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RESEARCH ARTICLE

COMPARISON OF SOFT TISSUE CHIN THICKNESS AT DIFFERENT CEPHALOMETRIC POINTS AND ITS CORRELATION WITH MANDIBULAR DIVERGENCE PATTERN IN SOUTH INDIAN POPULATION

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ABSTRACT

Objectives of the study: To compare soft tissue chin thickness at different cephalometric points and its correlation with mandibular divergence pattern in south indian population

Materials and Method: Lateral cephalograms of 90 South Indian patients in the age group 18 and above were taken and divided into three groups – low angle, medium angle and high angle of manbibular plane to the cranial base. Soft tissue chin thickness was measured at three different levels of chin: Pogonion, Gnathion, Menton. The soft tissue chin thickness was also compared between males and females.

Results: One-way analysis of variance (ANOVA), followed by comparison between different growth pattern groups using Post Hoc Tukey's test was done. Statistically significant difference was seen between the low angle and high angle groups with increased soft tissue chin thickness in high angle cases. No statistically significant difference was observed between males and females.

Conclusion: Soft tissue chin thickness was minimum at menton and maximum at pogonion. Thicker soft tissue was seen in low angle cases, with no statistically significant sexual dimorphism.

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INTRODUCTION

In the early era of orthodontics, the primary goal of treatment was to achieve a ideal dental occlusion and skeletal profile, with a shift from angle paradigm the primary focus was placed on achieving a harmonious soft tissue profile and relative dentoskeletal components. (Ackerman *et al*., 1999) Evaluation of the soft tissue profile and establishing various soft tissue compartments i.e chin lips and nose in the ideal size and proportions helps in achieving an esthetic profile. When measurements of facial features are outside the norms, there is often a decrease in facial attractiveness. (Burstone, 1967) How accurately the orthodontist and surgeon manage the dentoskeletal components, greatly influences the resulting profile. Obvious deviations that are noted by the patients and parents during orthodontic consultation should be identified and improved with appropriate treatment. Orthodontic treatment planning should consider both the hard and soft tissues. The triumph of orthodontic treatment completes with fulfilling the objective treatment goals and subjective patient desires. Therefore, improvement in facial appearance should be considered in the treatment plan. (James L Ackerman and William R Profit, 1997) Soft tissue of the mandible is seen to follow the hard tissue contour which is not same in case of maxilla or mid face. Soft-tissue thickness has also been shown to differ between persons with short and long faces. (Schendel *et al*., 1976) The various factors affecting the skeletal contour are growth pattern, sagittal relationship of the jaws growth rotations, sex, age, genetic predisposition, race etc. Growth pattern has evidently been seen to affect the positioning of chin i.e. Reduced chin prominence in vertical growth pattern or clockwise rotation of mandible and normal or increased chin prominence in average or horizontal growth pattern owing to anticlockwise rotation of mandible. (Bjork, 1969) The soft tissue chin thickness adapts respectively to the resultant skeletal chin position, although it is not uniform thickness of soft tissue is differential at different levels of the chin. (Macari, Hanna, 2014) Uysal *et al*. stated that ethnic or racial variation also affects the soft tissue envelope thickness. (Uysal *et al*., 2012) Males are observed to have thicker soft tissue in comparison to females (Dong *et al*., 2012), whereas Hoffelder observed no gender based differences of chin thickness and length during the growth period. (Hoffelder *et al*., 2007) Previous studies have evaluated the soft tissue chin thickness at the anterior portion of the chin and its correlation to underlying growth pattern. (Feres *et al*., 2010) In the present study we will be evaluating the correlation of soft tissue chin thickness at anterior part, angle and the inferior most portion of chin, to

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mandibular divergence pattern in South Indian adult population.

MATERIALS AND METHODS

Inclusion criteria

- Age above 18 yrs
- Lateral cephalogram taken with lips at rest
- Lateral cephalogram taken at natural head position.

Exclusion criteria

- Previous orthodontic treatment /Orthognathic surgery
- Craniofacial anomalies.
- Non continuous soft tissue contour.

According to the inclusion criteria 90 pre treatment lateral cephalograms were collected which were above the age of 18 yrs. The pretreatment lateral cephalograms were taken a single digital Photostat (KODAK 8000c machine,69 kvp,12MA, 2 sec),with patient positioned in natural head position and soft tissues at rest. Manual tracing of the radiograph was done by a single operator on acetate paper using 0.5mm lead pencil. Mandibular divergence was determined using angular measurement of steiners analysis (SN-Go Gn). Based on the value of this angle, the cephalograms were divided into three groups-low angle, medium angle and high angle case. Each group comprised of 30 patients each (n=30).

- Medium= 27^0 - 34^0
- Low= <27^0
- High=>34^0

Soft tissue chin thickness was calculated at three levels of chin i.e. anterior portion,angle of the chin and the inferior part of chin.

- Anterior part (Pog-Pog')- hard tissue to soft tissue pogonion.
- Angle of chin (Gn-Gn')- hard tissue to soft tissue gnathion.
- Inferior part (Me-Me')- hard tissue to soft tissue menton.

Linear measurements were recorded using precalibrated scale, in mm (millimetres). 18 randomly selected tracings were retraced and measurements were repeated to evaluate reproducibility and accuracy of tracing. Data was compiled and statistical analysis was performed to evaluate the correlation of mandibular divergence pattern and sexual dimorphism pattern of soft tissue thickness of chin.

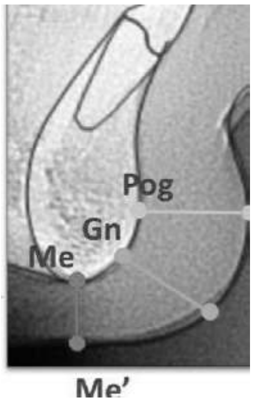


Figure 1. Soft tissue chin

RESULTS

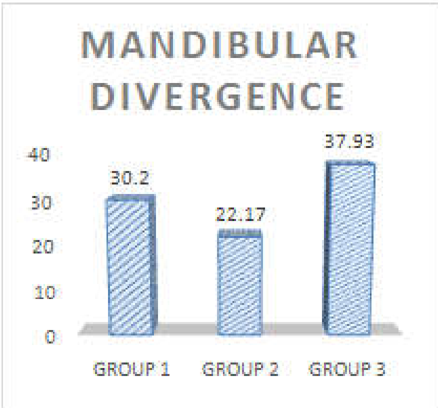
Comparison of pog-pog' between the three groups shows that GROUP 2 (low angle) has the highest value of 11.07 and GROUP 3(high angle) has the least value of 9.33. This difference is statistically significant with a test value of 5.714 and p value of 0.005. Posthoc Tukey's tests comparing GROUP 1(medium angle) and GROUP 2(low angle) shows a mean difference of -0.533 and is not statistically significant with a p value of 0.569. Comparing GROUP 1(medium angle) and GROUP 3(high angle) shows a mean difference of 1.2 and is not statistically significant with a p value of 0.063. Comparing GROUP 2 (low angle) and GROUP 3 (high angle) groups shows a mean difference of 1.733* and is statistically significant with a p value of 0.004. Comparison of gn-gn' between the three groups shows that GROUP 2(low angle) has the highest value of 8.93 and GROUP 3(high angle) has the least value of 6.8.

Table 1. One way anova test for comparing the 3 groups

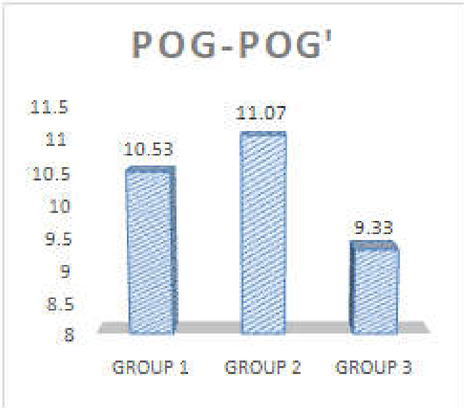
	GROUPS	N	Mean	Std. Deviation	Statistics/ mean squares	df2(welch) / F(Anova)	P VALUE
Age	GROUP 1	30	20.57	2.487	3.851	54.648	0.027
	GROUP 2	30	21.63	3.567			
	GROUP 3	30	23.13	4.524			
	Total	90	21.78	3.735			
Mandibular divergence	GROUP 1	30	30.2	2.124	243.982	56.276	<0.001
	GROUP 2	30	22.17	3.384			
	GROUP 3	30	37.93	2.196			
	Total	90	30.1	6.977			
Pog-pog'	GROUP 1	30	10.53	2.432	23.644	5.714	0.005
	GROUP 2	30	11.07	1.552			
	GROUP 3	30	9.33	2.023			
	Total	90	10.31	2.139			
Gn-gn'	GROUP 1	30	7.67	2.139	34.533	8.503	<0.001
	GROUP 2	30	8.93	1.617			
	GROUP 3	30	6.8	2.235			
	Total	90	7.8	2.179			
Me-me'	GROUP 1	30	6.1	1.47	34.811	12.169	<0.001
	GROUP 2	30	7.73	2.016			
	GROUP 3	30	5.7	1.535			
	Total	90	6.51	1.892			

Table 2. Posthoc test

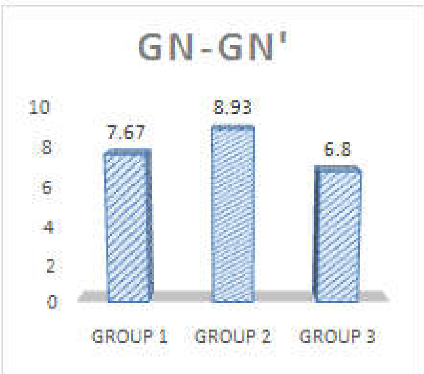
Dependent variable	(I) group	(J) group	Mean Difference (I-J)	Std. Error	P VALUE
Age	GROUP 1	GROUP 2	-1.067	0.935	0.492
		GROUP 3	-2.567*	0.935	0.02
	GROUP 2	GROUP 3	-1.5	0.935	0.25
Mandibular divergence	GROUP 1	GROUP 2	8.033*	0.68	<0.001
		GROUP 3	-7.733*	0.68	<0.001
	GROUP 2	GROUP 3	-15.767*	0.68	<0.001
Pog-pog'	GROUP 1	GROUP 2	-0.533	0.525	0.569
		GROUP 3	1.2	0.525	0.063
	GROUP 2	GROUP 3	1.733*	0.525	0.004
Gn-gn'	GROUP 1	GROUP 2	-1.267*	0.52	0.044
		GROUP 3	0.867	0.52	0.224
	GROUP 2	GROUP 3	2.133*	0.52	<0.001
Me-me'	GROUP 1	GROUP 2	-1.633*	0.437	0.001
		GROUP 3	0.4	0.437	0.632
	GROUP 2	GROUP 3	2.033*	0.437	<0.001



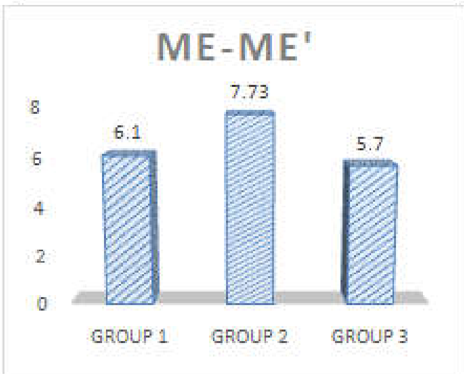
Graph 1: Mandibular divergence angle



Graph 2: Comparison of pogonion



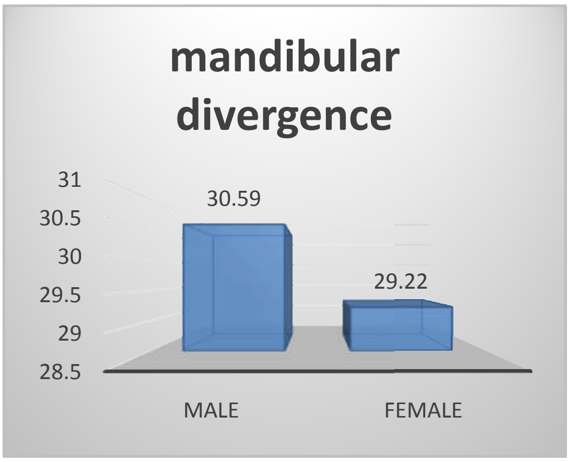
Graph 3: Comparison of gnatthion



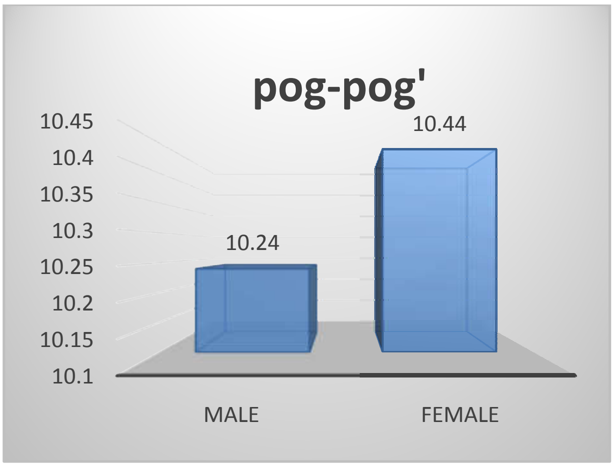
Graph 4: Comparison of menton

Table 3. Comparison of Gender

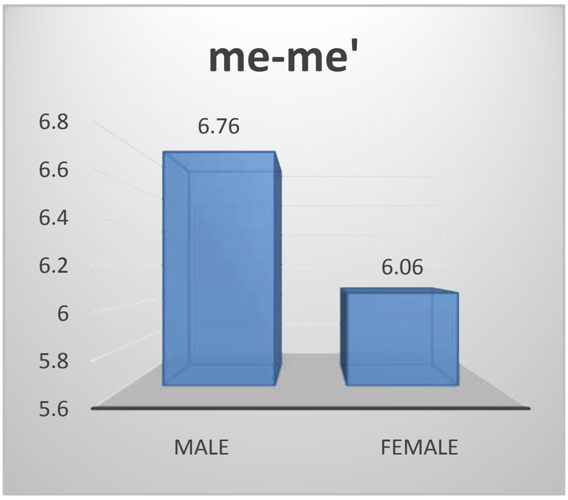
	sex	N	Mean	Std. Deviation	t	df	P VALUE
Age	MALE	58	22.22	4.155	1.734	85.59	0.087
	FEMALE	32	20.97	2.694			
Mandibular divergence	MALE	58	30.59	7.356	0.889	88	0.376
	FEMALE	32	29.22	6.246			
Pog-pog'	MALE	58	10.24	2.394	-0.463	84.531	0.644
	FEMALE	32	10.44	1.605			
Gn-gn'	MALE	58	7.81	2.438	0.067	84.41	0.946
	FEMALE	32	7.78	1.641			
Me-me'	MALE	58	6.76	1.976	1.688	88	0.095



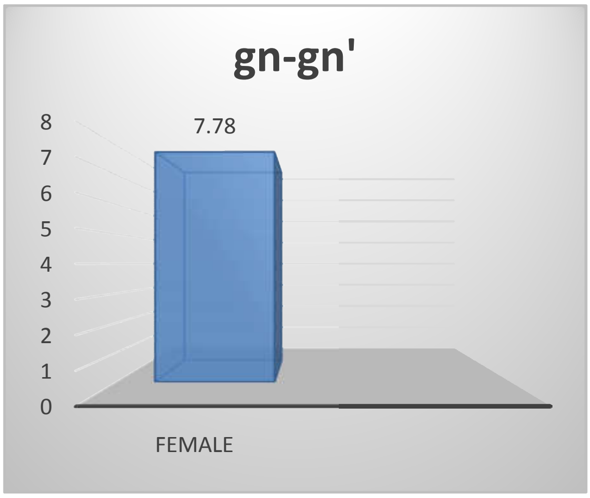
Graph 5: Comparison of Mandibular divergence angle in males and females



Graph 6. Sexual dimorphism of Pogonion



Graph 7. Sexual dimorphism of Menton



Graph 8. Sexual dimorphism of Gnathion

This difference is statistically Significant with a test value of 8.503 and p value of <0.001. Posthoc Tukey's tests comparing GROUP 1(medium angle) and GROUP 2 (low angle) shows a mean difference of -1.267* and is statistically significant with a p value of 0.044. Comparing GROUP 1 (medium angle) and GROUP 3 (high angle) shows a mean difference of 0.867 and is not statistically significant with a p value of 0.224. Comparing GROUP 2 (low angle) and GROUP 3 (high angle) groups shows a mean difference of 2.133* and is statistically significant with a p value of <0.001. Comparison of me-me' between the three groups shows that GROUP 2 (low angle) group has the highest value of 7.73 and GROUP 3 (high angle) has the least value of 5.7. This difference is statistically Significant with a test value of 12.169 and p value of <0.001.Posthoc Tukey's tests comparing GROUP 1 (medium angle) and GROUP 2 (low angle) shows a mean difference of -1.633* and is statistically significant with a p value of 0.001. Comparing GROUP 1 (medium angle) and GROUP 3 (high angle) shows a mean difference of 0.4 and is not statistically significant with a p value of 0.632. Comparing GROUP 2 (low angle) and GROUP 3 (high angle) shows a mean difference of 2.033* and is statistically significant with a p value of <0.001.

Comparison of the age between the two groups shows that age is higher in male group with a t value of 1.734 and is statistically non significant with a p value of 0.087 Comparison of the mandibular divergence between the two groups shows that mandibular divergence is higher in male group with a t value of 0.889 and is statistically non significant with a p value of 0.376. Comparison of the pog-pog' between the two groups shows that pog-pog' is higher in female group with a t value of -0.463 and is statistically non significant with a p value of 0.644. Comparison of the gn-gn' between the two groups shows that gn-gn' is higher in male group with a t value of 0.067 and is statistically non significant with a p value of 0.946 Comparison of the me-me' between the two groups shows that me-me' is higher in male group with a t value of 1.688 and is statistically non significant with a p value of 0.095.

DISCUSSION

According to the findings of the overall soft tissue chin thickness, it is observed that patients with greater mandibular divergence have thinner STC, with statistically significant difference between the low angle and high angle groups (Table 1). Similar results were seen in previous studies conducted by Macari *et al*. (2014), Celikoglu *et al*. (2015) At the level of pogonion, highest thickness was found in low angle and least thickness in high angle group with a statistically significant difference, but there was no significant difference between the medium angle and high angle groups. (Table 2) At gnathion significant difference was found in all groups except medium and high angle cases. Highest thickness was found in low angle and least thickness in high angle group. The same pattern was observed even at menton. (Table 2) These observations indicate that the inferior part of the chin i.e. menton is the most affected by the madibular divergence and pogonion is the least affected. This finding suggests that as the vertical expansion of the skeletal tissues increases, it impinges on the thickness of a soft tissue thereby reducing the thickness of chin at menton and gnathion. (Macari, Hanna, 2014) The uniformity in the thickness of pogonion in all the groups can be contributed to the horizontal or anterior growth of the chin as a process of aging, which causes flattening of the profile with age and also suggests the presence of a differential extension between hard and soft tissues during growth. (Nanda *et al*., 1989; Foley and Duncan, 1997; Jakobsone *et al*., 2013) This ratio of 1:1 displacement of hard tissue to soft tissue has been reported in clinically normal development and after orthognathic surgery of the mandible and chin. (Stephen, 1983; Reddy *et al*., 2011) the same ratio cannot be applied for other treatment modalities. Forsbergand (1981) stated that after activator therapy, there was forward movement of pogonion and subsequent thickening at pogonion whereas no significant changes were stated at gnathion and menton. It was observed that activator therapy caused anterior rotation of the mandible and vertical development of the chin than sagittal correction, which was observed as vertical displacement of soft tissue pogonion. (Ruf *et al*., 2001) Singh *et al* stated that no major changes are seen in soft tissue except in labio-mental groove after the treatment using twin block. (Singh and Clarks, 2003)

Overall soft tissue chin thickness increases after treatment (Jokic *et al*., 2013), greater increase in soft tissue thickness is seen in dolichofacial patterns. (Singh, 1990) Pre surgical soft tissue thickness is a very important factor to be considered during planning of the surgical treatment. The greater the preoperative thickness, the greater the expected change after mandibular setback surgery. (Mobarak *et al*., 2001; Veltkamp *et al*., 2002) A 1:0.90 mean ratio of bone to soft tissue advancement was observed at B point/labiomental sulcus and at pogonion/soft tissue pogonion. Magnitude of advancement, age, and sex of the patient had no effect on these ratios. (Melugin *et al*., 2006) The soft tissue of the chin was found to follow bony movement in a ratio of 0.9:1 during genioplasty. (Shaughnessy *et al*., 2006) Evaluating the effect of gender on STC, it was observed that males had thicker soft tissue when compared to females, as stated in previous studies, although the difference was not statistically significant. This pattern can be attributed to more vertical development of face in males and increased chin prominence. Aging of the male facial profile began 10 years later than for females; however, when the changes did occur, they were of greater magnitude. (Kalha *et al*., 2008; Torlakovic and Faerovig, 2011) Females acquire more growth as percentage of their adult size in all soft tissue variables,except the angle or inclinination of chin, which is more in males. An average change of 2.4mm in males and 1.5 in females at pogonion is seen by the age of 18. (Nanda *et al*., 1989) This observation is contradicted by previous studies, which states no sexual dimorphism in soft tissue thickness. (Hoffelder *et al*., 2007; Jeffrey *et al*., 1990) Aging of the male facial profile began 10 years later than for females; however, when the changes did occur, they were of greater magnitude. (Torlakovic and Faerovig, 2011) The present study was conducted on only south Indian population to avoid any racial or ethnic variations that affect the STC as stated by uysal *et al*. The vertical expansion of the skeletal tissues impinges on the thickness of a soft tissue that no longer displaces in a ratio of 1:1; accordingly, changes expected at Gn and Me during surgery may not be relevant unless related to affecting changes in an increased lower face height. (Macari, Hanna, 2014) Even in the sagittal plane, a similar disproportion might develop at pogonion. Kazutaka stated that a small ANB angle (Class III tendency) is associated with a smaller pogonion thickness. (Kazutaka Kasai, 1998) It is observed that more advancement genioplasty to achieve better chin projection may be needed in patients with severe hyperdivergence because the mandible has grown more vertically at the expense of its anterior projection, this justifies the high rate of genioplasty observed in patients with hyperdivergent or long faces. (Blanchette *et al*., 1996) Earlier Treatment in growing children might be recommended to favour the forward projection of the chin by removing obstacles to more horizontal growth (eg, sustained mouth breathing) and controlling the extrusion of posterior teeth thereby controlling or altering the rotation of mandible.

Conclusion

1. Soft tissue chin thickness was seen to be highest in low angle group or hypodivergent cases, and lower values were seen in hyperdivergent cases.
2. Soft tissue chin thickness was not uniform at all levels of chin, pogonion was least affected by the mandibular divergence.
3. Males had thicker soft tissue than females, but the values were not statistically significant.
4. Soft tissue envelope is seen to follow the growth of hard tissue and adapts accordingly so as to camouflage any discrepancy.

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