India, from December 2007 to January 2010. Subjects were residents of Hyderabad , Andhra Pradesh, India. For ethical concern, approval was taken from Dr NTR University of Health Sciences, Vijayawada, Andhra Pradesh, India. The study participants were selected by convenience sampling, consisting of 16 to 25 years of age population. From all participants in the study, written informed consent was taken, which was provided in English and Telugu. A sample of 135 people, (52 male, 83 female) with the aesthetically pleasing profile were taken following all inclusion criteria, all of them are natives of Hyderabad and they had Telugu as a mother tongue.

Sample size calculation: The sample size was measured by using the formula:

$$n \geq \frac{2(Z_{1-\alpha/2} + Z_{1-\beta})^2}{[\delta_{Difference}/\sigma_{Difference}]^2} + \frac{Z_{1-\alpha/2}^2}{2}$$

Where n=Required sample size; Z=Standard normal variate, α=Alpha, β=Beta; dDiff= Mean of difference,

sDiff=Standard deviation of difference. The minimum sample size calculated was 95.

Inclusion criteria: Those male and female subjects, age group 16 to 25 years old, residents of Hyderabad, had Telugu as their mother tongue, aesthetically pleasing profiles [7]. They had bilateral angle's class I molar relation, no history of previous Orthodontic, Prosthodontic or Orthognathic surgical treatment, no history of systemic or mental illness that might interfere with the development of dentofacial structures and no wounds, burns or scar tissues in the head and neck region [4,8].

Exclusion criteria: Photographs that were not selected by any orthodontist or layperson as pleasing profiles, and subjects for whom, natural head position could not be determined were excluded from the study.

Study Procedure

The selected subjects were clinically examined, name, age, sex and address was noted. Lateral facial photographs were taken in natural head position in a standardised photographic set-up. A committee of three orthodontists and three laypeople were formed and each facial profile photograph was shown to all committee members. To include in the study, all six members should consider as the aesthetically pleasing profile. If any of the committee members did not considered profile as aesthetically pleasing profile, those photographs were excluded from the study. Total 31 profile photographs were excluded from the study [4,8].

i) Photographic set-up: The method described by Fernandez-Riveiro P et al for the photographic set-up and record taking was used [8]. The photographic set-up consists of a tripod that held a Nikon SLR camera with a 100 mm macrolens [Table/Fig-1], chosen to avoid distortions. The stability of the element and the easy adjustment of the tripod height allowed the optical axis of the lens to be harmoniously horizontal. An adjustable stool was kept to make records in sitting position. A vertical mirror was placed approximately 110 cm from the subject, An inverted L-shaped scale (divided into one-inch segments) was fixed to the wall, opposite to the mirror, such that the vertical arm parallel to the plumbline was held by the thick black thread, which indicates True Vertical (TV). This scale allowed measurements at life-size (1:1) [8].

ii) Subject positioning: To take the records in natural head position, the subjects were asked to sit on an adjustable stool. The head of the subject was framed by the scale such that its vertical arm coincided with the midsagittal plane. They were asked to look into their eyes in the mirror with their lips relaxed, adopting the position they normally show during the day. Glasses were removed and the patient's forehead, neck and ears were visible during the recording [Table/Fig-2].

[Table/Fig-1]: Photographic set-up.
[Table/Fig-2]: Subject positioning. (Images from left to right)

iii) Camera set up: The camera was used in its manual position. The shutter speed was 1/125 per second and the opening of the aperture was f/ 11. The camera to subject distance was standardised at 1.5 meters [8].

iv) Tracing technique: Three crosses shaped orientation marks were marked on the photograph. Matt acetate tracing paper was secured tightly with office clips, then tracing of the photographs were done using 2B lead pencil. Soft tissue landmarks points were marked on the tracing paper, and 12 angular measurements were measured. The 35 randomly selected photographs were retraced after two weeks to determine the reliability. The reliability of the method was analysed by using Dahlberg's formula ME=$\sqrt{\sum}$ (x1-x2)2/2n in which x1 is the first measurement, x2 is 2nd measurement and n is the number of repeated records [9]. Dahlberg's error reported range from 0.32 to 0.64 (Inferior facial-third height=0.32 and Nasolabial angle=0.64).

Soft Tissue Landmark Points

Reference lines used in study (Table/Fig-3) [8]: The following angular measurements were made on the lateral photographs [8].

G-N-Prn (Glabella-Nasion-Pronasal): It is the angle formed by the line drawn from glabella to nasion and nasion to pronasal. This is called the Nasofrontal angle [Table/Fig-4].

Cm-Sn (Collumella-Subnasal)/N-Prn(Nasion-Pronasal): It is the angle formed by the line drawn from columella to subnasal and a line drawn from nasal to pronasal. It denotes the Nasal angle [Table/Fig-4].

N-Prn(Nasion-Pronasal)/TV(True Vertical): It is the angle formed by the line drawn from nasion to pronasal and true vertical through nasion vertical nasal angle [Table/Fig-4].

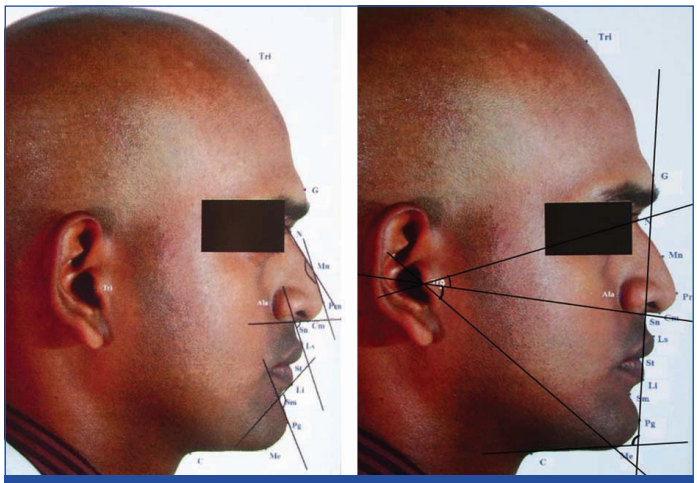
N-Mn-Prn (Nasion-Mid nasal-Pronasal): It is the angle formed by the lines from nasion to mid nasal and mid nasal to pronasal, denoting nasal dorsum angle [Table/Fig-5].

Cm-Sn-Ls (Columella-Subnasal-Labial superior): It is the angle formed by the lines drawn from columella to subnasal and from sub nasal to labial superior, it denotes Nasolabial angle [Table/Fig-5].

Li-Sm-Pg (Labial inferior-Supramental-Pogonion): It is the angle found by the lines drawn from labioinferior to supramental and supplemental to pogonion and it denotes Mentolabialsulcul angle [Table/Fig-5].

C-Me (Cervical-/G-Pg (Glabella-Pogonion): It is the angle formed between the lines from cervical point to Menton and glabella to Pogonion, Cervico-mental angle [Table/Fig-6].

[Table/Fig-3]: Soft tissue Landmark points, Tri: Trichion (sagittal midpoint of the forehead that borders the hairline): G. Glabella (Most Anterior/prominent point on Mid line of the forehead): N; Nasion (point in the mid line located at the Nasal root); Mn: Mid Nasal (Middle of the dorsum of the nose); Prn:Pronasal (most prominent point on the tip of the nose); Cm: Columella (most inferior and anterior point of the nose); Sn: subnasal (Point where the upper lip joins the columella); Ls: Labial superior (point that indicates the mucocutaneous limit of the upper lip); St: Stomion (junction between Upper and lower lip); Li: Labial inferior (point that indicates the mucocutaneous limit of the lower lip); Sm: Supramental (deepest point of the Inferior sublabel concavity); Pg: Pogonion (Most prominent/anterior point on chin); Me: Menton (Most inferior point of the inferior edge of the chin); Trg: Tragus (most posterior point of the articular tragus); Al: Alar (most lateral point of the alar contour of the nose); C: Cervical (Innermost point between submental area and neck located at intersection of lines drawn tangent to neck and lower border of the mandible).
[Table/Fig-4]: Nasofrontal angle (G-N-Prn), Nasal angle (Cm-Sn/N-Prn), Vertical Nasal angle (N-Prn/TV); TV: True vertical Lane parallel to plump line; TV-N: Nasion vertical Parallel to TV through nasion; TH: True horizontal perpendicular to TV through tragus. (Images from left to right)



[Table/Fig-5]: Nasal dorsum angle (N-Mn-Prn), Naso-labial angle (Cm-Sn-Ls), Mentolabialsulcul angle (Li-Sm-Pog). **[Table/Fig-6]:** Cervico-mental angle (C-Me/G-Pog), height of the middle-third of the face (N-Trg-Sn), inferior-third facial height (Sn-Trg-Me). (Images from left to right)

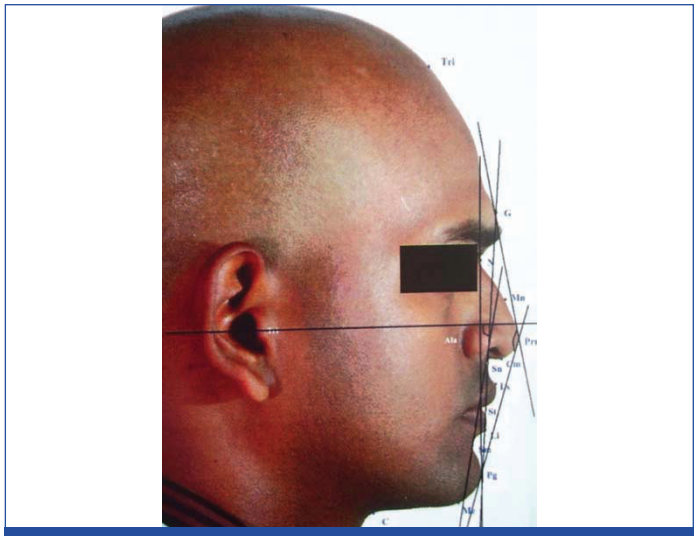
N-Trg-Sn (Nasion-Tragus-Subnasal): It is the angle formed between the lines from nasion to tragus and tragus to subnasal. It denotes the height of the middle-third of the face [Table/Fig-6].

Sn-Trg-Me (Subnasal-Tragus-Menton): This is the angle found between the lines from subnasal to tragus and tragus to Menton. It denotes inferior-third facial height [Table/Fig-6].

Sn-Sm (Subnasal-submental)/TH(true Horizontal): It is the angle formed between the lines from the subnasal to the submental and true horizontal line. The angle of head position [Table/Fig-7].

G-Sn-Pg (Glabella-Subnasal-Pogonion): It is the angle formed between the line drawn from glabella to subnasal and subnasal to Pogonion. it denotes the angle of facial convexity [Table/Fig-7].

G-Prn-Pg (Glabella-Pronasal-Pogonion): It is the angle formed between the line drawn from Glabella to Pronasal and Pronasal to Pogonion. It denotes the angle of total facial convexity [Table/Fig-7].



[Table/Fig-7]: Angle of head position (Sn-Sm/TH), Angle of facial convexity (G-Sn-Pg), Angle of total facial convexity (G-Prn-Pg). (Images from left to right)

STATISTICAL ANALYSIS

A descriptive statistical analysis of all variables was done with the help of statistical software, namely MATLAB, National Institute Nutrition, Hyderabad. Mean, maximum value, minimum value, standard deviation and Confidence of intervals were calculated. The Student's t-test was done to determine sexual dimorphism. A p-value ≤0.05 was considered statistically significant. Microsoft Word and Excel have been used to generate graphs, tables, etc. A descriptive statistical analysis of all the measurements was carried out. The Student's t-test was applied to all variables to determine the influence of gender in the measurements.

RESULTS

The final sample size consisted of 104 individuals, 42 male subjects and 62 female subjects, between 16 to 25 years of age (mean age of male- 21.4 years and female- 19.6 years). The mean, maximum values, minimum values and standard deviation for the angular measurements have been tabulated [Table/Fig-8]. Student's t-test and ranges of the confidence intervals for the angular measurements are provided [Table/Fig-9].

S. No.	Parameter	Gender	Mean (Degrees)	Max (Degrees)	Min (Degrees)	Std. Deviation (Degrees)	Std. Error mean (Degrees)
1	G-N-Prn	Male	137.86	148	130	5.287	0.858
		Female	141.09	151	133	4.804	0.701
2	Cm-Sn/N-Prn	Male	80.78	94	70	6.948	1.127
		Female	84.46	103	70	9.007	1.314
3	N-Prn/TV	Male	32.08	37	24	3.356	0.544
		Female	28.33	35	21	3.636	0.530
4	N-Mn-Prn	Male	180.19	194	165	7.112	1.154
		Female	174.43	190	163	6.648	0.970
5	Cm-Sn-Ls	Male	106.97	124	77	13.369	2.169
		Female	103.87	129	77	14.586	2.128
6	Li-Sm-Pog	Male	123.05	149	102	11.055	1.793
		Female	122.46	150	107	10.369	1.512
7	C-Me/G-Pog	Male	95.70	104	87	5.130	0.832
		Female	98.41	110	87	5.460	0.796
8	N-Trg-Sn	Male	27.05	30	25	1.355	0.220
		Female	26.91	32	25	1.530	0.223
9	Sn-Trg-Me	Male	32.89	37	29	1.997	0.324
		Female	32.37	37	29	1.673	0.224
10	Sn-Sm/TH	Male	76.24	80	73	2.705	0.439
		Female	76.65	81	70	2.838	0.414

11	G-Sn-Pg	Male	169.68	180	161	4.894	0.794
		Female	173.28	180	167	4.431	0.646
12	G-Prn-Pg	Male	144.46	155	133	5.269	0.855
		Female	149.72	160	142	4.605	0.672

[Table/Fig-8]: Descriptive statistics for angular measurements; males are 42 and females are 62 in number.
Al- Alar, C- Cervical, Cm- Columella, G- Glabella, Li- Labial inferior, Ls- Labial superior, Me- Menton, Mn- Mid nasal, N- Nasion, Pg- Pogonion, Prn- Pronasal, Sm- Supramental, Sn- Subnasal, St- Stomion, Trg- Tragus, Tri- Trichion, TH- True horizontal, TV- True vertical, TV-N- Nasion vertical

S. No.	Parameter	Sub-parameters	Sig. (2-tailed) (p-value)	Mean difference	Std. Error difference	95% Confidence interval of the difference	
						Lower	Upper
1	G-N-Prn	Equal variances assumed	**0.004**	-3.222	1.096	-5.403	-1.042
		Equal variances not assumed	**0.005**	-3.222	1.108	-5.428	1.016
2	Cm-Sn/N-Prn	Equal variances assumed	**0.042**	-3.673	1.779	-7.211	-0.135
		Equal variances not assumed	**0.037**	-3.673	1.731	-7.116	-0.230
3	N-Prn/TV	Equal variances assumed	**0.001**	3.755	0.767	2.230	5.280
		Equal variances not assumed	**0.001**	3.755	0.760	2.243	5.267
4	N-Mn-Prn	Equal variances assumed	**0.001**	5.754	1.496	2.778	8.731
		Equal variances not assumed	**0.001**	5.754	1.507	2.753	8.756
5	Cm-Sn-Ls	Equal variances assumed	0.314	3.103	3.067	-2.996	9.203
		Equal variances not assumed	0.310	3.103	3.038	-2.941	9.148
6	Li-Sm-Pog	Equal variances assumed	0.798	0.598	2.330	-4.037	5.232
		Equal variances not assumed	0.800	0.598	2.346	-4.074	5.269
7	C-Me/G-Pog	Equal variances assumed	**0.022**	-2.710	1.160	-5.017	-0.404
		Equal variances not assumed	**0.021**	-2.710	1.152	-5.002	-0.419
8	N-Trg-Sn	Equal variances assumed	0.658	0.141	0.317	-0.490	0.772
		Equal variances not assumed	0.654	0.141	0.313	-0.482	0.764
9	Sn-Trg-Me	Equal variances assumed	0.193	0.522	0.398	-0.269	1.314
		Equal variances not assumed	0.202	0.522	0.406	-0.286	1.331
10	Sn-Sm/TH	Equal variances assumed	0.502	-0.409	0.606	-1.615	0.797
		Equal variances not assumed	0.500	-0.409	0.603	-1.609	0.791
11	G-Sn-Pg	Equal variances assumed	**0.001**	-3.607	1.013	-5.622	-1.592
		Equal variances not assumed	**0.001**	-3.607	1.024	-5.646	-1.568
12	G-Prn-Pg	Equal variances assumed	**0.001**	-5.258	1.072	-7.389	-3.127
		Equal variances not assumed	**0.001**	-5.258	1.087	-7.424	-3.192

[Table/Fig-9]: Student t-test and confidence interval for angular measurements.
Sig.- Significance

Seven of the angles out of twelve showed the sexual dimorphism. Nasofrontal angle (G-N-Prn, p-value=0.004) showed a significant difference between males and females and a wider angle was found in females (141°±4.8°) than males (137.86°±5.2°). Nasal angle, Cm-Sn/N-Prn, (p-value=0.037) showed significant sexual dimorphism and a wider angle was found in females (84.46°±9°) than males (80.78°±6.9°).

Vertical nasal N-Prn/TV, (p-value=0.001) showed the difference between male and female and wider angle was found in males (32.08°±3.3°) than females (28.33°±3.636°).

Nasal dorsum angle N-Mn-Prn, (p-value=0.001) showed the difference between male and female and a wider angle was found in males (180.19°±7.112°) than females (174.43°±6.648°). Cervico-mental angle, C-Me/G-Pog (p-value=0.021) showed a significant difference between male and female and a wider angle was found in females (98.41°±5.4°) than males (95.7°±5.1°).

The angle of facial convexity, G-Sn-Pg, (p-value=0.001) showed a significant difference between males and females and a wider angle was found in females (173.2°±4.4°) than males (169.6°±4.89°). The angle of total facial convexity, G-Prn-Pg (p-value=0.001) showed a significant difference between males and females and a wider angle was found in females (149°±4.6°) than males (144.4°±5.2°). Nasolabial angle. Cm-Sn-Ls (p-value=0.314), Mentolabialsulcul angle. Li-Sm-Pog (p-value=0.798) Height of the middle-third of the face, N-Trg-Sn, (p-value=0.658), Inferior-third facial height, Sn-Trg-Me, (p-value=0.193), angle of the head position Sn-Sm/TH (p-value=0.502) did not show any sexual dimorphism.

DISCUSSION

Research into balancing aberrant profiles has indicated that the position of the lips is usually responsive to orthodontic treatment and is, therefore, more critical in orthodontic diagnosis than the nose and chin, which can only be altered with orthognathic surgery. By positioning the anterior teeth, changes in lip profile can be made to balance the profile. This concept has a direct impact on extraction and non extraction decisions in orthodontic treatment planning [9]. There is a great need for objective and quantitative norms for facial harmony, orientation and proportions.

Facial features have been evaluated with anthropometric, photometric and cephalometric measurements. The inevitable conclusion is that great variations exist in what is considered a good to an excellent face within a given culture. However, an average face is considered more aesthetic than one that is typical. Allowance can then be made for variations in facial attractiveness while maintaining the familiar and ethnic characteristics that make a person unique [10].

Several factors influence the facial trait values skeletal pattern, dental pattern, soft tissue thickness like ethnic and cultural origin, gender difference and age. If optimal facial attractiveness is your treatment goal, all of these influencing factors must be taken into account [11]. As correction of malocclusions brings about changes in appearance, soft tissues profile plays an important part in orthodontic considerations. The authors should determine before

it, that the purposed orthodontic treatment will not result in adverse facial changes [12].

The main intention of the present study was to obtain average parameters of soft tissue facial profile of young adults of Hyderabad and analyse the data for sexual dimorphism and for average measurements. In the present investigation, standardised facial profile photographs were taken in natural head position prescribed by Fernandez-Riveiro P et al., [8]. The selection of photographic analysis over the cephalometric analysis was done since angular measurements are not affected if the photographs are taken in life-size that is 1:1 ratio. Usually, 6% to 8% enlargement is present in lateral cephalograms this is not desired while the authors strove for accuracy. Exposing patients to unnecessary radiation can be avoided. Photogrammetric set up is simple and does not require expensive armamentarium, and it allows digitization of records. Moreover, both linear and angular measurements useful for characterising the facial morphology can be reliably measured from facial photographs [13].

The selected sample was 16 to 25 years old, and all subjects fulfilled the requirements included and analysis done in the present study. Class- I type of relationship was considered because the study by Subtenly JD, in 1959 stated that not all parts of the soft tissue facial profile directly exhibits the underlying dento-skeletal profile [14]. Nasofrontal angle (G-N-Prn) p-value=0.004, showed a significant difference between males and females and a wider angle was found in females (141.09°±4.8°) than males (137.86°±5.2°). Epker BN in the year 1992 stated that Caucasian's frontal and lateral facial views do not show gender difference in nasofrontal angle [15]. The vertical nasal angle N-Prn/TV (p-value=0.000) males (32.08°±3.3°) than females (28.33°±3.636°) and the nasal dorsum angle N-Mn-Prn, (p-value=0.000) males (180.19°±7.112°), females (174.43°±6.648°) showed significantly wider angles in males than females. Nasal angle, Cm-Sn/N-Prn, (p-value=0.037) showed marked sexual dimorphism and a wider angle was found in females (84.4°±9°) than males (80.7°±6.9°).

McNamara JA et al., in the year 1992, in their observation, reported that gender variation in nasal tip angle of 141 adult Caucasians those are having aesthetically pleasing profiles and class-I molar relation but, the present study was a cephalometric study [16]. Lines PA et al., in the year 1978, reported a mean range of 60-80 degrees for the nasal angle which is obtained by lines intersecting the dorsum of nose and tangent to the columella, in that study silhouettes of facial profile were selected [17].

Nasolabial angle is the relationship of nasal base and upper lip, one of the important facial profile parameters which shows wide clinical uncertainty, in the present sample, this angle showed large variability in males 106.9±13° (range from 77 to 124°), in females as 103.8±14° (range 77 to 129°), the method of error was also high, for this reason, the result of this measurement should be interpreted with caution. Burston CJ; reported a nasolabial angle of 74°±8° (range from 60 to 90°) in Caucasian adults in year 1959 [18], Fernandez RP et al., in a study of asian adults reported nasolabial angle of 102.7°±11° in males and 101.6°±11° in females, in the year 2003 [8], Miyajima K et al., also reported a similar finding in the cephalometric study (males 102.8°±8°, females 102.4°±8° [19].The other measurement that should be evaluated with caution is mentolabial angle because large standard deviation 9-10° and high error (2°) Li-Sm-Pog, males 123°±11°, females 122.4°±10°, these findings of the present study were found similar to those of Miyajima K et al., as they also showed measurement of angle Li-Sm-Pg as 133°±10° [19].

Cervico-mental angle is used to access the youthfulness of the neck, this angle increases with age because of platysma spreading and loosening of the skin. The angles of 90 to 100° is considered as youthfulness of the neck and its increases with age, in the present study the authors obtained, 98.41°±5.4° in females and 95.7°±5° in males. Cervico-mental angle, C-Me/G-Pog (p-value=0.021) showed a significant difference between males and females and a wider angle was found in females than in males [20]. The angle of head position is the angle formed between the lines from the subnasal to the submental and true horizontal line, in the present study males showed 76.24±2.7° and females showed 76.65±2.8°, hence no sexual dimorphism was shown.

In the present study, the facial convexity angle and total facial convexity angles showed similarity. The G-Sn-Pg angle of facial convexity of 169±4.8° in males and 173±4.4° in females, G-Prn-Pg total facial convexity angle 144±5.2° in males and 149±4.6° in females. Following the study of Arnett GW and Bergman RT in the year 1993 [21], the present study measured the angle of facial convexity between 161 and 180 degrees.

Peck H and Peck S, in the year 1970, studied profilometric based analysis on standardised cephalometrics and photographs to assess the soft tissue facial profile, they analysed utilising angles such as the total vertical (N-T-Pg),the nasal (N-T-Prn), the maxillary (Prn-T-Ls) and the mandibular angles (Ls-T-Pg), in present investigation the middle and inferior facial-thirds are evaluated by the N-T-Sn and Sn-T-Me angles, and obtained results as the inferior-third was larger (36±4°) than the middle-third (29±2.6°) [22,23]. Similar National and International studies have been tabulated in [Table/Fig-10] [9,24-29].

S. No.	Authors name and year	Place of study	Number of subjects	Age considered	Parameters compared	Conclusion
International studies						
1.	Anic-Milosevic S et al., 2008 [24]	Croatia	110 52 male, 58 female	23-28	Angular	Nasofrontal, nasal vertical, nasal, and nasal dorsal angles showed gender difference.
2.	Malkoç S et al., 2009 [25]	Turkey	100 46 male, 54 female	19-25	Angular	Nasofrontal, nasal vertical, nasal, and nasal tip angles showed gender difference.
3.	Akter L and Hossain MZ, 2017 [26]	Bangladesh	200 100 male,100 female	18-25	Angular	Nasofrontal and mentolabial angles showed gender difference.
4.	Al Taki A et al., 2018 [27]	UAE	71 37 male, 34 female	20-25	Angular	Three facial forms and three lip forms showed statistical difference.
National studies						
5.	Munish Reddy C et al., 2011 [28]	North India	150 78 male,72 female	18-25	Angular	Nasal, mental, facial thirds, nose and lip lengths shows significant difference.
6.	Snigdha P and Sudhakar P, 2014 [29]	South India	300 150 male, 150 female	18-25	Angular	Nasofrontal and mentolabial angles showed gender difference.
7.	Pandian KS et al., 2018 [30]	Chennai, India	90 45 male, 45 female	18-25	Angular	Facial convexity, maxillary lip contour, nasal tip, nasolabial, nasomental,nasofrontal angles showed gender variation.
8.	Present study	Hyderabad, India	104 42 male, 62 female	16-25	Angular	Nasofrontal, nasal angle, vertical nasal, nasal dorsal Angle, cervicomental angle ,angle of facial convexity and angle of total facial convexity showed sexual dimorphism.

[Table/Fig-10]: International and National studies compared with the present study [24-30].

Limitation(s)

Only angular measurements were taken in this part of the study, the inclusion of linear measurements will give more completeness to the present study.

CONCLUSION(S)

Analysis of the soft tissue facial profile and its comparison with standard soft tissue facial profile measurements are necessary for all medical specialities that can change facial traits. The results showed a sexual difference in seven of the twelve angular measurements. The nasofrontal, nasal angle, vertical nasal, nasal dorsal angle, cervico-mental angle, angle of facial convexity and angle of total facial convexity showed sexual dimorphism. Another important finding was large variability for the nasolabial and mentolabial angles. The result of these two measurements should be assisted with caution. More studies of facial profile analysis through angular and linear measurements will give an overall idea of facial form, in this regard need more studies coupled with angular and linear measurements are considered for future research.

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