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Original Article

## COMPARATIVE EVALUATION OF SOFT TISSUE IN DIFFERENT GENDERS ON FACIAL PHOTOGRAPHS & LATERAL CEPHALOGRAMS IN SOUTH RAJASTHAN POPULATION

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### ABSTRACT

**Aim:** Comparative evaluation of soft tissue analysis in different genders using lateral cephalograms and profile photographs.

**OBJECTIVES :** To assess the soft tissues in different genders using profile photographs, to assess and compare soft tissue using lateral cephalograms and profile photographs of different genders, to assess and compare the lateral Cephalograms parameters with standard Arnett's Caucasians Norms.

**Material and methods:** This study consisted of 100 subjects with age range of 17-26 years, in which 50 males and 50 females lateral cephalograms and standardized lateral profile photograph in natural head position were taken in the department of orthodontics and dentofacial orthopaedics, Daswani Dental college, Ranpur, Kota, Rajasthan. All these soft tissues parameters of lateral cephalogram and profile photographs were measured by computerized means and compared by using paired T-test, independent T-test, One-sample T-test.

**Results:** Within the South Rajasthan Female Group there is significant difference between the parameters TVL-ULA, TVL-LLA, TVL-B', Steiner's U-LIP and L-LIP. In between



Profile photographs of South Rajasthan male and female subjects, results showed significant difference in mean values of parameters Steiner's S-line's U-lip and Rickett's Esthetic E-line - Lower Lip. In between Lateral Cephalograms of South Rajasthan Males and Females, of TVL-LLA parameter showed us significant difference. In between Lateral cephalograms of South Rajasthan males and females and Arnett's Caucasian males and females we obtained significant results of every parameters which indicated that Soft tissue pattern of south Rajasthan Males are different and did not follow Caucasian Norms.

**Conclusion:** A single norm for esthetics does not apply to all ethnic origins. The normative data thus obtained might serve as a useful reference for orthodontists for the proper diagnosis and treatment planning when dealing with the patients of South Rajasthan ethnic group.

**Keyword:** Evaluation, Soft Tissue, Facial Photographs & Lateral Cephalograms

#### **INTRODUCTION :**

Cephalometry is considered as a gold standard in orthodontic diagnosis. As an essential diagnostic tool for treatment planning of an orthodontic case, cephalometry has also basic demerits: Patients are exposed to harmful radiation and it requires a radiation source and a cephalostat which is will not be available everywhere<sup>1</sup>.

Today, with lots of awareness about radiation exposure, unnecessary irradiation should be avoided. There is an increasing need of resorting to methods that can give equal if not better results<sup>2</sup>. Importance of intraoral and extraoral photography since then is gaining momentum in orthodontic practice. Photographic analyses are inexpensive, and they help in diagnosis of the harmonic

relationships among external craniofacial structures, which includes effects of muscles and adipose tissue<sup>(3,4)</sup>.

Facial photography, also an essential diagnostic tool, has been part of both pretreatment and post-treatment orthodontic records historically.<sup>5</sup> A patient judges the results of an orthodontic treatment by assessing the final improvement in facial esthetics.

However comparisons between cephalometric and photographic measurements have rarely been performed and with conflicting results<sup>(6,7)</sup>. The analyses proposed by Arnett et al (1999)<sup>8</sup> and Holdaway (1983)<sup>9</sup> based on white American population, have been widely adopted by orthodontists and maxillofacial surgeons in diagnosis and treatment planning.



Arnett and Bergman<sup>8</sup> presented the facial keys to orthodontic diagnosis and treatment planning as a 3-dimensional blueprint for soft-tissue analysis and treatment planning. Later, they developed the soft tissue cephalometric analysis (STCA) for orthodontic diagnosis and treatment planning. The STCA is a simple radiographic analysis that have a mutual relationship in various facial hard- and soft-tissue structures that determine equilibrium and harmony as well as to a true vertical line (TVL), in both the sagittal and vertical planes. It also emphasizes the importance of clinical facial assessment of the patient, to increase and explain cephalometric findings.

These are the prevalent soft tissue measurements commonly used to analyses soft tissue profiles and thus purpose of this study was to compare and correlate the measurements obtained from lateral cephalograms and analogous measurements from standardized facial profile photographs in skeletal class I cases with pleasing profile and comparing it with Caucasian soft tissue norms given by Arnett et al<sup>8</sup>. This possibility of predicting cephalometric values through photographs may give us a feasible, cost

effective and non invasive diagnostic tool which could be used as a non radiographic alternative to lateral cephalometry.

## **MATERIAL AND METHOD :**

### Source of Data:

This study was conducted to develop soft tissue cephalometric norms for South rajasthan people using soft tissue cephalometric analysis (STCA) and comparing them with Caucasian Norms in the department of orthodontics and dentofacial orthopaedics, Daswani Dental college , Ranpur , Kota, Rajasthan.

This study consisted of 100 subjects with age range of 17-26 years, in which 50 males and 50 females lateral cephalograms and standardized lateral profile photograph in natural head position were taken.

For the purpose of this study an individual was considered 'South Rajasthan origin'.

### **SELECTION CRITERIA:**

#### **Inclusion Criteria :**

01. 17-26 years of age range.
02. Skeletal and Dental Class I occlusion with pleasing profile.
03. No history of orthodontic therapy.



### **Exclusion Criteria :**

01. Craniofacial syndromes.
02. History of maxillofacial or plastic surgery.
03. Previous history of facial trauma.

### **ARMAMENTARIUM:**

- 1) Lateral Cephalograms.
- 2) Profile Photographs.
- 3) 0.36 Micron Matte Sheet.
- 4) 0.3mm H-Pencil.
- 5) Metal Scale.
- 6) Wooden Scale.
- 7) Tracing Board.
- 8) 8) CorelDraw 12 Software
- 9) 9) DSLR Canon 1300D .

### **METHODOLOGY:**

This lateral cephalograms were taken from PlanMeca Proline Xc Machine at 60Kvp 5ma with exposure time of 14 seconds using digital sensor. For the standardization of the photographic technique the subjects were made to stand in front of a mirror with posture upright at a fixed distance of 1.2 meter away from the camera on a platform stand.

A wooden scale was placed in front of the subject to provide the scale factor that was used to correct for magnification differences among the photographs. The subject looked straight into the image of his / her own eyes in the mirror which

was fixed at a distance of 2 meter from the subject. This should correspond to natural head position and centric relation and condyles seated position.

Photographs also should be of good quality taken from Canon 1300 D camera. Lateral photographs were cropped and digitized with 1:1 standard ratio from software image coral draw 12 version.

All lateral cephalometric films were manually traced on a transparent cellulose acetate sheets and on cropped image of facial photographs were also manual traced from tracing sheet obtained from lateral cephalogram. The magnification factor was considered when the measurements were recorded. Thus , all parameters of Soft tissue cephalometric analysis (STCA) will be compared to the Caucasian Males and Females to get soft tissue cephalometric Norms for South Rajasthan (Kota) population.

Parameters taken in reference with True Vertical line (TVL), Steiner's S line and Rickett's Esthetic E- line :

1. TVL –Glabella' (G').
2. TVL- Nasal Tip (NT).
3. TVL- Upper Lip Anterior point (ULA).
4. TVL-Lower Lip Anterior point (LLA).

5. TVL- B' (Soft tissue B point).
6. TVL- Soft tissue Pogonion' (P').
7. Steiner's Sline –Upper Lip.
8. Steiner's Sline –Lower Lip.
9. Rickett's E-line –Lower Lip.

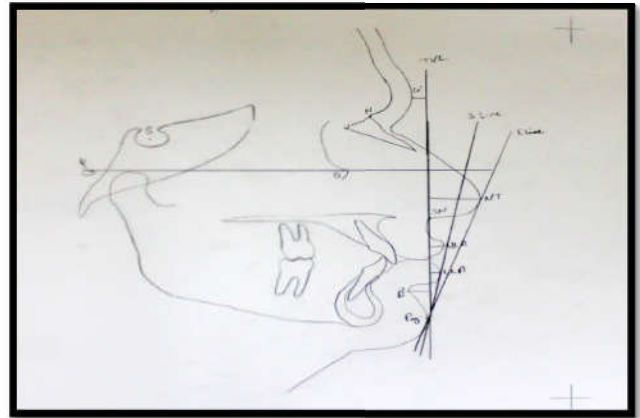


Fig 7 and 8 : Lateral Cephalogram and manual hand tracing of lateral cephalogram on acetate sheet.

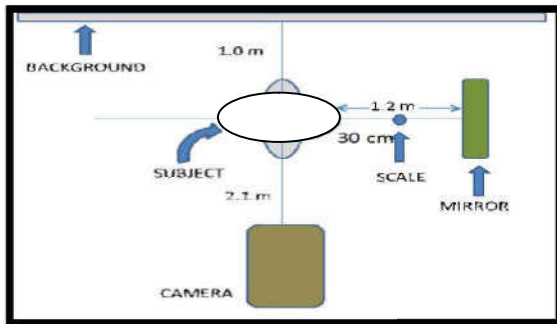


Fig 1. A photographic Setup in Department.



Fig2 . Planmeca Proline XC Machine

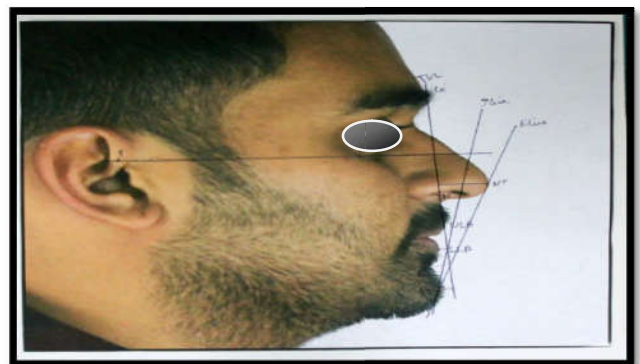


Fig 9 & 10 : Standardized photograph of Male Sample With Canon 1300 D Camera and Standardized Cropped image with 1:1 ratio



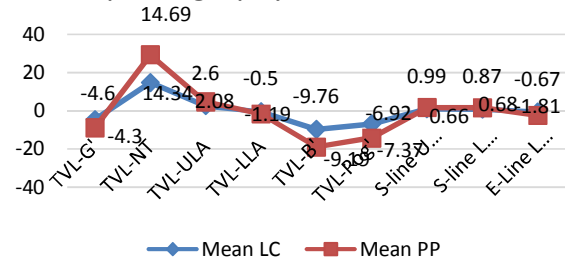


### Statistical Analysis:

The statistical Analysis was done using MS EXCEL and SPSS (Statistical package for social sciences) Version 23.0 statistical analysis software. The values were represented in numbers and mean and standard deviation along with significant P values have been used. Paired t test was performed to see if there exists any significant difference ( $P < 0.05$ ) in mean between lateral cephalograms and profile photographs parameters within South Rajasthan males and Females Independent t test was used to compare the soft tissue parameters using profile photographs between male and female. Independent t test was used to compare the soft tissue parameters using lateral cephalograms between male and female. One sample t test was used to compare the means of lateral cephalograms parameters of South Rajasthan Males and Females with the standard Arnett's Caucasians norms of Males and Females.

**RESULTS :** Graph 1 : Comparison of cephalometric and photographic methods in assessments of linear variables in skeletal class I (Pleasing profile) Male subjects using paired t test ( $p < 0.05$ -significant).

Lateral Cephalogram and Profile photography mean - Male

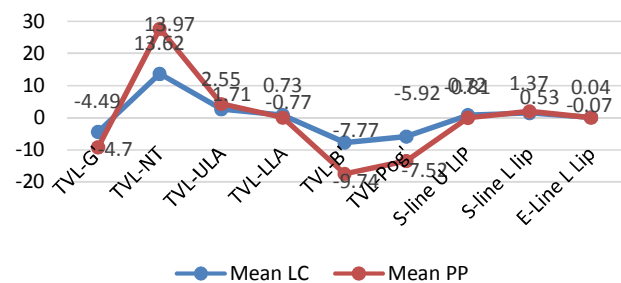


Interpretation of graph 1 :

Within the male group there is no significant difference between lateral cephalogram and profile photography parameters.

Graph 2 : Comparison of cephalometric and photographic methods in assessments of linear variables in skeletal class I (Pleasing profile) Female subjects using paired t test ( $p < 0.05$ -significant).

Lateral Cephalogram and Profile Photography mean - Female



INTERPRETATION of graph 2:

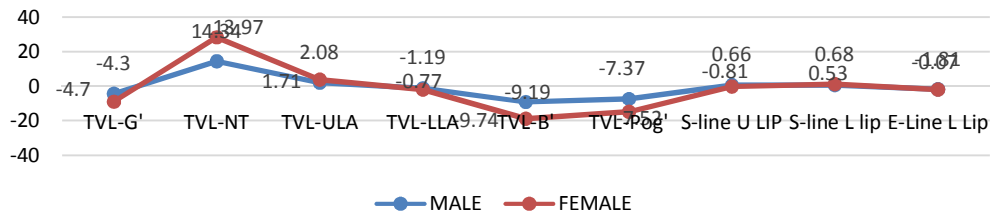
There exists a significant difference in mean ( $p < 0.05$ ) between the parameters



TVL-ULA ,TVL-LLA, TVL-B', U-LIP L-LIP, and L-LIP-A within the females. There is no significant difference in mean between the other parameters within the females.

Graph 3: Comparison of soft tissue using profile photography parameters between male and female subjects using Independent Samples T test ( $p < 0.05$ -significant).

Profile Photography Mean values of Male and Female

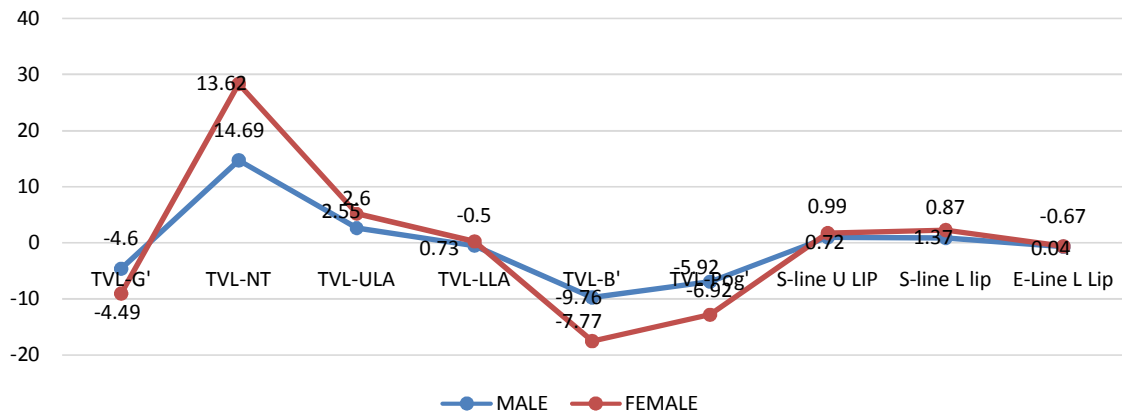


Interpretation of graph 3 :

The parameters L-LIP\_A and Steiner's U-LIP showed significant difference ( $p < 0.05$ ) in mean when compared between male and female. The other parameters did not have any significant difference in mean between male and female.

Graph 4: Comparison of soft tissue using Lateral Cephalogram parameters between male and female subjects using Independent Samples T test ( $p < 0.05$ -significant).

LATERAL CEPHALOGRAM MEAN VALUES OF MALE AND FEMALE





Interpretation of graph 4:

The parameter TVL-LLA of lateral cephalogram showed significant difference ( $p < 0.05$ ) in mean when compared between male and female. The other parameters did not have any significant difference in mean between male and female.

Table 1: Comparison of Lateral Cephalogram parameters in the South Rajasthan male subjects with the Arnett's Caucasian Norms using One Sample T test ( $p < 0.05$ -significant)

One Sample T test						
Parameters	Lateral Ceph Kota Males (N-50)		Lateral ceph (N-50) Caucasian Males		t value	significance P
	mean	standard deviation	Mean	Standard deviation		
TVL-G'	-4.6	2.62	-8	2.5	9.1181	0.00
TVL-NT	14.69	1.84	17.4	1.7	123.488	0.00
TVL-ULA	2.6	2.35	3.3	1.7	-2.049	0.046
TVL-LLA	-0.5	2.92	1	2.2	-3.636	0.001
TVL-B'	-9.76	3.44	-7.1	1.6	-5.462	0.000
TVL-Pog'	-6.92	3.61	-3.5	1.8	-6.698	0.000
S-line U LIP	0.99	1.91	0	0	3.660	0.001
S-line L lip	0.87	2.54	0	0	2.419	0.019
E-Line L Lip	0.67	3.61	-2	2	2.566	0.013

Table 2: Comparison of Lateral Cephalogram parameters in the South Rajasthan Female subjects with the Arnett's Caucasian Norms using One Sample T test ( $p < 0.05$ -significant).

One Sample T test						
Parameters	Lateral ceph (N-50) Kota Females		Lateral ceph (N-50) Caucasian Females		t value	Significance P
	mean	standard deviation	mean	standard deviation		
TVL-G'	-4.49	4.48	-8.5	2.4	6.322	0.000
TVL-NT	13.62	3.96	16	1.4	4.253	0.000
TVL-ULA	2.55	1.49	3.7	1.2	5.437	0.000
TVL-LLA	0.73	2.59	1.9	1.4	3.197	0.002
TVL-B'	-7.77	6.27	-5.3	1.5	2.796	0.007
TVL-Pog'	-5.92	5.75	-2.6	1.9	4.085	0.000
S-line U LIP	0.72	1.36	0	0	3.734	0.000
S-line L lip	1.37	1.51	0	0	6.425	0.000
E-Line L Lip	0.04	2.04	-2	2	7.054	0.000

Interpretation of Table 1 & 2: With one sample t test, when the parameters means of lateral cephalogram compared with the standard means of Arnett's Caucasians norms in males and females there exists a significant difference ( $p < 0.05$ ), indicating that the values of South Rajasthan people differ from the standard Arnett's Caucasians norms.

## DISCUSSION:

Cephalometry has been established to be the contemporary gold standard for diagnosis of skeletal craniofacial





morphology in orthodontic clinical practice. But because of its low cost, and no harmful radiation exposure, the photographic assessment is a pronounced diagnostic tool for epidemiologic studies. The standardized photographic technique has numerous advantages as the subject does not move, there are no skin pressure-related errors, also it is easier to take measurements, the time needed with the patient is also lesser, also it is easier for the clinician to explain the photographs to the patient rather than a cephalogram. There are some disadvantages of the photographic technique as well distortion of the image due to the presence of some distance between the subject and the lens as it causes objects farther to the camera appear smaller than those closer to it. But this factor is only critical when we are making an attempt to equate structures located in the various planes of space. Most landmarks obtained from the cephalograms and photographs in the current study are at the midline, so this should not affect our measurements too much. Furthermore, angular variables were used more often, which partially incapacitates the difficulty of magnification<sup>10</sup>.

Our first comparison between Lateral cephalometric male mean values with profile photograph male mean values of south rajasthan male subjects showed no significant difference. Our results suggest that facial photography is at least as reliable as cephalometrics which was quiet similar. Therefore, photography might be a practical alternative when radiography is considered too invasive or is logistically impractical.

Our second comparison between Lateral cephalometric female mean values with profile photograph female mean values of south rajasthan female subjects showed a significant difference in mean ( $p < 0.05$ ) between the parameters TVL-ULA profile photography and TVL-ULA lateral cephalogram ( $P = 0.000$ ), TVL-LLA profile photography and TVL-LLA lateral cephalogram ( $P = 0.003$ ), TVL-B' profile photography and TVL-B' lateral cephalogram ( $P = 0.023$ ), Sline's U-LIP profile photography and U-LIP lateral cephalogram ( $p = 0.003$ ), Sline's L-LIP profile photography and L-LIP lateral cephalogram ( $P = 0.019$ ). There is no significant difference in mean between the parameters like TVL-G', TVL-NT, TVL-Pog', E-line's L-lip which shows good analogous with photographic



measurements which were similar with Pooja Mehta et al 2017<sup>45</sup>. The advantages of photographs are that they are safe and free from radiation, easy, less time consuming, do they do not require any special equipment. However, there are a few disadvantages which include the magnification error in photographs, and difficulty in palpation of some points<sup>10</sup>.

Our third comparison Independent t Test in between Profile photographic South Rajasthan male and female subjects were used. Results showed significant difference ( $P < 0.05$ ) in mean values of parameters S-line's U-lip and E-line's L-lip. Thus, in South Rajasthan male upper lip were protruded compare to females subjects. Mean of male subjects(0.66) and mean of females (-0.81) And Lower lip is more protruded in female mean (-0.07) subjects as compared to males mean (-1.81). *Ricketts* (1968) found that the lower lip position is 1-2 mm and upper lip position is 2-3 mm behind a line drawn from tip of nose to skin pogonion. Lips which protrude beyond the aesthetic plane seemed undesirable in adults. This strengthens the viewpoint that facial pattern of Asians (e.g. Chinese) is measurably different. What is not acceptable in the Caucasians might be

normal in our racial group (Chan et al., 1972)<sup>11</sup>. Similar results obtained in Kathiravan et al. (2013)<sup>12,13</sup> study in Malaysian Chinese population also showed the lips were more protrusive in the female compared to the males as per E line.

Our fourth Comparison was done by Independent t Test in between lateral Cephalogram of South Rajasthan male and female subjects were used. Results showed significant difference ( $P < 0.05$ ) in mean value of parameter of Arnett's TVL-LLA( $p = 0.028$ ). Thus results were found between the sexes with females having higher values for lower lip anterior when compared with males. This difference in male and female lip thickness and anterior position had to be considered while planning the amount of incisor retraction for improving esthetics. Similar results were seen in the study conducted by Kalha et al.<sup>14</sup> and Arnett et al<sup>15</sup>. The nasal projection in males was higher as compared to females. This is in accordance to the study conducted by Scheideman et al.<sup>17</sup> Kalha et al,<sup>14</sup> Arnett et al<sup>15,16</sup>, and Lalitha and Gopa Kumar.<sup>13</sup>

Our fifth Comparison was done by one sample t test in between lateral cephalogram of south Rajasthan Males



mean values with the standard Arnett's Caucasian norms. Significant differences ( $P < 0.05$ ) were obtained which indicated that the values of south rajasthan males differ from standard arnett's Caucasian norms and thus south rajsathan males. The mean values of linear measurements with respect to TVL line of South rajasthan males were TVL-G'(-4.6mm),TVL-NT(14.69mm),TVL-ULA(2.6mm),TVL-LLA(-0.5mm),TVL-B'(-9.67mm), TVL-Pog'(-6.92mm) were comparatively shorter than Arnett's Caucasian males TVL-G'(-8mm),TVL-NT(17.4mm),TVL-ULA(3.3mm),TVL-LLA(1mm),TVL-B'(-7.1mm),TVL-Pog'(-3.5mm) . Steiner's S-line U-Lip (0.99mm), L-LIP (0.87mm) showed south rajasthan males have protrusive lips then normal .Thus, this clearly shows that we need to establish norms for south rajasthan population .

Uysal et al , Scavone et al and Gunaid et al also found that the Caucasian norms for different soft-tissue cephalometric analysis were not applicable on the Turkish, Japanese-Brazilian and Yemeni population respectively, so they established separate soft-tissue cephalometric analysis norms for their population. Among the various soft tissue analyses, Arnett's analysis is a

combination of hard tissue and soft tissue analysis; it evaluates the upper face, mid face and lower face structures, and has the advantage of gender consideration.

Also, upper lip was more prominent in males shown by larger ULA and acute nasolabial angle, though the difference was insignificant compared to females. Similar results were observed by Kalha et al<sup>14</sup> in their study on south Indian males.. This was significantly different from Arnett's et al<sup>15,16</sup> , and Scheideman et al<sup>17</sup> conclusions, where females showed fuller and prominent lip regions than males. Compared to Arnett's male group, the soft tissues were thinner in the men of the study population except the lower lip thickness (insignificantly high) and the nasolabial angle was more acute. This is in accordance with the study on south Indians.<sup>3</sup> On the other hand, women show similar values of soft tissue thickness as compared to Arnett's sample (also observed by Kalha et al<sup>14</sup>). Only soft tissue chin thickness and ULA was significantly higher in Caucasian females. Therefore, apart from sexual dimorphism, differences in soft tissue thickness were also found in different races. In comparison with Caucasians, upper lip thickness was found more in Indoaryans<sup>20</sup>, Yemeni<sup>21</sup> and



Indians<sup>18,20,22</sup> and less in Turkish population<sup>19</sup>.

Our Sixth Comparison was done by one sample t test in between lateral cephalogram of south rajasthan Males mean values with the standard Arnett's Caucasian norms<sup>8</sup>. Significant differences ( $P < 0.05$ ) were obtained which indicated that the values of south rajasthan males differ from standard arnett's Caucasian norms and thus south rajsathan males. The mean values of linear measurements with respect to TVL line of South rajasthan males were TVL-G'(-4.49mm), TVL-NT(13.62mm), TVL-ULA(2.55mm), TVL-LLA(0.73mm), TVL-B'(-7.77mm), TVL-Pog'(-5.92mm) were comparatively shorter than Arnett's Caucasia Females TVL-G'(-8.5mm), TVL-NT(16mm), TVL-ULA(3.7mm), TVL-LLA(1.9mm), TVL-B'(-5.3mm), TVL-Pog'(-2.6mm). Steiner's S-line U-Lip (0.72mm), L-LIP (1.37mm) showed south rajasthan Females have protrusive lips then normal.

The results of the present study suggested that the differences exist in the facial structures of two ethnic groups (South Rajasthan and Caucasians). So separate norms for distinctive populations are necessary and that one set of norms cannot be applied to patients of different

racas and ethnic origin. Hence, the results of the present study suggests that these racial differences should be observed during diagnosis of orthodontic and orthognathic treatment planning.

A bigger panel of judges including other professionals and lay persons for selection of samples of pleasing profile and a larger sample size makes the scope for future studies in establishing Arnett's soft tissue analysis norms for the South Rajasthan population.

#### CONCLUSION :

The significant findings of this study were:

1. Within the South Rajasthan Male Group there is no significant difference between lateral Cephalograms and Profile photographs.
2. Within the South Rajasthan Female Group there is significant difference between the parameters TVL-ULA (True Vertical Line-Upper Lip Anterior), TVL-LLA (True Vertical Line-Lower Lip Anterior), TVL-B', Steiner's U-LIP and L-LIP. Rest other parameters were not significant. This can be verified by taking larger sample size.
3. In between Profile photographs of South Rajasthan male and female



subjects , results showed significant difference in mean values of parameters Steiner's S-line's U-lip and Rickett's Esthetic E-line - Lower Lip. Thus, in South Rajasthan male upper lip were protruded compare to females subjects. Lower lip is more protruded in female subjects as compared to males.

4. In between Lateral Cephalograms of South Rajasthan Males and Females, of TVL-LLA (True Vertical Line-Lower Lip Anterior) parameter showed us significant difference.
5. In between Lateral cephalograms of South Rajasthan males and females and Arnett' s Caucasian males and females we obtained significant results of every parameters which indicated that Soft tissue pattern of south Rajasthan Males are different and did not follow Caucasian Norms. So we need established separate soft-tissue cephalometric analysis norms for their population.

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**Conflicts of interest:**

There are no conflicts of interest.

**REFERENCES:**

1. Patel DP, Trivedi R. Photography versus lateral cephalogram: Role in facial diagnosis. *Indian J Dent Res* 2013;24:587-92.
2. Gomes LDCR, Horta KOC, Gandini LG, Gonçalves M, Gonçalves JR. Photographic assessment of cephalometric measurements. *Angle Orthod.* 2013;83(6):1049–58.
3. Ferrario VF, Sforza C, Miani A. Craniofacial morphometry by photographic]evaluations. *Am J Orthod Dentofac Orthop.* 1993;130(4):327-37
4. Ozdemir ST, Sigirli D, Ercan I, Cankur NS. Photographic facial soft tissue analysis of Healthy Turkish young adults: Anthropometric measurements. *Aesthetic Plast Surg.* 2009;33(2):175–84.
5. Graber TM. *Orthodontics□principles and practice.* 3rd ed. Philadelphia: W. B. Saunders; 1972. p. 397□431.
6. Zhang X, Hans MG, Graham G, Kirchner HL, Redline S. Correlations between cephalometric and facial photographic measurements of



- craniofacial form. *Am J Orthod Dentofacial Orthop.* 2007;131(1):67–71.
7. Staudt CB, Kiliaridis S. A nonradiographic approach to detect Class III skeletal [8] discrepancies. *Am J Orthod Dentofacial Orthop.* 2009;136(1):52–58.
8. Arnett GW, Jelic JS, Kim J, Cummings DR, Beress A, Worley CM, Chung B and Bergman R. Soft tissue cephalometric analysis: diagnosis and treatment planning of dentofacial deformity. *Am J Orthod Dentofacial Orthop* 1999; 116:239-53.
9. Holdaway RA. A soft tissue cephalometric analysis and its use in orthodontic treatment planning: part I. *Am J Orthod* 1983;84:1-28.
10. Mehta P, Sagarkar RM, Mathew S. Photographic Assessment of Cephalometric Measurements in Skeletal Class II Cases: A Comparative Study. *Journal of clinical and diagnostic research: JCDR.* 2017,11(6):ZC60.
11. Chan GK. A cephalometric appraisal of the Chinese (Cantonese). *Am J Orthod*,1972, 61, 279-285
12. Kathiravan P, Alam MK, Norzakiah MZ. Cephalometric norms of Malaysian adult Indian. *International Medical Journal*,2013, 20(2), 192-196.
13. Lalitha C, Gopalkumar KG. Assessment of Arnett soft tissue cephalometric norms in Indian (Andhra) population. *Orthod Cyber Journal* 2010;1:1-6.
14. Kalha AS, Latif A, Govardhan SN. Soft-tissue cephalometric norms in a South Indian ethnic population. *American journal of orthodontics and dentofacial orthopedics.* 2008 ;133(6):876-81.
15. Arnett GW, Bergman RT. *Facial Keys to Orthodontic Planning. Part I Diagnosis and Treatment.* *Am J Orthod Dentofacial Orthop.* 1993.
16. Arnett GW, Bergman RT. *Facial keys to orthodontic diagnosis and treatment planning—part II.* *American journal of orthodontics and dentofacial orthopedics.* 1993 ;103(5):395-411.
17. Scheideman GB, Bell WH, Legan HL, Finn RA, Reisch JS. Cephalometric analysis of dentofacial normals. *Am J Orthod* 1980;78:404–20.



18. Mehta P, Kumar M, Goel M, Kosh S. Holdaway's soft tissue cephalometric norms for the population of Lucknow, India. *J Oral Health Res* 2010;1(4):153-159.
19. Uysal T, Yagci A, Basciftci FA, Sisman Y. Standards of soft tissue Arnett analysis for surgical planning in Turkish adults. *Eur J Orthod* 2009;31(4):449-456.
20. Grewal H, Sidhu SS, Kharbanda OP. A cephalometric appraisal of dentofacial and soft tissue pattern in Indo-Aryans. *J Pierre Fauchard Acad* 1994;8(3):87-96.
21. Al-Gunaid T, Yamada K, Yamaki M, Saito I. Soft-tissue cephalometric norms in Yemeni men. *Am J Orthod Dentofacial Orthop* 2007;132(5):576.e7-e14.
22. Kumar BS, Shree VP, Revathi P. Dentofacial cephalometric norms for Hyderabad population. *J Orofacial Sci* 2009;1(1):7-13.
23. Banerjee S, Ray S, Narayan SV, Seth S, Jana D. A Comparative Study of Photographic and Cephalometric Measurements in Adult Female Bengalee Population. *IOSR-JDMS*, 2019, PP 33-39.
24. Lundström A, Lundström F, Lebet LM, Moorrees CF. Natural head position and natural head orientation: basic considerations in cephalometric analysis and research. *Eur J Orthod*. 1995;17(2):111-20.