ORIGINAL ARTICLE

COMPARISON OF SOFT TISSUE CHIN AND LOWER LIP THICKNESS IN ADULT PATIENTS WITH VARIOUS MANDIBULAR DIVERGENCE PATTERNS

Ambar Farooq[1], Maimoona Afsar[1], Verda Ahmad Khan[1], Adil Shahnawaz[2], Sardar Danial Hafeez[1], Samia Shad[3], Fatima Afsar[4]

Orthodontics Department, [2]Operative Department, [3]Oral and Maxillofacial Surgery Department, Abbottabad International Dental College, Abbottabad-Pakistan, [4]National University of Modern Languages, Islamabad-Pakistan

Background: The influence of hard tissue discrepancies on soft tissue cannot be ignored. The divergence or angle of the mandible can influence the lower lip and chin (soft tissue), similar to the influence of incisors inclinations on the pro/ retrusion of the lips. Hence this study was carried out to find out the impact of mandibular divergence patterns on the contour and thickness of lower facial soft tissues. **Methods:** Using the Lateral cephalograms of 105 subjects, Lip thickness was measured between the protruding endpoint of the maxillary incisors (U1) to the stomion point (St) and between the infra dentale (Id) and labrale inferius (Li). Soft tissue chin thickness was measured between the landmarks at hard tissue bony pogonion (Pog) to its opposite point on soft tissue (Pog'), hard tissue gnathion (Gn) to soft tissue gnathion (Gn') and hard tissue menton (Me) to its opposite point on ST menton (Me'). **Results:** Lower lip thickness from Id-Li (infradentale-labrale inferius) was greater in subjects with mandibular hyperdivergent pattern (*p*-value 0.097) while soft tissue chin thickness was decreased in hyperdivergent and increased in individuals with mandibular hypodivergence in both genders (p-value at gnathion was 0.596, menton was 0.023, and pogonion was 0.004, respectively). **Conclusion:** Lower lip thickness was increased in the individuals with mandibular hyperdivergence measured from infradentale to labrale inferius. While increased soft tissue thickness was observed at points gnathion and menton in patients with mandibular hypodivergence with no obvious difference at pogonion point.

Keywords: Facial Soft tissues; High mandibular divergence; Lower facial height; Lip chin thickness

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INTRODUCTION

Orthodontists interest in creating ideal hard tissue relationships have significantly shifted to soft tissue profile aesthetics as the main objective of the treatment as orthodontists have observed soft tissues greatly influencing the overall appearance of the face.[1,2] Hard tissue was considered as the only interest of study in the assessment and treatment planning in orthodontics previously,[3] but on observing the great impact on aesthetics, the soft tissue paradigm is emerging as an important aid in diagnosis and treatment planning. The importance of the appearance of facial soft tissues in society has laid major emphasis on studying the pattern of adaptability and contour of facial soft tissues in relation to hard tissues.[3] In this manner the adaptability and contour of the facial soft tissues to that of the facial hard tissue limits the extent of movement and manipulation of dental or facial hard tissues.[4]

Facial soft tissue contour has to be studied properly and soft tissue assessment in relation to various skeletal forms must be carried out in patients with underlying skeletal or hard tissue discrepancy, which will aid in the diagnosis and treatment planning of the patients.[4,5]

The facial skeletal profile is classified into long faced and short faced according to vertical discrepancies,[5] and into class I, class II, and class III according to horizontal discrepancies.[6] Patients with these profiles exhibit specific extraoral and intraoral features. Increased lower facial height, dolichocephalic head form, leptoprosopic facial form, narrow alar base, retrognathic mandible, incompetent lips with mentalis strain, orthognathic or prognathic maxilla, shallow mento labial sulcus and flattened or recessive chin being the main characteristics of long faces individuals,[7] while patients who are short faced exhibit lower anterior facial height, obtuse nasolabial angle, acute mento labial sulcus, retrognathic mandible and adequate or excessive soft tissue chin.[8] Rasool *et al* from Khyber College of dentistry Peshawar Pakistan carried out a similar study and they inferred that soft tissue chin thickness was

greatest in patients with hypo divergent profile irrespective of gender.[9] Rasool and Alam carried out another study where they compared the lip thickness among different skeletal malocclusion classes. In this study, the patients were classified into three classes; class I, II and III based on the ANB angle and Witz analysis. He measured the distance between: 1) point A and sub nasale, 2) prosthion and labrale superius, 3) infradentale and vermillion border of the lower lip, 4) point B and deepest point of labiomental crease. He came out with the results that soft tissue thickness at points stomion, bottom lip and pogonion was different among the three classes.[10] In the study on FST (facial soft tissue) thickness among various vertical facial patterns in adult Pakistani subjects, by Waqar Jeelani *et al*, it was concluded that FST thickness at stomion, pogonion, gnathion and menton was greater in short facial patterns in both the genders.[11]

Surani and Bhat in 2019 studied the effect of mandibular divergence patterns on soft tissue chin and soft tissue nose thickness and through their study, they came to the conclusion that STN (soft tissue nose) and STC (soft tissue chin) thickness is reduced in individuals with vertical growth pattern.[12] Thus, proving the fact that facial soft tissue contour and thickness is highly dependent upon the growth pattern of facial hard tissue. Celikoglu *et al* also reported that soft tissue thickness at labrale superius and labrale inferius and pogonion were lesser in subjects with vertical growth patterns.[13]

"The hyper divergence of mandible results in decreased soft tissue chin thickness" as stated by Macari *et al*.[14] Macari *et al* evaluated the association between mandibular divergence and STC and the difference in the soft tissue of male and female adults by taking a lateral cephalometric radiograph of white adults. They concluded that the thickness of ST (soft tissue) is decreased in hyperdivergent individuals. A similar study was conducted by Perovic´ in 2021, in which he evaluated the influence of mandibular divergence on FST thickness in class I individuals. His study concluded that facial soft tissue thickness depended majorly on hard tissue divergence patterns.[15]

This study was conducted with the aim of finding the significant association of varying mandibular divergent patterns with the lower lip and soft tissue chin thickness in the population of Pakistan. This will help orthodontists in proper and more accurate treatment planning in future, more importantly when planning genioplasty, as the significant correlation of soft tissue thickness with different bone growth patterns will have a great impact on considering the soft tissue aesthetics in future orthodontic treatment planning.

MATERIAL AND METHODS

This Cross-sectional study was conducted at Abbottabad International Medical and Dental Institute using lateral cephalograms. The sample size was calculated using the online sample size calculator. The confidence level was kept at 95%, and population size and population proportion parameters were added.[9] The calculated sample size was 105. Non-probability convenient sampling was carried out. The cephalograms were taken from the hospital archives. Patients who reported in the past 5 years and fulfilled the inclusion criteria were part of the study. Consent from the patients and approval from the Institutional review board was obtained. Patients aged 16 years and above were included in the study. Lateral cephalograms of all the selected subjects were obtained in the natural head position. The cephalograms were traced and measurements were done by a single operator to avoid any bias in readings.

The following cephalometric landmarks and planes were traced and marked. Pogonion (Pog), gnathion (Gn) and menton (Me) (on both hard and soft tissues), laberale inferius, gonion (Go), anterior nasal spine (ANS) and posterior nasal spine (PNS). A line between the Anterior nasal spine and posterior nasal spine represented the maxillary plane and from menton to gonion represented the mandibular plane. The patients were divided into three groups with 35 subjects each, separated on the basis of mandibular divergence pattern: Group A (normodivergent), Group B (hypodivergent) and Group C (hyperdivergent). Mandibular divergence was calculated by measuring the maxillary mandibular plane angle (MMPA) with a mean value of 27±4˚. Individuals who had MMPA values between 24–31˚ were categorized as normodivergent, those with MMPA values equal to or less than 23˚ were categorized as hypodivergent and the individuals who had MMPA values equal to or greater than 32˚ were added in the category of hyperdivergent patients.

The readings were re-evaluated by the fellow orthodontist and then measurements of Pog-Pog' (distance between bony pogonion to soft tissue pogonion), Gn-Gn' (distance between bony gnathion to soft tissue gnathion), Me-Me' (distance between bony menton and soft tissue menton) were taken using vernier scale having 0.01mm of accuracy. For the evaluation of lower lip thickness, the distance between U1 to stomion and the distance between infradentale to labrale inferius was measured.

The collected data was analysed using SPSS software Version 21. To check the even distribution of data Skewness and Kurtosis was checked. One-way ANOVA test was applied to compare the three groups. An Independent t-test was applied to compare the genders. The power of the test was kept at 80%. *p*-value of <0.05 was considered significant.

RESULTS

The sample size of 105 subjects included 51 male and 54 female patients (Table-1). Table-2 shows that skewness and kurtosis are in the range of normality and the data is evenly distributed. Descriptive statistical analysis including the correlation of age, gender and profile were carried out (Table-1). A statistically significant difference at Gn-Gn' p-value 0.009 for males (Table-3) and at Me-Me' *p*-value 0.021 for females (Table-4) was obtained amongst the genders. One-way ANOVA results are depicted in Table-5, showing statistically significant difference for Gn-Gn' *p*-value 0.004.

Table-1: Gender Frequency

Profile	Gender			
	Male		Female	
	N	%	N	%
Normodivergent	12	23.5	23	42.6
Hypodivergent	19	37.3	16	29.6
Hyperdivergent	20	39.2	15	27.8
Total	51	100	54	100

Table-2: Normality test

	N	Skewness	Kurtosis
	Statistic	Statistic	Statistic
Age	105	.967	.415
Gender	105	.058	-2.036
Profile	105	.000	-1.515
Lip_thickness_UI	105	.085	.781
Lip_thickness_Id	105	-.022	-.395
ST_chin_pog	105	1.228	2.196
ST_chin_gn	105	.713	.341
St_chin_me	105	.697	-.002
Valid N (listwise)	105		

Table-3: Comparison of soft tissue thickness in males

	U1-St Mean (S.D)	Id-Li Mean (S.D)	Pog-Pog' Mean (S.D)	Gn-Gn' Mean (S.D)	Me-Me' Mean (S.D)
Normodivergent	2.000 (3.548)	16.282 (4.225)	11.173 (1.519)	8.500 (1.864)	7.587 (2.180)
Hypodivergent	3.625 (3.437)	15.656 (2.461)	11.531 (1.802)	9.593 (2.444)	8.313 (3.239)
Hyperdivergent	3.000 (2.035)	17.600 (1.005)	10.933 (0.961)	8.866 (2.325)	10.200 (3.075)
***p*-value**	0.118	0.666	0.959	0.009	0.328

Table-4: Comparison of soft tissue thickness in females

	U1-St Mean (S.D)	Id-Li Mean (S.D)	Pog-Pog' Mean (S.D)	Gn-Gn' Mean (S.D)	Me-Me' Mean (S.D)
Normodivergent	6.083 (4.225)	18.416 (2.960)	12.291 (2.388)	8.8750 (2.111)	8.291 (1.802)
Hypodivergent	5.947 (3.651)	19.447 (4.013)	12.578 (2.416)	10.763 (2.973)	9.657 (2.141)
Hyperdivergent	4.000 (2.152)	19.500 (3.379)	12.500 (3.120)	8.200 (2.330)	9.050 (3.012)
***p*-value**	0.281	0.059	0.531	0.310	0.021

Table-5: One-way ANOVA Test

		Mean Square	Sig.
Lip_thickness_UI	Between Groups	23.124	.151
	Within Groups	11.995	
	Total		
Lip_thickness_Id	Between Groups	24.660	.097
	Within Groups	10.352	
	Total		
ST_chin_pog	Between Groups	2.579	.596
	Within Groups	4.958	
	Total		
ST_chin_gn	Between Groups	32.771	.004
	Within Groups	5.589	
	Total		
St_chin_me	Between Groups	27.202	.023
	Within Groups	6.954	
	Total		

DISCUSSION

Significant correlation of soft tissue thickness with that of differing patterns of hard tissue has diverted the attention of orthodontists towards the balancing factors in soft tissue thickness. Previous studies have suggested a positive correlation between the mandibular divergence and the thickness of lower lip and soft tissue chin.[14–19] Reports have suggested a decrease in thickness when the mandible is hyperdivergent and vice versa. This study was set to establish results based on a different population group.[9,11]

The analysis of this study revealed that the upper and lower lip thickness did not change significantly in males among normo, hypo, and hyperdivergent patterns respectively. The upper and lower lip thickness did vary largely among females in the normo, hypo, and hyper divergent patterns. The difference although was not enough to generate a statistical significance. The thickness between Pog-Pog' remained almost constant between the three divergence patterns in both males and females with the thickness slightly higher in females than males but not significantly. Gn-Gn' distance varied among males and females with the values showing significant change in males. The distance increased in the hypo divergent pattern and decreased in the hyper divergent pattern. There was not much difference in values of Gn-Gn' between hyper and normo divergent pattern in males. Me-Me' distance showed significant difference, with an increase in hypo divergence in females and a decrease in hyper divergence. The value further decreased in normo divergent pattern as well. The value remained insignificant in males, but a noticeable increased in the average value can be seen in the hyper divergence pattern while the normo divergent and hypo divergent patterns showed a decreased but relatively same average values. These results are in conformity with the results of similar studies where an increase with hypo divergence is reported. Rasool *et al* carried out a study which reported that the soft tissue chin thickness was greatest in patients with hypodivergent profile irrespective of the gender.[9] Jellani *et al* also conducted a study on the Pakistani population and concluded that facial soft tissue thickness at stomion, pogonion, gnathion and menton was greater in short facial patterns in both the genders.[11] The results of our study also presented similar answers, where the soft tissue thickness increased in hypodivergent patients and decreased with the hyper divergence of the mandible.

In soft tissue analysis of chin, upper lip length and lip thickness in patients with different mandibular divergence patterns studied by Ashraf *et al*, it was observed that soft tissue thickness was least at the point of menton among gnathion, pogonion and menton in hyperdivergent subjects, however upper lip length was not significantly different among hyper and hypodivergent groups but in certain individuals with hypodivergent profiles the upper lip length was short and upper lip thickness was greater making the possibility of argument that lips closure in short face individuals decreases the length of the lip but gathering of the soft tissue makes the thickness greater.[16] Our study, was carried out on a different population group where upper and lower lip thickness remained relatively the same among the different divergence patterns. The values of Me and Gn did vary and showed significant results.

In 2017 a study carried out in Karnataka compared the thickness of STC with various divergence patterns in Kodova population. Their study concluded that STC thickness was decreased in hyperdivergent patients regardless of the gender. In individuals who does not exhibit hyperdivergence, men have greater STC thickness than women.[17] Reporting on the soft tissue prominence in various mandibular divergence patterns in Tamil Nadu population, by Subramanium *et al* it was observed that the difference of STC thickness was highly significant in patients with hyperdivergent profile and STC thickness differs on the most part in the region of Gn.[18] The results of soft tissue thickness among individuals with different divergent patterns in our study supported the results of the above mentioned studies. The correlation among these two population types is important as they belong to a largely similar region. Our results were different in one aspect, as increased thickness of soft tissues was not seen in males as compared to females.

Maria *et al* reported similar correlation between facial soft tissue thickness and different vertical patterns of face. Statistically significant values were obtained for stomion, labiomentale and pogonion and between the length of mandible, ramus length and soft tissues of face, moderate to high correlations were reported. This study suggested the correlations between hard tissue pattern and thickness of facial soft tissues.[19] This correlation of soft tissue thickness and divergence patterns exhibited in the population group of the above-mentioned study is supported by the results of our study as well which suggests that the changing divergence patterns of the mandible also has an effect on the thickness of soft tissue most importantly in the chin area at gnathion and menton landmarks. Several other studies[16–19] have verified the correlation between different growth patterns of bone with soft tissue thickness. The results of our study analysis are also in conformity with previous studies[9,11,16–19] supporting the

hypothesis that increasing mandibular divergence decreases the soft tissue thickness on certain landmarks.

The results of this study along with other similar studies carried out on Pakistani population can help better understand the soft tissue role in facial profiles and can help with patients who are candidates for surgical orthodontics. Since sample was chosen from the hospital archives, the possibility of including the entire Pakistani population is limited. Envoirmental and geographical changes do affect the facial patterns. Concluding that these results can be used for the entire Pakistani population might not be correct and similar studies including population from other areas and provinces should be carried out.

CONCLUSION

No significant correlation was seen among the values of lip thickness with increasing mandibular divergence. Soft tissue chin thickness decreased in hyperdivergent mandibular pattern and increased with mandibular hypo divergence. While no difference in soft tissue chin thickness was seen at the reference point of pogonion (pog-pog'), a significant difference at the level of gnathion (Gn-Gn') and menton (Me-Me') for males and females was observed. Studies including a wider population group should be carried out to better understand the soft tissue profile and changes amongst the Pakistani population.

AUTHORS' CONTRIBUTION

AF: Conception of study, Design, critical analysis. MA: Literature Search, Data Collection. VAK: Literature Search, Write-up, proof reading. SDH: Literature search. SS: Proof reading, critical analysis. AS: Proof reading, critical analysis.

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Address for Correspondence:

Dr. Syed Majid Hussain Shah, Assistant Professor Oral and Maxillofacial Surgery Department, Abbottabad International Dental College, Abbottabad-Pakistan

Cell: +92 334 895 3009

Email: syedmajidshah@gmail.com