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Radiographic Assessment of Soft Tissue Thickness at the Anterior Area of Maxilla and Mandible in A Patient With Different Dental Malocclusions

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Abstract: Background: Concerns about the accuracy and reliability of soft tissue thickness using CBCT and lateral cephalometric techniques.

Objective: The aim of the study is to estimate the accuracy and reliability of soft tissue thickness with CBCT and lateral cephalometric imaging for gender determination and to indicate the difference in soft tissue thickness in different dental malocclusions.

Material and methods: This study was conducted using 57 radiographic images (35 CBCT and 22 lateral cephalometric). Measurements for the thickness of soft tissue were done on the area of the anterior maxilla and mandible for both techniques.

Results: males have significantly thicker soft tissue than females in the area of the chin and distance from the labial surface of upper and lower central incisors to the surface of the lip, with p-values (0.0325,0.010,0.0094) respectively. An individual with Cl III shows a significant increase in soft tissue thickness in the area of distance from the labial surface of the upper central incisor to the surface of the upper lip, with a p-value 0.0018.

Conclusion: Males were characterized by thicker facial soft tissue compared with female patients in Class I. Individuals with Cl III show a reduction in the thickness of soft tissue in the area of the chin and an increase in the thickness in the area of the upper lip.

Keywords: CBCT, lateral cephalometric, gender, malocclusion.

Introduction

Malocclusion describes any deviation from the normal relationship of the maxillary and mandibular teeth, which can occur in one or several teeth, segments, or entire arches.[1] Assessment of soft-tissue thickness and volume in the anterior maxillary and mandibular regions is a critical consideration for multiple orthodontic and restorative procedures.[2] Soft tissue affects the position, shape of the underlying bone, and also the growth of the alveolar processes. Therefore, examination of the soft tissue is an essential part of orthodontic diagnosis and treatment planning. [3] Systematic studies have shown that the thickness of facial soft tissue varies among subjects with different skeletal patterns, and the variations differ for various points of the face. [4,5,6] Since soft tissue displays some significant differences in various malocclusions, it is likely to improve insight into the diagnosis and treatment planning. The soft-tissue profile provides more accurate and reliable information about the amount of retraction or projection of the incisors because it takes into account the immediate effect on the profile of the patient. In orthodontic treatment, these differences must be taken into consideration; if not considered, they may lead to unrealistic treatment goals and improper diagnosis and correction of malocclusion. Radiographic techniques enable accurate measurements of high-quality images. [7,8,9] The evaluation of tissues covering the anterior teeth region, both on the maxillary and mandibular arches, holds clinical relevance owing to the significant influence of these soft tissues on dental

aesthetics and functionality. Radiography offers a rapid and minimally invasive technique for measuring the thickness of these soft tissues in the anterior region, applicable to patients exhibiting various forms of malocclusion.[10]

Cephalometric radiography is a diagnostic technique that produces two-dimensional X-ray images of the craniofacial region, capturing hard and soft tissues of the head in either anteroposterior or lateral projection.[11] It allows evaluation of craniofacial morphology in a standardized and reproducible manner following widely accepted protocols. Although its most frequent application was for assessing changes in dentoskeletal relationships and growth patterns, procedures have been developed for the measurement of anterior facial soft tissue thickness using cephalometric radiographs, which are considered universally accepted datasets for various applications from clinical purposes to forensic analysis. [12]

Cone beam computed tomography (CBCT) provides a better three-dimensional visualization of the facial soft tissue, which allows for more detailed analysis. CBCT technology creates undistorted 3D images of facial soft and hard tissues, allowing for comprehensive examination, which facilitates the prediction of post-treatment profiles and lip positions. [13]

Gender, in particular, remains an incompletely understood factor concerning anterior facial soft tissue thickness. Prior South Korean research found males to possess significantly greater soft tissue thickness at the supraglabella, nasion, rhinion, mid-philtrum, supradentale, and supraglenoid landmarks, while females exhibited greater thickness at the lateral orbit, inferior malar, and gonion sites. [14,15] Further examination of sex-related variability is warranted, given the influence of gender-based aesthetics and physiological distinctions on soft tissue morphology.

Although current orthodontic treatment methods can improve the facial appearance of patients to a certain extent, the complexity of facial tissue structure means that some patients still do not achieve the desired facial improvement after treatment. Moreover, existing research on the facial soft tissue characteristics of patients with different types of malocclusions is still insufficient. Therefore, this study aims to fill this gap by evaluating the effect of gender on soft tissue thickness in the anterior maxilla and mandible using CBCT and also evaluating the difference in soft tissue thickness in different dental malocclusions using lateral cephalometric images.

Material and methods

The samples were composed of 57 dentate patients aged between 20-50 years old, the total sample including patients who attended a dental private clinic in Baquba-Diyala for CBCT and lateral cephalometric investigation for different diagnostic purposes.

The data is grouped as follows:

1. 35 images for patients with Cl I (10 females and 15 males)

2. 22 images for a patient with Cl I, Cl II, and Cl III dental malocclusion.

The image of patients used in this study included patients with different dental malocclusions without a history of trauma, facial asymmetry, or cystic lesions.

The study includes assessing the efficiency of CBCT and lateral cephalometric in measurements of anterior maxillary and mandibular soft tissue thickness.

The New Tom Giano CBCT (Volt = 110 kV, Exposure time=24 seconds, Electrical current=5-7mA, voxel size=0.5 mm, field of view=16 cm*14 cm) used in this study, and sagittal views were reconstructed from the CBCT image.

The lateral cephalometric used for the imaging analysis was the Rotograf Plus (20090 Buccinasco MI, Italy) (Number and series: 00036045), and the CEI-OPX/105 X-ray tube (CEI, Bologna) in March 2000, which had a protective filter (2.5 mm aluminum-equivalent). Lateral cephalometric films were taken from a distance of 165 cm from the tube, using a cephalostat to ensure rigid head fixation.

For absolute measurements, distances between two landmarks were measured on both CBCT and the lateral cephalometric. The resultant differences in soft tissues were then compared and analyzed according to gender in CBCT and according to different dental malocclusions in the lateral cephalometric.

The soft tissue thickness was measured for each CBCT and lateral cephalometric image at selected landmarks, which are:

Point A: the deepest point on the curved profile of the maxilla.

Point B: the deepest point on the curved profile of the mandible.

Pog: the most anterior point on the bony chin.

Lmx: the most prominent point on the labial surface of the maxillary central incisor.

Lmn: the most prominent point on the labial surface of the mandibular central incisor.

Linear measurements: (Figure 2.1-2.2)

1. The distance from point A to the outer surface of soft tissue.
2. The distance from Lmx to the surface of the upper lip.
3. The distance from Lmn to the surface of the lower lip.
4. The distance from point B to the outer surface of soft tissue.
5. The distance from Pog to the outer surface of soft tissue.

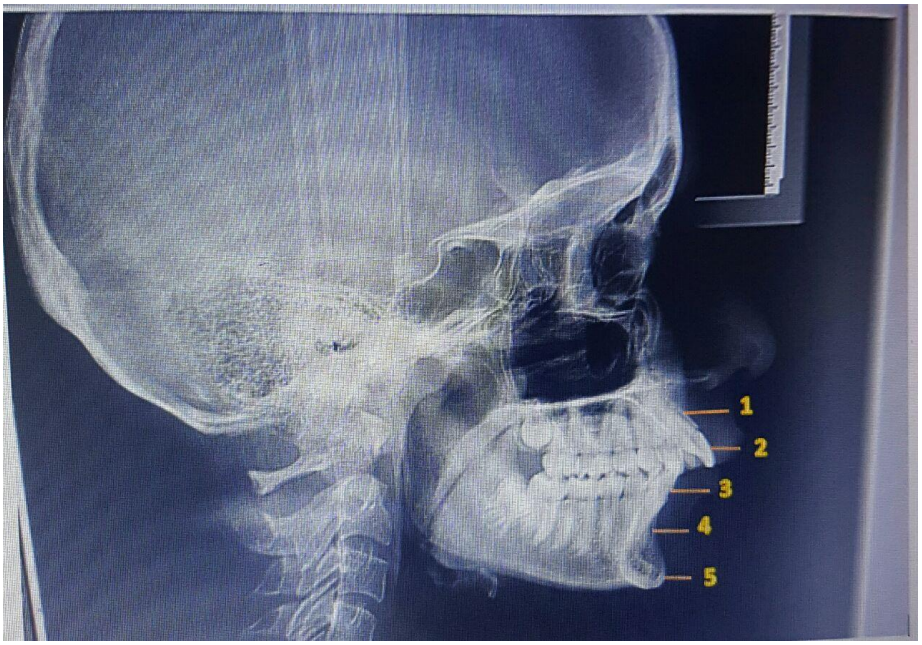

Figure 1: soft tissue measurements on lateral cephalometric

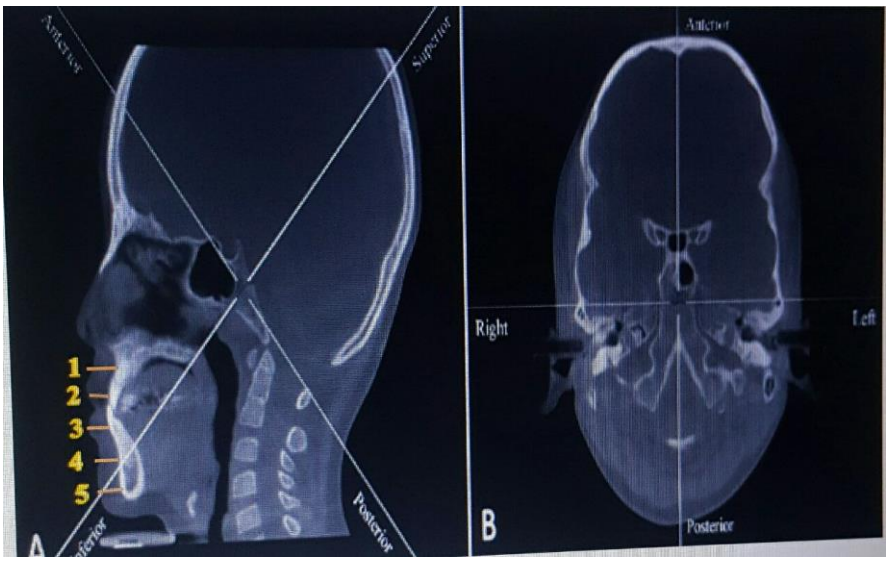

Figure 2: soft tissue measurements on sagittal section of CBCT

Statistical Analysis:

The Statistical Analysis System (SAS) program (2018) was used to detect the effect of different factors on study parameters. The t-test and Least Significant Difference (LSD) test (Analysis of Variance-ANOVA) were used to compare means significantly in this study.

Results

Table 1: Descriptive statistics of facial soft tissue thickness (mm) at various landmarks in CBCT image.

Measurements	Mean	Minimum	Maximum	Range	SD
Point A	9.57	8.81	10.60	1.78	**0.41**
Lmx	6.71	4.05	9.65	5.61	**1.48**
L mn	7.03	4.84	11.01	6.17	**1.44**
Point B	7.24	4.14	11.51	7.36	**1.57**
Pog	8.30	5.34	13.24	7.90	**1.77**

Table 1 summarizes the mean, standard deviation, as well as minimum, maximum, and range of each anatomical landmark. The results show that the highest mean value of anterior soft tissue thickness was in the measurement of point A (9.57).

Table 2: Mean and SD of soft tissue thickness according to gender in CBCT images.

Measurements	female (Mean, SD	male (Mean, SD)	P-value
Point A	9.54±0.29	9.64±0.62	**NS 0.498**
Lmx	6.32± 1.37	7.70± 1.34	**** 0.010**
L mn	6.80±1.44	7.59±1.36	**NS 0.152**
Point B	6.81± 1.26	8.30± 1.83	**** 0.0094**
Pog	7.89± 1.65	9.30± 1.77	***** 0.0325**

According to the results shown in **Table 2**, the gender had a significant difference in measurements of Lmx, point B, and Pog with *p* value (0.010, 0.0094, 0.0325) respectively, while the measurements of point A and Lmn had a non-significant difference between genders with *p* value (0.498, 0.152) respectively. The male shows a higher mean value than the female, and the area of point A shows a great mean value for both male and female (9.64, 9.54)

Table 3: Descriptive statistics of facial soft tissue thickness (mm) at various landmarks for Cl I in the lateral cephalometric image.

Measurements	Mean	Minimum	Maximum	Range	SD
Point A	9.78	7.77	11.53	3.76	**1.23**
Lmx	7.10	5.78	9.04	3.26	**1.45**
L mn	8.23	6.66	11.32	4.66	**1.67**
Point B	7.88	6.67	8.86	2.19	**0.90**
Pog	7.18	5.76	8.08	2.32	**0.88**

Table 4: Descriptive statistics of facial soft tissue thickness (mm) at various landmarks for Cl II in lateral cephalometric image.

Measurements	Mean	Minimum	Maximum	Range	SD
Point A	9.28	7.89	10.45	2.55	**0.837**
Lmx	5.77	4.96	6.73	1.77	**0.684**
L mn	8.54	6.93	10.25	3.31	**1.05**
Point B	6.61	4.75	9.38	4.63	**1.42**
Pog	6.76	5.53	7.72	2.19	**0.589**

Table 5: Descriptive statistics of facial soft tissue thickness (mm) at various landmarks for Cl III in the lateral cephalometric image.

Measurements	Mean	Minimum	Maximum	Range	SD
Point A	10.21	8.43	11.78	3.35	**1.32**
Lmx	8.35	6.86	10.34	3.48	**1.38**
L mn	7.97	4.37	9.20	4.82	**1.82**
Point B	6.88	5.02	9.93	4.91	**1.86**
Pog	7.10	4.76	10.81	6.06	**2.31**

Tables (3, 4, 5) summarize the mean, standard deviation, as well as minimum, maximum, and range of each anatomical landmark, and the results seem to resemble the CBCT results for the thickness of anterior soft tissue in the measurement of point A, which shows a greater mean value as compared with other measurements.

Table 6: Mean and SD of soft tissue thickness according to different dental malocclusions in lateral cephalometric images.

Measurements	Cl I ((Mean, SD	Cl II (Mean, SD)	Cl III (Mean, SD)	(P-value)
Point A	9.78±1.23	9.28±0.83	10.21±1.32	**NS 0.299**
Lmx	7.10± 1.45	5.77± 0.68	8.35± 1.38	**** 0.0018**
L mn	7.97±1.67	8.54±1.05	8.23±1.82	**NS 0.763**
Point B	7.88±0.90	6.61±1.42	6.89±1.86	**NS 0.262**
Pog	7.18±0.87	6.76±0.58	6.10±2.31	**NS 0.814**

With respect to different dental malocclusion, our results show that the measurement of Lmx was significantly difference between different dental malocclusion with *p* value (0.0018) and the mean value for this measurement was greater in Cl III (8.35) as compared with Cl I and Cl II, while the other measurements show non significantly difference between different dental malocclusion also the thickness of soft tissue was higher in measurement of point A in Cl III (10.21) as compared with Cl I and Cl II while the mean value for the measurement of Pog shows lower mean value in Cl III (6.10) as compared with Cl I and Cl II. **(Table 6)**

Discussion

There is widespread and growing interest in facial esthetics and its attractiveness, and it has become one of the goals of contemporary orthodontic treatment. Scientific research on the quantitative measurable bases of facial esthetics is still in progress, and various analyses of the soft tissues are performed, evaluating facial morphology and helping to plan orthodontic treatment. [16-19]

When analyzing the human face, maxillofacial surgeons, plastic surgeons, and orthodontists always try to set certain principles that would help in maxillofacial reconstruction or the treatment of orthodontic malocclusion. [17,19]

Most frequently, the analysis of the soft tissue profile and the evaluation of the relationships of the nose, lips, and chin are performed. [20]

This study was performed to evaluate anterior soft tissue thickness for the maxilla and mandible in CBCT and lateral cephalometric techniques in different dental malocclusions.

In CBCT, we measure the thickness at a selected area in a patient with Cl I and compare the results between males and females. The main findings of the current study have shown that male patients with Cl I had significantly thicker soft tissues in the area of Lmx, point B, and Pog. Other linear distances (point A, Lmn) were greater in males, but this difference was not statistically significant.

These results come to be agree with the results of the study made by **Perović and Blažej in 2018** [21], who studied the characteristics of facial soft tissue thickness in different orthodontic malocclusions, and they conclude that males had thicker facial soft tissue than females in Cl I.

Kaur *et al* in 2017 [22] established the differences between men and women in facial soft tissue thickness in patients from northeast India using CT scanning and MRI. **Aggarwal and Singla in 2016** [23] reported on the presence of significant differences between males and females, and males had increased values for facial soft tissue thickness. The results of this study agree with our results.

The results indicated that the facial soft tissue thickness was greater in males as compared with females, possibly because of the effect of testosterone in facilitating the synthesis of collagen that provides men with thicker skin. However, estrogen hormone in women facilitates the synthesis of hyaluronic acid, resulting in a decrease in the synthesis of collagen, which makes women's skin thinner. [24]

In the lateral cephalometric, we measured the thickness of maxillary and mandibular anterior soft tissue at selected areas in patients with Cl I, Cl II, and Cl III malocclusion, and the results were compared.

Our results show that the thickness of soft tissue in Cl III was greater in the area of point A, Lmx, as compared to Cl I and Cl II, whether the difference is statistically significant in the Lmx area and non-statistically significant in the point A area. This result agrees with the study made by **Tanic *et al* in 2011**[25] and the study made by **Kamak and Celikoglu in 2012** [26], who conclude an increase in soft tissue thickness in the area of the upper lip and upper lip sulcus in Class III malocclusion.

The results of this study shows that soft tissue thickness in area of chin (Pog) was reduced in Cl III than in other classes and this seem to be close with the results of the study made by **Perović and Blažej in 2018** [21] and the study made by **Jabbar *et al* in 2016**[27] who conclude reduced thickness of soft tissue in the chin area in patients in Class III in comparison with other classes.

Conclusion

Males have greater soft tissue thickness in the anterior maxilla and mandible than femalesand the area of the chin shows a reduction in thickness of soft tissue in Cl III as compared with other classes. The area of the upper lip shows thicker soft tissue in Cl III than other classes.

References

1. Saghiri, M.A., Eid, J., Tang, C.K. and Freag, P., 2021. Factors influencing different types of malocclusion and arch form–A review. Journal of Stomatology, Oral and Maxillofacial Surgery, 122(2), pp.185-191.
2. Nisanci Yilmaz, M.N., Koseoglu Secgin, C., Ozemre, M.O., İnonu, E., Aslan, S. and Bulut, S., 2022. Assessment of gingival thickness in the maxillary anterior region using different techniques. Clinical Oral Investigations, 26(11), pp.6531-6538.
3. Kharbanda, O.P., Wadhawan, N. and Sennimalai, K., 2023. Orthodontic diagnosis and treatment planning: Collaborating with medical and other dental specialists. Integrated Clinical Orthodontics, pp.18-51
4. Rajbhoj, A.A., Stroo, M., Begnoni, G., Willems, G. and De Llano-Perula, M.C., 2023. Skeletal and soft-tissue changes in humans with untreated normal occlusion throughout lifetime: a systematic review. Odontology, 111(2), pp.263-309.
5. Alhumadi, A., Al-Khafaji, T.J., Alyassiri, A.M.H. and Alhamadi, W.W., 2022. Gender differences in lower facial soft tissue thickness among different skeletal patterns, based on soft tissue cephalometric analysis. Journal of Orthodontic Science, 11(1), p.54.
6. Togninalli, D., Antonarakis, G.S. and Papadopoulou, A.K., 2024. Relationship between craniofacial skeletal patterns and anatomic characteristics of masticatory muscles: a systematic review and meta-analysis. Progress in Orthodontics, 25(1), p.36.
7. Guo, J.X., Xu, X., Fan, L. and Pan, Y.C., 2024. Facial soft tissue characteristics of patients with different types of malocclusion. *BMC Oral Health*, *24*(1), p.1173.
8. Moon, S., Mohamed, A.M.A., He, Y., Dong, W., Yaosen, C. and Yang, Y., 2021. Extraction vs. Nonextraction on Soft-Tissue Profile Change in Patients with Malocclusion: A Systematic Review and Meta-Analysis. *BioMed research international*, *2021*(1), p.7751516.
9. Kiełczykowski, M., Perkowski, K., Kamiński, K., Zadurska, M. and Czochrowska, E., 2024. Evaluation of the soft tissue facial profile in different skeletal malocclusions in relation to age. BMC Oral Health, 24(1), p.711.
10. Maddalone, M., Losi, F., Rota, E. and Baldoni, M.G., 2019. Relationship between the Position of the Incisors and the Thickness of the Soft Tissues in the Upper Jaw: Cephalometric Evaluation. *International Journal of Clinical Pediatric Dentistry*, *12*(5), p.391.
11. Bulut, O., Gungor, K., Thiemann, N., Hizliol, I., Gurcan, S., Hekimoglu, B., Kaya, E., Ozdede, M. and Akay, G., 2017. Repeatability of facial soft tissue thickness measurements for forensic facial reconstruction using X-ray images. *Australian Journal of Forensic Sciences*, *49*(2), pp.134-141.
12. Cha, K.S., 2013. Soft-tissue thickness of South Korean adults with normal facial profiles. *Korean Journal of Orthodontics*, *43*(4), p.178.
13. Machado, G.L., 2015. CBCT imaging–A boon to orthodontics. *The Saudi dental journal*, *27*(1), pp.12-21.
14. Alhumadi, A., Al-Khafaji, T.J., Alyassiri, A.M.H. and Alhamadi, W.W., 2022. Gender differences in lower facial soft tissue thickness among different skeletal patterns, based on soft tissue cephalometric analysis. Journal of Orthodontic Science, 11(1), p.54
15. Piombino, P., Esposito, E., Committeri, U., Barone, S., Arena, A., Cataldo, R., Carraturo, E., Vaira, L.A., De Riu, G., Mariniello, D. and Califano, L., 2023. Facial soft tissue thickness measurement method and relationship with BMI, age and sex. Journal of Stomatology, Oral and Maxillofacial Surgery, 124(4), p.101420

16. Joshi, M., Wu, L.P., Maharjan, S. and Regmi, M.R., 2015. Sagittal lip positions in different skeletal malocclusions: a cephalometric analysis. *Progress in orthodontics*, *16*(1), p.8.

17. Anic-Milosevic, S., Mestrovic, S., Prlić, A. and Slaj, M., 2010. Proportions in the upper lip–lower lip–chin area of the lower face as determined by photogrammetric method. *Journal of Cranio-Maxillofacial Surgery*, *38*(2), pp.90-95.

18. Anicÿ-Miloševicÿ, S., Lapter-Varga, M. and Šlaj, M., 2008. Analysis of the soft tissue facial profile by means of angular measurements. *The European Journal of Orthodontics*, *30*(2), pp.135-140.

19. Rose, A.D., Woods, M.G., Clement, J.G. and Thomas, C.D.L., 2003. Lateral facial soft-tissue prediction model: analysis using Fourier shape descriptors and traditional cephalometric methods. *American Journal of Physical Anthropology: The Official Publication of the American Association of Physical Anthropologists*, *121*(2), pp.172-180.

20. Dimaggio, F.R., Ciusa, V., Sforza, C. and Ferrario, V.F., 2007. Photographic soft-tissue profile analysis in children at 6 years of age. *American Journal of Orthodontics and Dentofacial Orthopedics*, *132*(4), pp.475-480.

21. Perović, T. and Blažej, Z., 2018. Male and female characteristics of facial soft tissue thickness in different orthodontic malocclusions evaluated by cephalometric radiography. *Medical science monitor: international medical journal of experimental and clinical research*, *24*, p.3415.

22. Kaur, K., Sehrawat, J.S. and Bahadur, R., 2017. Sex dependent variations in craniofacial soft-tissue thicknesses estimated from MRI and CT scans: A pilot study based on Northwest Indian subjects. *Int J Diagn Imaging*, *4*, pp.47-56.

23. Aggarwal, I. and Singla, A., 2016. Soft tissue cephalometric analysis applied to Himachali ethnic population. *Indian Journal of Dental Sciences*, *8*(3), pp.124-130.

24. Al-Mashhadany, S.M., Al-Chalabi, H.M. and Nahidh, M., 2017. Evaluation of facial soft tissue thickness in normal adults with different vertical discrepancies. *Int J Sci Res*, *6*(2), pp.938-42.

25. Tanić, T., Blažej, Z. and Mitić, V., 2011. Soft tissue thickness of face profile conditioning by dento-skeletal anomalies. *Srpski arhiv za celokupno lekarstvo*, *139*(7-8), pp.439-445.

26. Kamak, H. and Celikoglu, M., 2012. Facial soft tissue thickness among skeletal malocclusions: is there a difference?. *Korean journal of orthodontics*, *42*(1), p.23.

27. Jabbar, A., Zia, A.U., Shaikh, I.A., Channar, K.A., Memon, A.B. and Jatoi, N., 2016. Evaluation of soft tissue chin thickness in various skeletal malocclusions. *Pakistan Orthodontic Journal*, *8*(1), pp.62-66.