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Original Article

Comparative Evaluation of Soft Tissue Chin Thickness in Skeletal Class I and Class II Adults with Three Mandibular Divergence- A Cephalometric Study

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ABSTRACT:
Background: The rationale of conducting this study was that beside skeletal and dental problems, chin thickness is an important factor for making profile more acceptable. According to many studies describe the soft tissue chin thickness of different population in all three mandibular divergence patterns, which will help us in treatment planning and making evidence based decisions in patients with complaints regarding chin and lower jaw prominence**. Material and method:** Lateral cephalogram were obtained from the data of 120 patients who were stratified on the basis of ANB in to skeletal class I (n=60) and skeletal class II (n=60) above the age of 18 years and were divided in to three subgroups based on the cephalometric mandibular plane inclination (MP) to anterior cranial base (SN) as Hypodivergent- ($<28^0$). Normodivergent-(28^0-36^0) and Hyperdivergent -($>36^0$) , soft tissue chin thickness was measured at three points using dolphin imaging system namely soft tissue to hard tissue pogonion (Pog-Pog'), soft tissue to hard tissue Gnathion (Gn-Gn') and soft tissue to hard tissue menton (Me-Me') Collected data was analyzed statistically by using unpaired *t*-test and conclusions were drawn. **Results :** All STC thickness had the highest measurement in class II hypodivergent group as compared to class I and gradually decrease across the groups , lowest being in hyperdivergent group in both males and females. **Conclusion:** The result provide evidence of strong but complex relationship between STC thickness and skeletal class, it varies according to gender, race and growth pattern of individual.
Key words: Soft tissue, mandibular, thickness, chin.

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INTRODUCTION

In 4 BC, the Greek population 1st documented the facial esthetic paragon, Kingsley in 1880 Reviewed the several objectives surrounding the correction of different malocclusion.[1]

Assessment of facial hormony of the patient is an important factor for accurate diagnosis and is essential for deriving an accurate treatment plan.[2]

Angle took the model of Apollo Belvedere as his measure of corporal and facial beauty.[3] He believed that facial equilibrium is directly related to form. Holdaway affirms, "better treatment goals can be set if we quantify the soft tissue features" contributing or diminishing the "physical attractiveness stereotype" considered by the society.[2]

Esthetic improvement continues to be the driving force in majority of the patients

Who desire to obtain the orthodontic treatment, with functional benefit as a consequence.[4] Facial hormony and the drape of the soft tissues determines the facial equilibrium. Recently, the orthodontic field has experienced a paradigm shift to focus more on esthetics, with specific importance to the soft tissues around the mouth.[5] Well balanced facial hormony and functional occlusion are imperative objectives to be considered. for achieving them an understanding of growth of facial skeleton and implications of treatment on facial hormony is essential.[6] For proper surgical planning evaluation of soft tissues is important to the surgeon and orthodontist as well , Genioplasty, an orthognathic surgery in combination with

orthodontic treatment is recommended to restore adequate configuration and projection of the chin in the face, it has been performed to magnify soft tissue contours related to asymmetry between soft and hard tissue.[6]

One of the main objective of orthodontic treatment is to achieve and conserve best possible facial beauty, to attain this its imperative that the orthodontist perform a thorough facial examination.[7]

Two commonly used measurements are SN-MP angle and lower to overall facial height measured anteriorly.

Nowadays in treatment planning of individuals with craniofacial dismorphogenesis the facial appearance outcome is gaining attention.[8]

Such differences between skeletal and soft tissue can effect dissociation between the position of underlying bony structures and facial form to correct that patient possibly will undergo orthognathic and cosmetic surgery.[9]

When measurements of facial features are outside the norms there is often a decrease in facial attractiveness.[10]

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).[11]

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 level of chin.[11]

It is believed by some authors that the symphysis region properties could be good indicator of mandibular rotation , the symphysis is one of the most important region of craniofacial complex for clinical orthodontist, and it serves as primary reference for esthetic consideration in lower one third of the face.[12-13]

However, there is very minimal documentation on comparison of soft tissue characteristics particularly in skeletal class I and skeletal class II patterns , Thus the aim of this research is to relate soft tissue chin thickness in skeletal class I and class II subjects with variable facial divergence which will help the clinician in routine practice.

MATERIAL AND METHODS

This was an observational, in vitro study in which 120 adult male and female patients above the age of 18 years reporting to the department of Orthodontics & Dentofacial Orthopaedics at Dr D Y Patil Dental College & Hospital Pimpri, Pune were screened.

Inclusion Criteria:

1. Participants with Skeletal Class I jaw bases (ANB 1 to 3^0, WITS -1 to $+1^0$)
2. Participants with Skeletal Class II jaw bases (ANB > 3°, WITS: >+1mm)
3. Participants with ages above 18 years.
4. Well defined and identifiable chin structures on radiographs

Exclusion Criteria:

1. Participants with history of previous orthodontic and/or orthognathic intervention.
2. Participants with craniofacial anomalies

Lateral cephalogram of all the participants was taken from the same X-ray machine (PlanmecaProline XC Dimax3) using the standard protocol ,from the Department of Oral Medicine & Radiology, Dr. D. Y. Patil Dental College & Hospital, Pimpri, Pune

FIGURE 1:- Lateral Cephalogram Imaging Equipment

Cephalometric measurements will be calculated by Dolphin imaging system

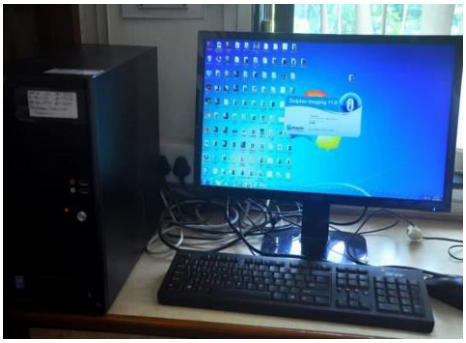


FIGURE 2 : Dolphin Imaging System

The sample was collected from the archives of the department and will have waiver of consent. If the desired sample size is not achieved then lateral cephalograms will be taken from patients reporting to the department and who are ready to participate in the study. Informed consent will be taken from these patients.

Sagittal relationship Between the jaws are assessed by the ANB angle and WITS appraisal.

• Sample is divided in to two basic groups:

Group 1- (n=60) Skeletal Class I - (ANB 1 to 3^0) (WITS -1 to +1)

Group 2- (n=60) Skeletal Class II - (ANB $>3^0$) (WITS >+1mm)

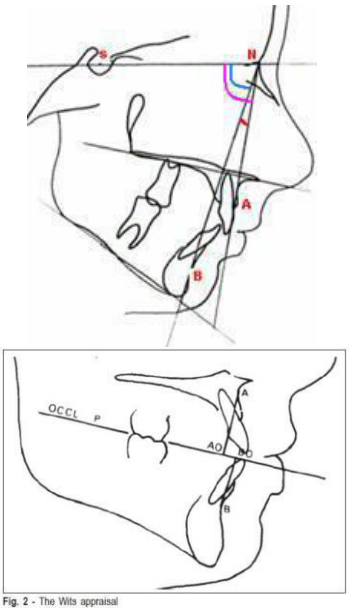


Fig. 2 - The Wits appraisal

FIGURE 3: Steiners Analysis (ANB Angle IMG 4: Wits Appraisal

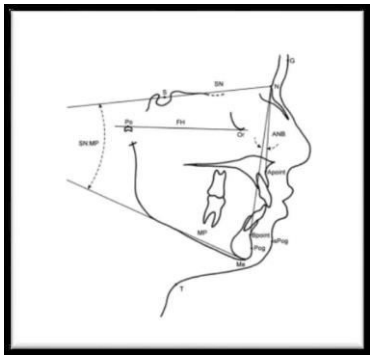


FIGURE 5- SN-MP ANGLE

These two groups were further divided in to three basic groups based on mandibular divergence plane to cranial base angle (SN-MP)

1. Skeletal Class I:
a) LOW (HYPODIVERGENT) (<28^0)
b) MEDIUM (NORMODIVERGENT) (28^0-36^0)
c) HIGH (HYPERDIVERGENT) (>36^0)

2. Skeletal Class II:
a) LOW (HYPODIVERGENT) (<28^0)
b) MEDIUM (NORMODIVERGENT) (28^0-36^0)
c) HIGH (HYPERDIVERGENT) (>36^0)

Soft tissue chin thickness was measured at three different levels:

∟ Pog-Pog'- Length between bony Pogonion (Pog) and its horizontal projection (Pog') over the vertical passing through soft tissue Pogonion.

∟ Gn-Gn'- Distance between bony Gnathion (Gn) and soft tissue Gnathion (Gn').

∟ Me-Me'- Distance between bony Menton (Me) and its vertical projection (Me') on the horizontal passing through soft tissue Menton

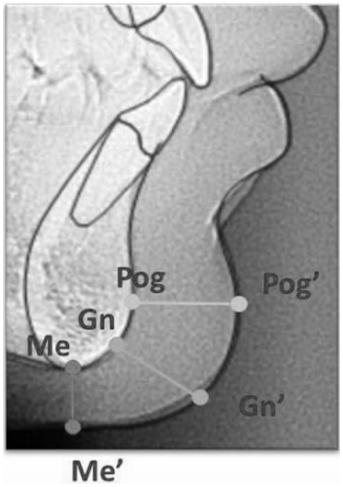


FIGURE 6 - Image depicting the soft tissue measurements

Collected data was analyzed statistically by using unpaired *t*-test and conclusions were drawn

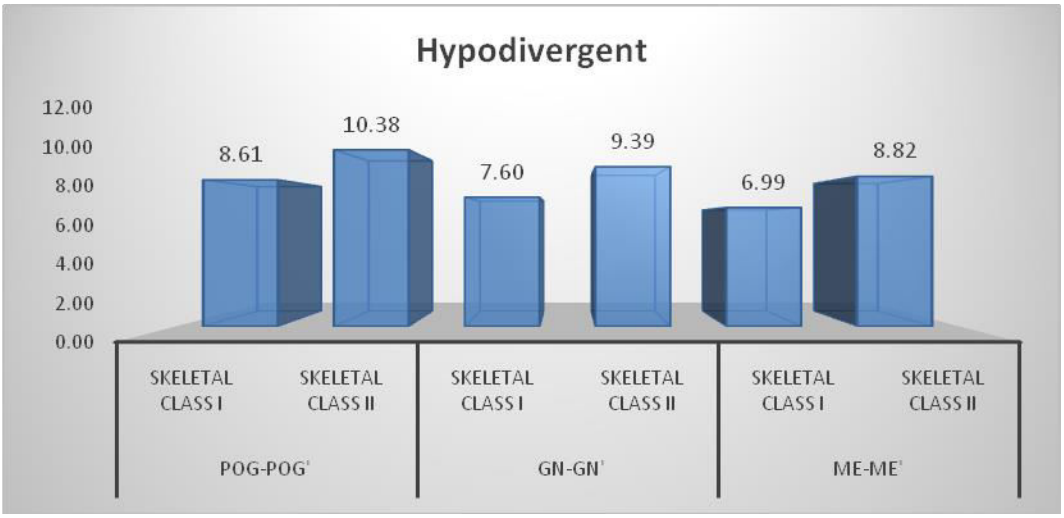
RESULTS

Skeletal Class I & Class II in Hypodivergent pattern

Hypodivergent		N	Mean	SD	SE	t-Value	P-Value	Result
Pog-Pog'	Skeletal Class I	20	8.61	0.71	0.16	-5.135	0.000	HS
	Skeletal Class II	20	10.38	1.37	0.31			
Gn-Gn'	Skeletal Class I	20	7.60	0.90	0.20	-5.193	0.000	HS
	Skeletal Class II	20	9.39	1.25	0.28			
Me-Me'	Skeletal Class I	20	6.99	1.06	0.24	-5.008	0.000	HS
	Skeletal Class II	20	8.82	1.25	0.28			

Table 1- Comparison of soft tissue chin thickness between Skeletal Class I & Class II in Hypodivergent pattern

Since observations are quantitative and sample size is less than 30. We have used unpaired t-test for comparison between two groups. From above table we can observe that P-Values are less than 0.001. We conclude that there is highly significant difference between Skeletal Class I and Skeletal Class II.
Further we can observe that mean values for Skeletal Class II are greater than Skeletal Class I.

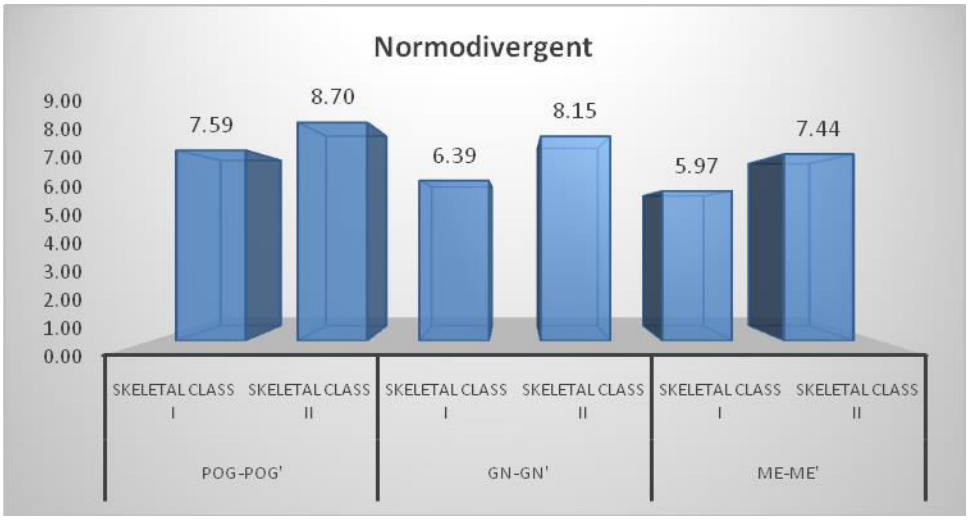


Graph 1- Comparison of soft tissue chin thickness between Skeletal Class I & Class II in Hypodivergent pattern

Normodivergent		N	Mean	SD	SE	t-Value	P-Value	Result
Pog-Pog'	Skeletal Class I	20	7.59	0.61	0.14	-5.868	0.000	HS
	Skeletal Class II	20	8.70	0.59	0.13			
Gn-Gn'	Skeletal Class I	20	6.39	0.77	0.17	-8.660	0.000	HS
	Skeletal Class II	20	8.15	0.48	0.11			
Me-Me'	Skeletal Class I	20	5.97	0.67	0.15	-7.199	0.000	HS
	Skeletal Class II	20	7.44	0.63	0.14			

Table 2 - Comparison of soft tissue chin thickness between Skeletal Class I & Class II in Normodivergent pattern

Since observations are quantitative and sample size is less than 30. We have used unpaired t-test for comparison between two groups. From above table we can observe that P-Values are less than 0.001. We conclude that there is highly significant difference between Skeletal Class I and Skeletal Class II. Further we can observe that mean values for Skeletal Class II are greater than Skeletal Class I.

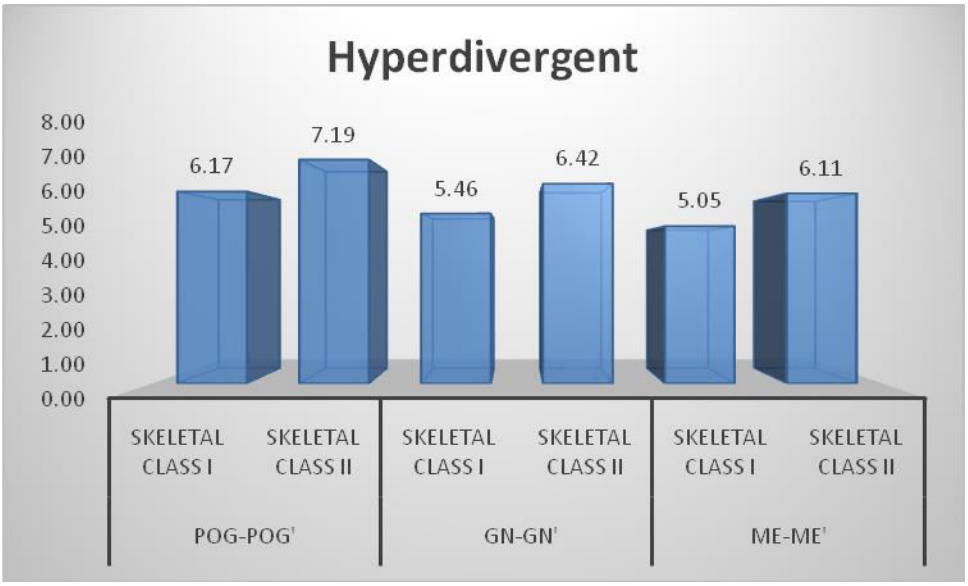


Graph 2 -Comparison of soft tissue chin thickness between Skeletal Class I & Class II in Normodivergent pattern

Hyperdivergent		N	Mean	SD	SE	t-Value	P-Value	Result
Pog-Pog'	Skeletal Class I	20	6.17	0.74	0.17	-4.404	0.000	HS
	Skeletal Class II	20	7.19	0.73	0.16			
Gn-Gn'	Skeletal Class I	20	5.46	0.72	0.16	-4.104	0.000	HS
	Skeletal Class II	20	6.42	0.75	0.17			
Me-Me'	Skeletal Class I	20	5.05	0.79	0.18	-4.307	0.000	HS
	Skeletal Class II	20	6.11	0.76	0.17			

Table 3 - Comparison of soft tissue chin thickness between Skeletal Class I & Class II in Hyperdivergent pattern

Since observations are quantitative and sample size is less than 30. We have used unpaired t-test for comparison between two groups. From above table we can observe that P-Values are less than 0.001. We conclude that there is highly significant difference between Skeletal Class I and Skeletal Class II.
Further we can observe that mean values for Skeletal Class II are greater than Skeletal Class I.



Graph 3 -Comparison of soft tissue chin thickness between Skeletal Class I & Class II in Hyperdivergent

		N	Mean	SD	SE	t-Value	P-Value	Result
Pog-Pog'	Skeletal Class I	20	8.61	0.71	0.16	-5.135	0.000	HS
	Skeletal Class II	20	10.38	1.37	0.31			
Gn-Gn'	Skeletal Class I	20	7.60	0.90	0.20	-5.193	0.000	HS
	Skeletal Class II	20	9.39	1.25	0.28			
Me-Me'	Skeletal Class I	20	6.99	1.06	0.24	-5.008	0.000	HS
	Skeletal Class II	20	8.82	1.25	0.28			

Table 4- Comparison of soft tissue chin thickness of skeletal class I and skeletal class II

Since observations are quantitative and sample size is less than 30. We have used unpaired t-test for comparison between two groups. From above table we can observe that P-Values are less than 0.001. We conclude that there is highly significant difference between Skeletal Class I and Skeletal Class II.
Further we can observe that mean values for Skeletal Class II are greater than Skeletal Class I.

DISCUSSION-

The soft tissue thickness of every patient is an important factor to consider during Orthodontic assessment. Many a times, severe skeletal discrepancy is masked by favourable soft tissue. Nature has a tendency of compensation, be it hard tissues for the soft tissues or vice versa. The patient must always be placed in relaxed state, when viewing the contour of the face as suggested by Arnett and Gunson.[7] during this procedure they advised patients lip to be in

relaxed state as it determines dentoskeletal deformities without any compensatory effects created by muscles.

The important finding of this research was analysis of relationship of the mandible in vertical plane and width of the soft tissues of the chin using lateral cephalogram where in measurements were carried out by means of dolphin imaging system.

Sample of 120 patients above the age of 18 years was chosen as in that age growth of the facial skeleton and soft tissue is seen to be complete.[14,25,33]

Witts appraisal[32] and ANB angle [23,25,34] was utilized for determining the sagittal relationship of upper and lower jaws.

More or less convex profiles of the patient is because of the thickness of their soft tissues rather than actual hard tissues (Scheideman GB, Am J Orthod. 1980)[22]

The reason for evaluating soft tissue chin thickness from (BonyPogonion to soft tissue pogonion, bony Gnathion to soft tissue gnathion and bony Menton to soft tissue menton) was beacause Soft tissue chin thickness is not uniform across different parts which is verified in our study.

Subtelny stated that contours of soft tissues does not give an idea of the skeletal configuration below, in some areas soft tissue contour diverges fromthe underlying skeletal structure while other shows strong tendency to follow the skeletal change. In our study there is significant difference in STC thickness between various mandibular divergence ,hypodivergent cases have increase STC thickness as compared to normodivergent and hyperdivergent cases due to adaptation of soft tissue , this indicates that there exist growth differential in thickness of soft tissue covering the underlying hard tissue .[14]

In the study conducted by Subramaniam S et al 2016 they found that there is no significant difference found between STC between hyper and normodivergent individuals which differes from the result of our study and study conducted by Macari and Hanna. Which shows there is significant difference found between normodivergent and hyperdivergent pattern.[35]

In our study the STC thickness is skeletal class I is less than STC thicknss in skeletal class II these outcomes correspond to other studies.[25,34] However it is contradictory to the studies by Ksai et al where he found the difference is not stastistically significant.[23]

Variation in the thickness of soft tissues seen in the divergence patterns of the mandible[31] which was in accordance with the studies by Macari and Hanna in 2014.[6]So, lesser the STC thickness greater the svererity of divergent pattern at all dimensions.

In our study at the level of pogonion highest thickness was found in low angle and least thickness was found in high angle cases with statistically significant difference which coincide with (Macari et al 2014, Celikoglu et al . 2015)[6,18] study

But at both pogonion and gnathion, no statistical difference found among medium angle and high angle group which differ from our study. Same pattern observed even at menton.

These observation indicate that inferior most part of the symphysisi.ementon mostly affected by the mandibular divergent pattern and least affected point on chin is pogonion this suggest that the vertical extension of skeletal tissue rises , it encroaches on thickness of soft tissue which reduces the chin thickness at gnathion and menton (Macari and Hanna 2014)[6]

In cases with skeletal class II jaw bases with hyperdivergent growth pattern, orthognathic surgery along with advancement genioplasty is indicated toimprove the facial profile and result are also found to be stable for long term (choe KS Facial plastsurg 2000)[30]

Nevertheless, low angle subjects require reduction or advancement genioplasty for improved facial hormony. It is also related to anteroposterior discrepancies.

Soft tissue pogonion was affected by the skeletal pogonion.[17,31]

Hambleton and Hillesund et al proved that thickness of soft tissues are closely associated to degree of prognathism of symphysis& more retruded chin symphysis, the less soft tissue chin thickness[20,21]

(Singh 1990) During planning of the surgical treatment pre surgical soft tissue thickness is very important factor which should be considered, the greater the preoperative thickness larger the predictable change later the mandibular setback surgery.[15]

(Mobarak et al ,2001 ; Veltkamp et al 2002)[29,38]Stated that 1:0:90 proportion of skeletal to soft tissue progression detected at point B & soft tissue pogonion. extent of advancement, sex, age of a patient had no effect on these ratios.

(Melugin et al 2006)[27] the soft tissue of the chin was found to follow boney structure in ratio of 0.9:1 during genioplasty

Evaluating the effect of gender on STC it was observed that male had thicker soft tissue than females which coincide with our study although the difference was not statistically significant (Shaughnessy et al 2006)[16]

Generally, female skin is deficient of collage and accelerates in production of hyaluronic acid due to estrogen. In contrary male show thick skin since testosterone helps in collagen production.[19]

Females acquire added growth as ratio of their adult size in all soft tissue variables except at the angle of inclination of chin which is more in males.

An average change of 2.4 mm in males and 1.5mm in females at pogonion is seen at the age of 18 (Nanda et al 1989)[26] this observation is contraindicated by (Hoffelder et al 2007, Jeffrey et al 1990)[17,26] which states no sexual dimorphism in soft tissue thickness

Comparison of results of our study with that of other authors is restricted due to the lack of the literature on the same.

CONCLUSION

The result provide evidence of strong but complex relationship between STC thickness and skeletal class, it varies according to gender, race and growth pattern of individual.

1 Soft tissue chin thickness was seen to be highest in hypodivergent group and lowest in hyperdivergent group

2 Soft tissue chin thickness is greater in skeletal class II as compared to skeletal class I

3 Soft tissue chin thickness was not uniform at all levels of chin, pogonion was least affected by the mandibular divergence

4 Soft tissue envelope is seen to follow the growth of hard tissue and adapts accordingly so as to camouflage any discrepancy

5 Differences in soft tissue thicknesses should be kept in mind while planning orthodontic treatment , in some clinical situations soft tissue compensation can help to convert a surgical situation to a well camouflaged orthodontic result making treatment more predictable and stable.

These results could form the basis and provide guidance for the subsequent shape and behavior of soft tissue chin thickness at different points and further research can be done using three dimensional imaging

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