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Comparisons of soft tissue chin thickness in adult patients with various mandibular divergence patterns

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Abstract

Introduction: Soft tissues define the limits of orthodontic treatment and are the main determinant of objectivity in treatment planning and diagnosis according to the soft tissue paradigm. Hence the objective of this study was to determine soft chin thickness in a sample of Peshawar population in different mandibular divergence patterns.

Material and Methods: A total of 95 pre-treatment lateral cephalograms of adult patients (39 males and 56 females) were included in this study. The soft tissue chin thickness was measured at anatomical land marks including; bony pogonion (Pog) and its horizontal projection (Pog') over the vertical passing through soft tissue pogonion (pog'), distance between bony gnathion (Gn) and soft tissue gnathion (Gn') and distance between bony menton (Me) and its vertical projection (Me') on the horizontal passing through soft tissue menton.

Results: Age was not statistically significantly different between males or females across the four groups or between men and women within each of the four groups. All soft tissue chin (STC) thicknesses had the highest measurements in the hypodivergent group (L) and gradually decreased across the groups the lowest being in the hyperdivergent group (H). Statistically significant differences were found only for Gn-Gn' across groups, i.e. in men between low and high angle (P =0.022) and medium-low and high (P =0.039); in women between low and high (P = 0.036).

Conclusions: Soft tissue thickness measurements were lesser in patients with hyper-divergent vertical patterns when compared with patients with clinically normal and hypo-divergent vertical skeletal patterns. All STC measurements were greater in men than in women. STC thickness in hyperdivergent pattern should be considered differently at its most anterior point (Pog) relative to its inferior landmarks (Gn and Me).

Keywords: Chin thickness, mandibular divergence, soft tissue pogonion

Introduction

OOrthodontic diagnosis and treatment planning in growing and adult patients are affected by vertical dimension. On the basis of vertical pattern; patients can be categorized into hypodivergent, normodivergent and hyperdivergent. To determine the vertical facial type in relation to underlying skeletal features, two commonly used measurements are; mandibular plane inclination to anterior cranial base or to maxilla and percentage of lower anterior to total anterior face height.[1]

Evaluation of the soft tissues of face play a significant role in diagnosis and treatment of orthopedic and orthodontic cases.[2] Although both hard and soft tissues influence facial harmony and balance but mainly the visual impact of the face is provided by the structures of overlying soft tissues and their relative proportions. Nowadays in treatment planning of individuals with craniofacial dysmorphogenesis, the facial appearance outcome is gaining attention.[3] Facial

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appearance is considered as a basic factor for communication and interaction with the society and environment.[4] An important aspect of facial appearance is facial symmetry, which is determined by both hard and soft tissues. Although hard tissue structures are reflected by overlying soft tissue structures, but it may not be fully expressed by the soft tissues because of variation in muscle tone as well as variation in thickness. The soft tissues may mask the underlying skeletal facial asymmetry.

The consideration of aesthetic factors and prediction of facial profile according to soft tissues have a significant role in planning orthognathic treatment.[6] Variations between skeletal and soft tissues can cause a disassociation between facial appearance and position of underlying bony structures that might shift treatment anywhere in the range of orthognathic or cosmetic surgery.[1] It is recommended that analysis of facial soft tissues should be seriously considered for correct analysis of underlying skeletal discrepancy because of individual differences in soft tissue thickness.[7]

The important variables considered in ideal chin profile are chin projection, thickness of chin pad, depth of labiomental fold and lower lip position. The shape, position and thickness of soft tissues in chin region can be altered by osseous movement through surgical intervention known as genioplasty.[8] For different ethnic groups, different soft tissues cephalometric standards have been developed. Different racial groups have their own characteristics and should be diagnosed and treated accordingly.[9] Feres et al[10] compared the soft tissue morphology of individuals according to their facial patterns using cephalograms of 90 patients of both genders, aged 12 to 16 years, which were divided into three distinct groups, according to their morphological patterns, i.e., mesofacial, dolichofacial and brachyfacial. Soft tissue chin showed no differences amongst the morphological groups. Macari et al[1] evaluated the association between soft tissue at the chin (STC) and mandibular divergence group in Lebanese population. The soft tissue thickness values were greater in men than women.

The rationale of conducting this study was that beside skeletal and dental problems, chin thickness is also an important factor in making the profile more acceptable. This study will provide us soft chin thickness of our local 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 or lower jaw prominence.

Material and Methods

This study was conducted on a total of 95 subjects, visiting the department of Orthodontics, Khyber College of Dentistry, amongst which 39 were males and 56 were females having age range of 18-53 years (mean age 27.84). After getting informed consent from patients, lateral cephalogram was obtained (Kodac 900C). All patients were oriented in natural head position with unstained lips and teeth in centric occlusion while the cephalogram was taken.

Acetate tracing sheet was used to draw the cephalograms of all patients. Gonion (Go) to Menton (Me) line defined the mandibular plane whereas Sella (S) to Nasion (N) plane defined the anterior cranial base. The angle Go-Me/S-N was used to define the mandibular divergence pattern. The soft tissue chin thickness was measured at; 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′) and Me-Me′ distance between bony menton (Me) and its vertical projection (Me′) on the horizontal passing through soft tissue menton. Measurements for chins thickness were taken with the help of vernier calipers having accuracy of 0.01 mm. All cephalometric

radiographs were traced by single operator to avoid intra observer variability and were sent for statistical computation and reviewed by other orthodontic colleagues to avoid bias in the calculations. Data was collected on proforma and were analyzed on SPSS 20.0. Mean and standard deviations were calculated for numerical variables like age, gender and various soft tissue thicknesses. The same were tested for gender differences. Comparison of STC among different vertical pattern was made using ANNOVA test. Statistical significance was set at P<0.05. SPSS (version 20.0) was used for

Table I: Vertical Distribution of Sample

Vertical cephalometric values	N	%	P-value*
Low angle MP/SN ≤ 27^0	24	25	NS
Medium-low angle MP/SN=27^0	30	31	
Medium-high angle MP/SN=32^0	19	20	
High angle MP/SN<37^0	22	23	
Total	95	100	

*Chi-square test

Table II: Distribution of Vertical pattern

Gender	Male	Female
Low angle	10	14
Medium-low angle	13	16
Medium-high angle	8	11
High angle	8	15
Total	39	56
P-value	Ns	

Table III: Comparison of soft tissue chin thickness in males

Vertical Groups	Male (n=39)		Pog-Pog′	Gn-Gn′	Me-Me
	Low angle (n= 10)	Mean (SD)	14.40 (4.42)	10.50 (2.11)	7.45 (1.60)
	Medium-low angle (n=13)	Mean (SD)	12.40 (2.51)	10.92 (2.01)	8.10 (1.10)
	Medium-high angle = 8	Mean (SD)	12.75 (2.10)	10.50 (2.50)	8.75 (1.60)
	High angle =8	Mean (SD)	11.20(2.10)	9.10 (2.10)	7.65 (1.95)
	P –value*		NS	0.019	NS

Table IV: Comparison of soft tissue chin thickness in females

	Female (n=56)	Pog-Pog′	Gn-Gn′	Me-Me
Low angle =14	Mean (SD)	11.25 (1.75)	9.25 (1.85)	5.85 (1.10)
Medium-low angle = 16	Mean (SD)	11.25 (2.15)	9.25 (1.15)	7.15 (1.22)
Medium-high angle = 11	Mean (SD)	10.95 (1.90)	8.65 (1.45)	7.95 (1.20)
High angle = 15	Mean (SD)	9.90 (1.35)	8.10 (1.32)	7.10 (2.10)
P-value		NS	0.037	NS

*ANOVA

*P<0.05 considered significant

Results

The intra-class correlation coefficients for the intra examiner repeated measurements were high for all measurements (r=0.993). Age was not statistically significantly different for males or females across the four groups nor between men and women within each of the four groups. The age, gender and vertical measurements for the groups were ascertained and correlated (Table I & II).

All STC thicknesses had the highest measurements in the hypodivergent group (L) and gradually decreased across the groups, the lowest being in the hyperdivergent group (H). Statistically significant differences for Gn-Gn′ was found across groups in men between low and high vertical patterns (P =0.022) and also between medium-low and high vertical pattern patients (P =0.039). The same was also ascertained in women and comparison was made between low and high vertical patterns which had statistical significant result (P = 0.036), (Table III & IV). All soft tissue measurements within each divergence group between men and women were statistically significantly different (P =0.001–0.03) except for group having high vertical skeletal pattern.

Discussion

The aim of this study was to find the association between mandibular vertical divergence patterns and STC thickness. Patients with greater MP/SN angle had thinner STC on all of the measured anatomical measurements on the chin except Pog–pog'. The increase in vertical pattern of skeletal tissues had a correlation with soft tissue thickness. This correlation did not exceed in a corresponding ratio of 1:1. This ratio has been stated in clinically normal growth and after orthognathic surgery of the mandible and chin.[11,12] The results show that ST thickness was significantly different at Gn and Me but not significantly different at Pog suggesting the existence of a differential extension between hard and soft tissues during growth.

Similar observations have been reported in studies of the effect of nasal obstruction on facial development, the long face syndrome being the most severe expression of such an insult.[13,14] The findings are further interpreted in the context of gender differences, growth, clinical implications and research issues. Except for gender differences in group H, like other studies,[15,16] present study found thicker soft tissues in all aspects of the face in men when compared with women.

Feres et al[10] compared the soft tissue morphology of individuals according to their facial patterns using cephalograms of 90 patients of both genders, aged 12 to 16 years, which were divided into three distinct groups according to their morphological patterns i.e. mesofacial, dolichofacial and brachyfacial. The groups were compared in terms of thickness and height of the upper and lower lips and thickness of soft tissue chin. Correlations between soft tissue variables, dental as well as cephalometric measurements were also investigated. They reported that thickness of upper lip, lower lip and soft tissue chin showed no differences in all morphological groups. However, upper and lower lip heights were significantly greater in dolichofacial pattern of faces. Brachyfacial group showed smaller upper lip height compared with mesofacial sample component, although no differences were found between those two groups in terms of lower lip measurement. Correlations between soft tissues, skeletal and dental variables concluded with evident vertical development of the upper and lower lips, commensurate with the vertical development of the skeleton. The vertical positioning of upper incisors significantly correlated with the same parameters related to the lips, which ensured a similar exposure level of these teeth in all groups. In the present study, lip thickness was not evaluated.

Macari et al[1] evaluated the association between chin (STC) thickness and mandibular divergence. Nongrowing patients seeking orthodontic treatment (n =190; 113 women and 77 men), who had an average age of 26.94 years (range = 18.10–53.50 years), were stratified in four subgroups based on cephalometric mandibular plane inclination to anterior cranial base low vertical (MP/SN ≤ 27^0, n = 48), medium-low vertical = average being 27^0 (MP/SN ≤ 32^0, n = 60) medium-high vertical with average being 32^0 (MP/SN ,<37^0, n = 37) and high vertical (MP/SN ≥ 37^0, n =45). The STC thicknesses were measured at pogonion (Pog), gnathion (Gn), and menton (Me). Group differences were evaluated with two-way analysis of variance and Student's t-test. The Pearson product moment correlation gauged associations between parameters. They reported that the STC values were greater in men than women (P <0.02) and were smaller in the high angle group (7.47 ± 2.42 mm) than in all other groups at Gn (mean values 5=9.00 mm <STC < 9.58 mm; P < .001) and at Me (high group = 6.30 ± 1.89 mm; other groups = 7.15 mm, <STC<7.57

mm; P =0.01). These results are in accordance with the present results.

These findings have many clinical implications. Increased extent of advancement genioplasty might achieve better chin projection in patients with severe hyper divergence because the mandible has grown more vertically at the expense of its anterior projection. Also earlier treatment in growing children might be recommended to favor the forward projection of the chin by removing obstacles to more horizontal growth component of growth (e.g, sustained mouth breathing) and controlling the extrusion of posterior teeth. Secondly most of the prediction soft wares work on the assumptions that soft tissues move in a ratio of 1:1 with the skeletal movement. The algorithms for the displacement of Pog, Gn, and Me are established with this ratio at hand and this should be viewed with caution.

Conclusions

Soft tissue thickness measurements were smaller in vertical hyperdivergent pattern compared with adult patients with clinically normal and hypodivergent patterns. Subjects with hyperdivergent mandible exhibited a statistically significantly thinner STC at Gn and Me in comparison with subjects having a hypodivergent pattern. More over all STC measurements were greater in men than in women. Finally, STC thickness in hyperdivergent pattern should be considered differently at its most anterior point (Pog) relative to its inferior landmarks (Gn and Me). This differential between different vertical patterns should be explored in further research, particularly given its potential implications for genioplasty in patients with extreme hyperdivergence who might require greater chin advancement to compensate for an increased vertical height.

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