folia medica

Folia Medica 63(1): 74-80
DOI: 10.3897/folmed.63.e52165

Original Article

Comparative Evaluation of Soft Tissue Chin Thickness in Adult Patients with Skeletal Class II Malocclusion with Various Vertical Growth Patterns: a Cephalometric Study

Harshal Santosh Patil[1], Sangeeta Golwalkar[2], Kishor Chougule[2], Nishita Rajeev Kulkarni[3]

[1] *Department of Orthodontics and Dentofacial Orthopedics, Bharati Vidyapeeth Deemed University, Dental College & Hospital, Pune, Maharashtra, India*
[2] *Department of Orthodontics and Dentofacial Orthopedics, Tatyasaheb Kore Dental College and Research Centre, New Pargaon, Kolhapur, Maharashtra, India*
[3] *Department of Conservative Dentistry & Endodontics, Bharati Vidyapeeth Deemed University, Dental College & Hospital, Sangli, Maharashtra, India*

Corresponding author: Nishita Kulkarni, Department of Conservative Dentistry & Endodontics, Bharati Vidyapeeth Deemed University, Dental College & Hospital, Sangli- 416414, Maharashtra, India; E-mail: nrkulkarni19@gmail.com; Tel.: +91 9421048101

Received: 18 Mar 2020 ♦ **Accepted:** 15 June 2020 ♦ **Published:** 28 Feb 2021

Citation: Patil HS, Golwalkar S, Chougule K, Kulkarni NR. Comparative evaluation of soft tissue chin thickness in adult patients with skeletal class II malocclusion with various vertical growth patterns: a cephalometric study. Folia Med (Plovdiv) 2021;63(1):74-80. doi: 10.3897/folmed.63.e52165.

Abstract

Introduction: Facial soft tissue thickness is important not only for plastic surgeons but also for orthodontists to plan the treatment procedure. Genioplasty, an orthognathic surgery in combination with orthodontic treatment is indicated to restore adequate shape and projection of the chin in the face. It has been performed to enhance soft tissue contours related to disproportion between soft and hard tissue. These treatments require the critical information regarding the relation between soft and hard tissues for proper treatment planning. However, there is very minimal documentation on comparison of soft tissue characteristics particularly in Class II malocclusion.

Aim: To evaluate and compare soft tissue chin thickness in class II subjects with various growth patterns. To evaluate soft tissue chin thickness difference in males and females and compare the results with previous studies.

Materials and methods: The study comprised 150 adults aged between 18 and 26 years (mean age 21 years). Based on FH/MP angle the study sample was allocated into three groups: group I - low (hypodivergent), group II – average, and group III - high (hyperdivergent). Radiographs were traced manually. Angular measurements were computed to determine the vertical position of the maxilla and mandible in relation to anterior cranial base, to true horizontal and to each other. Soft tissue chin thickness was measured at three different levels.

Results: Hyperdivergent group showed greater soft tissue chin thickness at Pog-Pog’ than the hypodivergent and average angle groups. Hypodivergent group showed greater soft tissue chin thickness at Me-Me’ and Gn-Gn’ as compared to average and hyperdivergent groups. Males showed greater soft tissue chin thickness at hypodivergent, average and hyperdivergent group than females.

Conclusions: Soft tissue thickness measurements were smaller in adult patients of hyperdivergent group compared to adult patients in clinically average and hypodivergent groups. All STC measurements were greater in men than in women. The findings suggested that STC thickness in hyperdivergent pattern should be considered differently at its most anterior point (Pog) relative to its inferior landmarks (Gn and Me).

Keywords

cephalogram, hypodivergent, hyperdivergent, soft tissue chin thickness

INTRODUCTION

Facial esthetic ideals were documented as early as 4 BC by the Greeks and were studied by the Egyptians, Romans, and Italians. Many ideas that surround the correction of the irregularities of teeth were first published in Britain by Kingsley in 1880.[1]

One of the most important components of orthodontic diagnosis and treatment planning is evaluation of the patient's soft tissue profile. Angle emphasized the importance of soft tissue and facial esthetics in orthodontic treatment.[2] He took the sculpture of Apollo Belvedere as his canon of corporal and facial beauty.[3] He believed that the harmony and balance of the face depend largely on form. Holdaway stated that "better treatment goals can be set if we quantify the soft tissue features" which contribute to or detract from that "physical attractiveness stereotype" which has been ingrained into our culture.[2]

Esthetic improvement continues to be the driving force in the majority of patients seeking orthodontic treatment, with functional benefit as a co-consequence.[4] Facial harmony and balance are determined by the facial skeleton and its soft tissue drape. Recently, the field of orthodontics has experienced a paradigm shift to focus more on esthetics, with specific emphasis on soft tissues around the mouth.[5]

Harmonious facial esthetics and optimal functional occlusion have long been recognized as the two most important goals of orthodontic treatment. To accomplish some of these goals, knowledge of the normal craniofacial growth as well as the effects of orthodontic treatment on the soft tissue profile is essential. A number of methods have been used to evaluate these facial changes including anthropometry, photogrammetry, computer imaging, and cephalometry. Profiles have been evaluated by using both cephalometric or photometric linear and angular measurements, or combinations of metric, angular, and proportional measurements.[6] Soft tissue thickness can be measured by many methods; e.g., puncture, X-ray, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography.[7]

The interrelationship of soft tissue components of the face, such as nose, lip, and chin, changes during growth as well as with orthodontic treatment. Thus, it becomes imperative for orthodontists to understand normal growth trends of the nose, lip and chin.[8] Soft tissue evaluation is integral for patients undergoing orthodontic treatment.[9] There is great individual variation in period, magnitude, and pattern of growth in different parts of the face.[10]

Facial soft tissue thickness is important not only for plastic surgeons but also for orthodontists to plan the treatment procedure. Genioplasty, an orthognathic surgery in combination with orthodontic treatment is indicated to restore adequate shape and projection of the chin in the face. It has been performed to enhance soft tissue contours related to disproportion between soft and hard tissue.[11]

These treatments require the critical information regarding the relation between soft and hard tissues for proper treatment planning. However, there is very minimal documentation on comparison of soft tissue characteristics particularly in class II malocclusion.

AIM

The aim of the present study was to compare soft tissue thickness in class II subjects with variable facial divergence which will help the clinician in routine practice.

MATERIALS AND METHODS

The study group comprised 150 adults (75 males and 75 females) aged 18 to 26 years (mean age, 21 years). These patients were treated at our Institute before the study was conducted. Based on FH/MP angle, angular measurements sample were divided into three groups: group I - horizontal (hypodivergent), group II – average, and group III - vertical (hyperdivergent).

Inclusion criteria:

1. Subjects with no previous orthodontic treatment or surgery.
2. Subjects with Angle's Class II malocclusion with angle ANB $\geq 4°$ and various growth patterns.
3. Patients in the age range of 18-26 years.
4. Well defined and identifiable chin structures on the radiographs.

Exclusion criteria:

1. Patients with history of previous orthodontic and/or orthognathic intervention.
2. Patients with craniofacial anomalies.
3. Presence of a non-continuous soft tissue contour at the level of the chin indicating chin strain.
4. Distorted images or images without adequate sharpness on the radiographs.

The lateral cephalograms were taken using the Cephalostat in a standardized manner in natural head position with the Frankfort horizontal plane (FHP) kept parallel to the floor and the midfacial plane kept in a vertical position using the 'X-TROPAN-2000' by the same operator. The size of the lateral cephalogram film was 8″ × 10″; anode voltage 70 kV; anode current 12 mA; exposure time 4 to 50 mAS and magnification 1.1. The size of OPG film was 6″ × 12″; anode voltage 50-85 kV; anode current 12 mA; exposure time 14 sec; magnification ×1.2.

Radiographs were traced manually; tracings were done on acetate paper using a 0.3 mm lead pencil. A single operator performed all the tracing in a standardized manner to avoid errors due to inter-operator variations. Linear measurements were made to 1 mm accuracy.

Angular measurements were computed to determine the vertical position of the maxilla and mandible in relation to anterior cranial base, to true horizontal and to each other.

The following angles were measured:

1. Palatal plane to mandibular plane (Down's MP i.e. Go-Me) (PP/MP).
2. Palatal plane to true horizontal plane (PP/HP).
3. Mandibular plane to true horizontal plane (MP/HP).
4. Mandibular plane to anterior cranial base (MP/SN) **(Fig. 1)**.

Soft tissue chin thickness was measured at three different levels:

1. Pog-Pog'- Linear distance between bony pogonion (Pog) and its horizontal projection (Pog').
2. Gn-Gn'- Distance between bony gnathion (Gn) and soft tissue gnathion (Gn').
3. Me-Me'- Distance between bony menton (Me) and its vertical projection (Me') **(Fig. 1)**.

Thus, a segregation based on FH-mandibular plane angle was done as follows:

- Horizontal growth pattern (hypodivergent): angle FH-MP < 20° (-<27°)
- Average growth pattern: angle FH-MP - 20° – 30° (32 -$^{+}$ 5°)
- Vertical growth pattern (hyperdivergent): angle FH-MP > 30° (->37°)

The lateral cephalograms were divided into 3 groups of 50 subjects each according to the growth pattern, as follows:

Group I: Class II subjects with horizontal growth pattern (hypodivergent subjects).

Group II: Class II subjects with average growth pattern (average angle subjects).

Group III: Class II subjects with vertical growth pattern (hyperdivergent subjects).

Based on the study by Zhong Z, et al., Frankfort mandibular plane angle (FMA) was considered to determine the growth pattern.

Statistical analysis

Descriptive statistics for all parameters was presented as mean and standard deviations. The parameters were compared between low, average and high groups by analysis of variance (ANOVA). The parameters were also compared between males and females based on the Independent samples *t* test (unpaired *t* test). Probability value of <0.05 was considered as statistically significant for all the comparisons.

RESULTS

In the present study, the mean values of Pog-Pog' were 10.98 mm, 10.88 mm, 11.44 mm, respectively in patients with hypodivergent, average, and hyperdivergent groups, with nonsignificant difference in all groups (p=0.357).

Mean values of Me-Me' were 6.64 mm, 6.54 mm, 6.36 mm, respectively in patients with hypodivergent, average, and hyperdivergent groups, with nonsignificant difference in all groups (p=0.706).

Mean values of Gn-Gn' were 8.26 mm, 7.70 mm, 7.68 mm, respectively in patients with hypodivergent, average, and hyperdivergent groups, with nonsignificant difference in all groups (p=0.264).

In the present study, the mean values of Pog-Pog' for males and females were 1.97 mm, 2.17 mm, respectively, with nonsignificant difference in males and females (p=0.255) **(Fig. 2)**.

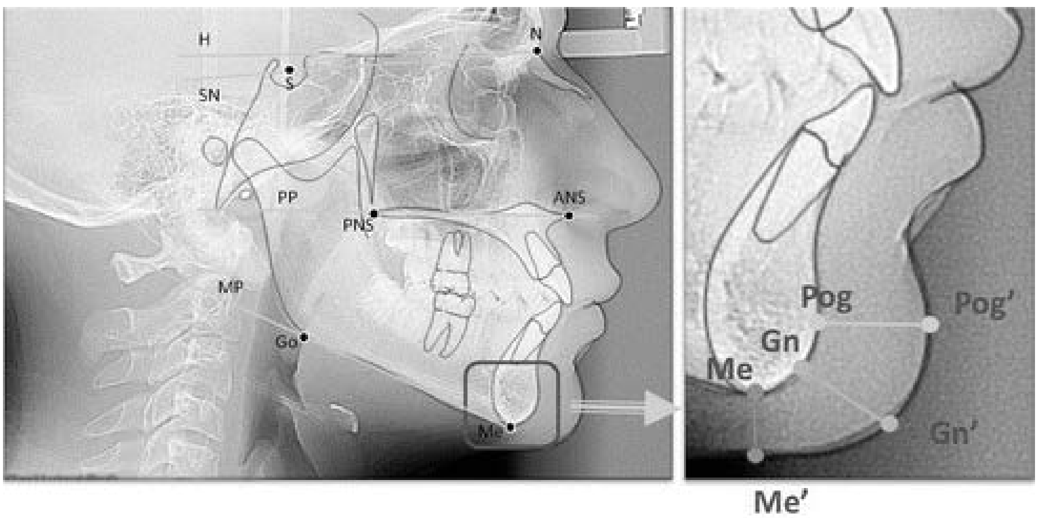

Figure 1. To the left: Mandibular plane (menton-gonion); palatal plane (anterior nasal spineposterior nasal spine); sella-nasion angle; true horizontal. To the right, measurements of skin thickness at the chin were evaluated: hard tissue pogonion and the distance to its horizontal projection on the soft tissue (Pog-Pog'), distance from hard tissue gnathion to soft tissue gnathion (Gn-Gn'), and the distance from hard tissue menton to its vertical projection on the soft tissue (Me-Me').

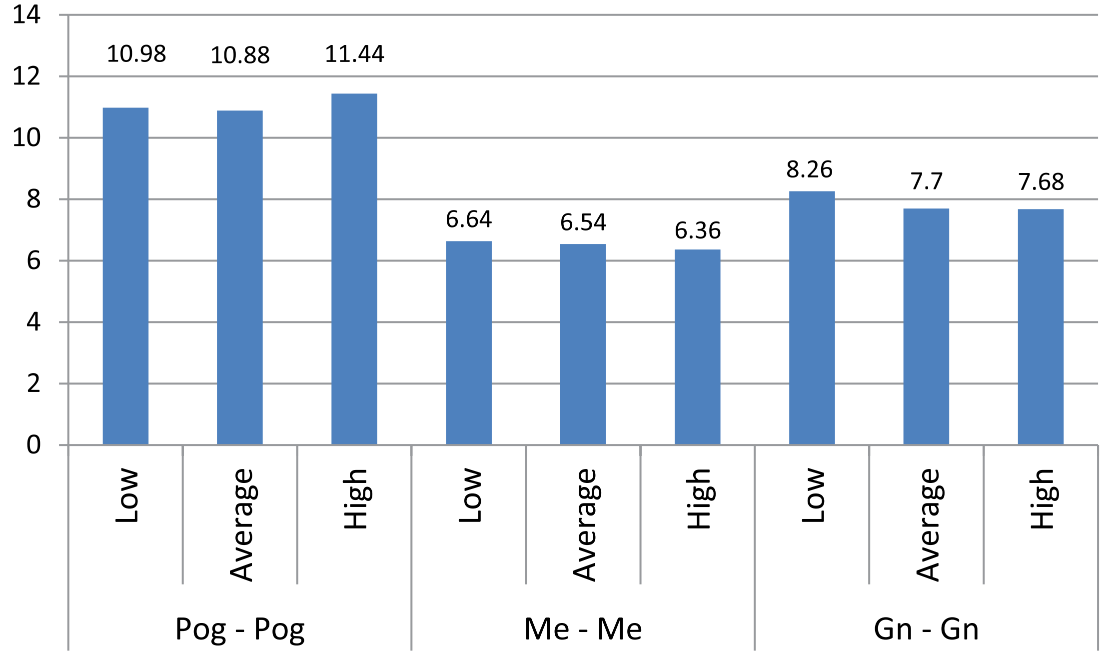

Figure 2. Comparison of study variables based on soft tissue thickness.

Mean values of Me-Me' for males and females were 1.70 mm, 1.64 mm, respectively, with nonsignificant difference in males and females (*p*=0.037).

Mean values of Gn-Gn' for males and females were 2.19 mm, 1.79 mm, respectively, with nonsignificant difference in males and females (p=0.105) **(Fig. 3)**.

DISCUSSION

An understanding of craniofacial growth and development is essential in orthodontics to attain treatment objectives. Soft tissue thickness can be measured by many methods; e.g., puncture, X-ray, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography.

Tannous Macari and Antoine Elias Hanna[11] stated that soft tissue thickness measurements were smaller in adult patients with 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.

All STC measurements were greater in men than in women. The findings suggest that STC thickness in hyperdivergent pattern should be considered differently at its most anterior point (Pog) relative to its inferior landmarks (Gn and Me).

Prasad Chitra and Alapati Prasanna[10] emphasized that class II division 1 subjects with varying mandibular divergences have differences in soft tissue chin thicknesses. Sagittal mandibular advancement improves their facial profile. Hypodivergent subjects have increased thickness at Pogonion and hypodivergent subjects have reduced thickness at Pogonion and varying thicknesses at Gnathion and Menton.

Mevlut Celikoglu et al.[12] concluded that soft tissue thickness values were greater in men than in women in all groups. Women had statistically significantly thinner thickness at the labrale superius, labrale inferius, and Pogonion in the high-angle group compared with the normal-angle group, whereas men had similar soft tissue thickness values at the lower anterior face in all groups. Soft tissue thickness values were the lowest in the high-angle group for both women and men. For women, the thickness values at the labrale superius, labrale inferius, and Pogonion were found to be statistically significantly smaller in the high-angle group compared with the values in the normal-angle group. For men, however, no statistically significant differences were found among the vertical growth patterns.

Abdul Jabbar, et al.[9] observed soft tissue chin thickness differences among skeletal malocclusions. The differences among different skeletal malocclusions may be taken into account in patients undergoing orthodontics or corrective jaw surgery, both during diagnosis and treatment planning. Sagittal class of the sample was significantly correlated to soft tissue thickness at Pogonion, Gnathion but not for Menton.

Ankur Gupta[2] stated that most soft tissue measurements were similar to the Holdaway norms. Some differences for soft tissue chin thickness, H angle and nose prominence were noticed. When comparisons were made between the sexes, some significant differences between males and females were noticed. On an average, males have relatively prominent upper lip thickness, soft tissue chin thickness, and basic upper lip thickness than do the females.

Antony GH McCollum[13] emphasized that the horizontal cephalometric measurements were shown to be more

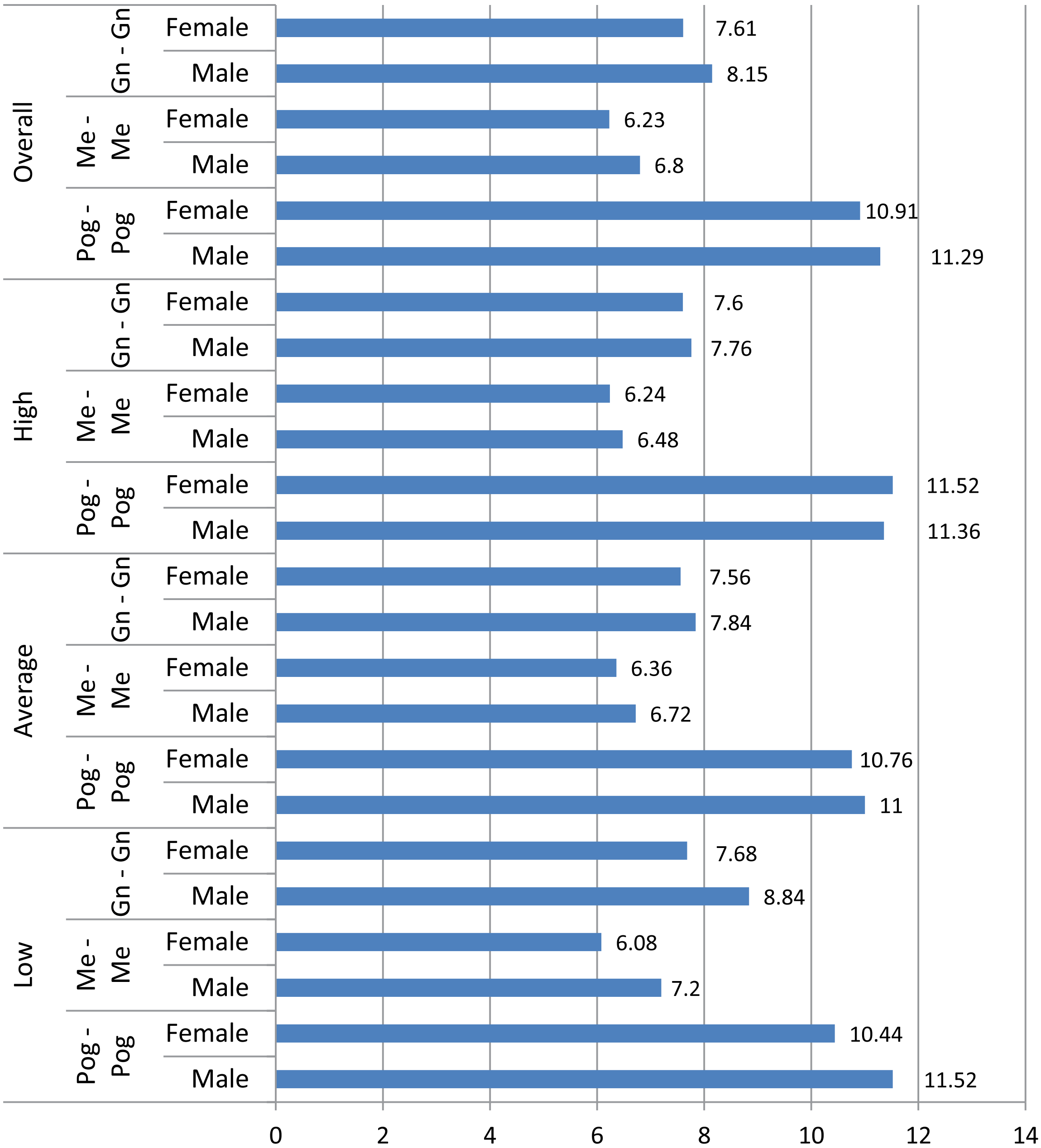

Figure 3. Comparison of all the study parameters between males and females.

reliable than vertical measurements. The soft-tissue changes of the chin area follow the horizontal and vertical changes of the bony chin in a 1:1 ratio. Hard tissue menton moves vertically in an effective 1:1 ratio with soft-tissue menton and with soft-tissue gnathion.

Paula Fernandez-Riveiro[3] stated that the labial, nasal, and chin areas showed sexual dimorphism in most of the parameters. Males have larger faces in general, with greater facial heights; longer nasal, labial, and chin lengths; larger nasal, labial, and chin prominences; and a greater nasal and facial depth in the tragus point. In particular, the differences were very well marked in the prominence of the lower lip and the chin with regard to the TV.

Clinical implications

The soft-tissue chin responds in an almost 1:1 relationship to corresponding hard-tissue movement in both the horizontal and the vertical planes of space. Soft-tissue thickness exerts almost no influence on the response of the lower lip and soft-tissue chin to autorotation of the mandible. The soft-tissue responses of the lower lip and chin to corresponding hard-tissue movement are highly predictable in both the horizontal and the vertical planes of space.[14]

CONCLUSIONS

1. Soft tissue thickness measurements were smaller in adult patients with vertical hyperdivergent pattern compared with adult patients with clinically normal and hypodivergent patterns.

2. Hyperdivergent group shows greater soft tissue chin thickness at Pog-Pog' as compared to hypodivergent and average angle groups.

3. Hypodivergent group shows greater soft tissue chin thickness at Me-Me' and Gn-Gn' as compared to average and hyperdivergent groups.

4. All STC measurements were greater in men than in women.

5. The findings suggest that 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 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 and not only initially deficient chin projection.

REFERENCES

1. Rathod AB, Araujo E, Vaden JL, et al. Extraction vs. no treatment: long-term facial profile changes. Am J Orthod Dentofacial Orthop 2015; 147:596–603.
2. Gupta A, Anand N, Garg J, et al. Determination of Holdaway soft tissue norms for the North Indian population based on panel perception of facial esthetics. J Pierre Fauchard Acad 2013; 27(1):18–22.
3. Fernández-Riveiro P, Suárez-Quintanilla D, Smyth-Chamosa E, et al. Linear photogrammetric analysis of the soft tissue facial profile. Am J Orthod Dentofacial Orthop 2002; 122:59–66.
4. Chaudhary DC, Kumar P, Sharma M, et al. Comparative evaluation of soft tissue changes one year post-treatment in Twin Block and Forsus FRD treated patients. Med J Armed Forces India 2016; 72(4):362–6.
5. Taki AA, Oguz F, Abuhijleh E. Facial soft tissue values in Persian adults with normal occlusion and well-balanced faces. Angle Orthod 2009; 79:491–4.
6. Bishara SE, Jakobsen JR, Hession TJ, et al. Soft tissue profile changes from 5 to 45 years of age. Am J Orthod Dentofacial Orthop 1998; 114:698–706.
7. Utsuno H, Kageyama T, Uchida K, et al. Facial soft tissue thickness in Japanese children. Forensic Sci Int 2010; 199:109.e1–6.
8. Prahl-Andersen B, Ligthelm-Bakker AS, Wattel E, et al. Adolescent growth changes in soft tissue profile. Am J Orthod Dentofacial Orthop 199; 107:476–83.
9. Jabbar A, Zia AU, Shaikh IA, et al. Evaluation of soft tissue chin thickness in various skeletal malocclusions. POJ 2016; 8:62–6.
10. Chitra P, Prasanna A. Soft tissue chin thickness comparisons in Indian adult class II division 1 subjects. Int J Sci Res 2014; 11:360–2.
11. Macari AT, Hanna AE. Comparisons of soft tissue chin thickness in adult patients with various mandibular divergence patterns. Angle Orthod 2014; 84:708–14.
12. Celikoglu M, Buyuk SK, Ekizer A, et al. Assessment of the soft tissue thickness at the lower anterior face in adult patients with different skeletal vertical patterns using cone-beam computed tomography. Angle Orthod 2015; 85:211–7.
13. McCollum AGH, Gardener GJM, Evans WG, et al. Soft-tissue changes related to mandibular advancement surgery. Seminars in Orthodontics 2009; 15:161–71.
14. Ksiezycki-Ostoya BK, McCollum AGH, Becker PJ. Sagittal soft-tissue changes of the lower lip and chin associated with surgical maxillary impaction and consequent mandibular autorotation. Seminars in Orthodontics 2009; 15(3):185–95.

Сравнительная оценка толщины мягких тканей подбородка у взрослых пациентов с неправильным прикусом скелетного класса II с различными моделями вертикального роста: цефалометрическое исследование

Харшал Сантош Патил[1], Сангета Голуалкар[2], Кишор Чоугуле[2], Нишита Раджеев Кулкарни[3]

[1] *Отделение ортодонтии и челюстно-лицевой ортопедии, Университет Бхарати Видьяпит Димед, Стоматологический колледж и больница, Пуна, Махараштра, Индия*

[2] *Отделение ортодонтии и челюстно-лицевой ортопедии, Стоматологический колледж и исследовательский центр Татьясахеб Коре, Нью-Паргаон, Колхапур, Махараштра, Индия*

[3] *Отделение консервативной стоматологии и эндодонтии, Университет Бхарати Видьяпит, Стоматологический колледж и больница, Сангли, Махараштра, Индия*

Адрес для корреспонденции: Нишита Кулкарни, Отделение консервативной стоматологии и эндодонтии, Университет Бхарати Видьяпит, Стоматологический колледж и больница, Сангли- 416414, Махараштра, Индия; E-mail: nrkulkarni19@gmail.com; Тел.: +91 9421048101

Дата получения: 18 марта 2020 ♦ **Дата приемки:** 15 июня 2020 ♦ **Дата публикации:** 28 февраля 2021

Образец цитирования: Patil HS, Golwalkar S, Chougule K, Kulkarni NR. Comparative evaluation of soft tissue chin thickness in adult patients with skeletal class II malocclusion with various vertical growth patterns: a cephalometric study. Folia Med (Plovdiv) 2021;63(1):74-80. doi: 10.3897/folmed.63.e52165.

Резюме

Введение: Толщина мягких тканей лица важна не только для пластических хирургов, но и для ортодонтов при планировании терапевтических процедур. Гениопластика, ортогнатическая операция в сочетании с ортодонтическим лечением назначают для восстановления адекватной формы и проекции подбородка лица. Она выполняется для улучшения контуров мягких тканей, связанных с диспропорцией между мягкими и твёрдыми тканями. Эти процедуры требуют важной информации о соотношении мягких и твёрдых тканей для правильного планирования лечения. Однако данных, сравнивающих характеристики мягких тканей, особенно при аномалиях прикуса 2 класса, мало.

Цель: Оценить и сравнить толщину мягких тканей подбородка у субъектов 2 класса с разными моделями роста. С целью измерить разницу в толщине мягких тканей подбородка у женщин и мужчин и сравнить результаты с предыдущими исследованиями.

Материалы и методы: В исследование были включены 150 пациентов в возрасте от 18 до 26 лет (средний возраст 21 год). Исходя из угла FH / MP, исследуемая группа была разделена на три группы: 1-я группа – низкая (гиподивергентная), 2-я группа – средняя и 3-я – высокая (гипердивергентная). Рентгенограммы исследовали вручную. Угловые измерения были рассчитаны для определения вертикального положения верхней и нижней челюсти по отношению к переднему основанию черепа, реальной горизонтали и друг другу. Толщина мягких тканей подбородка измерялась на трёх разных уровнях.

Результаты: Гипердивергентная группа имела большую толщину мягких тканей подбородка в точке Pog-Pog, чем группы с гиподивергентным и средним углом. Гиподивергентная группа имела большую толщину мягких тканей подбородка в точках Me-Me ‹и Gn-Gn› по сравнению со средней группой и группой с гипердивергентностью. У мужчин толщина мягких тканей подбородка в гиподивергентной, средней и гипердивергентной группах была больше, чем у женщин.

Заключение: Измерения мягких тканей у взрослых пациентов в группе гипердивергентности были меньше, чем у взрослых пациентов в группах клинически средних и гиподивергентных. Все измерения STC были выше у мужчин, чем у женщин. Результаты показывают, что толщину STC в гипердивергентной модели следует рассматривать по-другому в её самой передней точке (Pog) по сравнению с самыми низкими точками (Gn и Me).

Ключевые слова

цефалограмма, гиподивергентная, гипердивергентная, толщина мягких тканей подбородка