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RESEARCH ARTICLE

Degree of facial profile convexity using Subtelny's analysis in patients aged 6 to 12 years

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ABSTRACT

Skeletal malocclusion is caused by a disproportion of the maxilla and mandible, which leads to an unharmonious facial profile. Straight, convex, and concave soft tissue profiles may serve as a guide to determine the underlying skeletal relations and location of the jaws from the anteroposterior plane. In this study, Subtelny's cephalometric analysis of the skeletal and soft tissue profile is used to evaluate the facial profile convexity and is divided into three parts, which are the skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity. The purpose of this study is to determine the degree of facial profile convexity according to Subtelny's analysis in patients aged 6 to 12 years at Faculty of Dentistry Dental Hospital of Trisakti University. This was a descriptive observational study using samples of cephalograms of 40 patients aged 6 to 12 years. Cephalometry tracing and identification of anatomical landmarks were done to acquire the facial profile convexity degrees. The anatomical landmarks used were nasion, A-point, pogonion, soft tissue nasion, subnasale, pronasale, and soft tissue pogonion. The results of this study found that the average degree of the skeletal profile convexity was 171.26°, the soft tissue profile convexity was 166.18°, and the total soft tissue profile convexity was 144.83°. The degrees of skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity could be influenced by age, gender, and differences in growth and changes in the skeletal and facial soft tissue structures.

Keywords: facial profile; skeletal profile; soft tissue profile; Subtelny's cephalometric analysis

INTRODUCTION

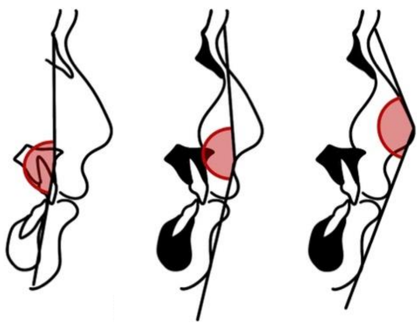
Malocclusion is a developmental condition that deviates from the normal relationship and arrangement of teeth.[1] Many cases of malocclusion are found during the mixed dentition period, which generally occurs from 6 to 12 years of age.[2–4] During this period, abnormal rate and direction of teeth development and craniofacial growth can cause malocclusion.[5] Craniofacial traits related to malocclusion may vary because their growth and development could be affected by age and gender.[6] Malocclusion in children can affect their facial appearance.[5] Skeletal malocclusion caused by a discrepancy in maxilla and mandible growth may result in a disharmonious facial profile.[7] For example, class II skeletal malocclusion with a protrusive maxilla may produce a convex facial profile, while class III skeletal malocclusion with a protrusive mandible may result in a concave facial profile.[8,9] Convex, concave, and straight soft tissue profiles can help determine the underlying skeletal relationship and position of the jaws from the sagittal plane.[10] According to Kasai, the relationship between facial soft tissue and skeletal structures may vary because soft tissues can be affected by thickness, function, and length.[11]

Facial profile evaluation can be done by clinical examination and cephalometric radiography, which is an essential step in orthodontic treatment. Various cephalometric analyses were developed to evaluate the facial profile, such as Downs, Ricketts, Holdaway, and Steiner analyses. Furthermore, Subtelny analyzed the skeletal profile and facial soft tissue to evaluate the facial profile convexity using cephalometric landmarks of the skeletal and soft tissue that are adjacent to each other. The main objective of Subtelny's analysis is to determine whether there are differences in the growth of the facial soft tissue structures and whether the soft tissue profile is related to the skeletal profile. Subtelny's analysis of the facial profile convexity is divided into three parts: the skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity. The skeletal profile convexity is seen from the angle formed by the nasion (N), A-point (A), and (Pog) points and can be used to evaluate the position of the upper face relative to the skeletal profile from the anteroposterior view. The degree of soft tissue profile convexity is measured using the soft tissue nasion (N'), subnasale (Sn), and soft tissue pogonion (Pog') points. This angle measurement uses cephalometric points anatomically close to the skeletal profile structures. The measurement of the total soft tissue profile convexity uses the soft tissue nasion (N'), pronasale (P), and soft tissue pogonion (Pog') points. This analysis considers the nose because it plays a significant role in the overall soft tissue profile. According to Subtelny, the skeletal profile convexity decreases while the total soft tissue profile convexity increases with age. Furthermore, the soft tissue profile convexity is relatively stable with minimal changes. Subtelny states that the skeletal and facial soft tissue changes are not analogous and could impact a person's facial appearance.[12]

Based on a study on orthodontic patients in Faculty of Dentistry Dental Hospital of Trisakti University (RSGM-P FKG USAKTI), 75% of the patient needed treatment on malocclusion.[13] Malocclusion that develops during growth can affect the facial profile.[5] This study aims to describe the skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity in patients aged 6 to 12 years at the Faculty of Dentistry Dental Hospital of Trisakti University.

MATERIALS AND METHODS

A cross-sectional descriptive observational study was done at RSGM-P FKG USAKTI from September to December 2022. The samples used were 40 cephalograms of patients aged 6 to 12 years at RSGM-P FKG USAKTI between 2019 and 2020. The criteria used were patients were currently in the mixed dentition period, never had orthodontic treatment, had Angle's class I malocclusion, and their cephalograms were still in good condition. Cephalograms of patients with facial soft tissue disorders such as tumors and cephalograms with poor quality in terms of detail, sharpness, contrast, and anatomical features were excluded from this study. The tools and materials used were medical records, lateral cephalograms, tracing papers, an 0.5 mm HB mechanical pencil, an eraser, a ruler, a protractor, and tape. Tracing lateral cephalograms on tracing papers was done from the soft tissue profile, cranium base, maxilla, mandible, incisors, and first molars. The landmarks identified in Subtelny's analysis were nasion (N), A-point (A), pogonion (Pog), soft tissue nasion (N'), subnasale (Sn), pronasale



(A) (B) (C)

Figure 1. Subtelny's analysis on facial profile convexity. (A) Skeletal profile convexity. (B) Soft tissue profile convexity. (C) Total soft tissue profile convexity.

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(P), and soft tissue pogonion (Pog'). Subtelny's analysis was performed by measuring the angles of skeletal profile convexity (N–A–Pog), soft tissue profile convexity (N'–Sn–Pog'), and total soft tissue profile convexity (N'–P–Pog') in unit of angle (°) (Figure 1). Angle measurements were carried out twice over a week to obtain data reliability using intraclass correlation coefficient (ICC). The results of facial profile convexity measurements according to Subtelny's analysis were recorded, and a descriptive analysis was carried out using the IBM SPSS Statistics version 29 (New York, United States).

RESULTS

In this study, a total of 40 cephalograms of patients aged 6 to 12 years at RSGM-P FKG USAKTI between 2019 and 2020 were studied. They consisted of 20 cephalograms of female patients and 20 of male patients. Of these cephalograms, one was of a 6-year-old patient, eight were of 7-year-old patients, thirteen were of 8-year-old patients, ten were of 9-year-old patients, five were of 10-year-old patients, two were of 11-year-old patients, and one was of a 12-year-old patient.

As shown in Table 1, the average degree of skeletal profile convexity was 171.26° with a standard deviation of 4.80, a maximum value of 183.50°, and a minimum value of 160.50°. The average degree of soft tissue profile convexity in this study was 166.18° with a standard deviation of 5.68, a maximum value of 186.0°, and a minimum value of 156.0°. The average degree of total soft tissue profile convexity was 144.83° with a standard deviation of 4.03, a maximum value of 154.0°, and a minimum value of 136.0°.

Table 2 compares the descriptive statistics of facial profile convexity by gender. From the cephalograms of 20 female patients, the average degrees of skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity were 171.61°, 167.02°, and 145.03°, respectively. Meanwhile, from those of 20 male patients, the average degrees of skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity were 170.92°, 165.34°, and 144.64°, respectively.

DISCUSSION

Many cases of malocclusion are found in the mixed dentition period which generally occurs from 6 to 12 years of age.[2–4] Irregular rate and direction of teeth development and craniofacial growth during the mixed dentition period may

Table 1. Descriptive statistics of facial profile convexity

Variable	n	Mean ± SD	Range	Minimum	Maximum
Skeletal profile convexity	40	171.26° ± 4.80	23.00°	160.50°	183.50°
Soft tissue profile convexity	40	166.18° ± 5.68	30.00°	156.00°	186.00°
Total soft tissue profile convexity	40	144.83° ± 4.03	18.00°	136.00°	154.00°

Table 2. Descriptive statistics of facial profile convexity by gender

Variable	Gender	n	Mean ± SD	Range	Minimum	Maximum
Skeletal profile convexity	Female	20	171.61° ± 4.68	19.5°	163.0°	182.5°
	Male	20	170.92° ± 5.01	23.0°	160.5°	183.5°
Soft tissue profile convexity	Female	20	167.02° ± 6.22	27.5°	158.5°	186.0°
	Male	20	165.34° ± 5.10	15.5°	156.0°	171.5°
Total soft tissue profile convexity	Female	20	145.03° ± 4.32	16.5°	137.5°	154.0°
	Male	20	144.64° ± 3.83	13.0°	136.0°	149.0°

cause skeletal malocclusion, which could manifest in a disharmonious facial profile.[5,7] In this study, facial profile convexity was analyzed according to Subtelny's analysis using analogous landmarks on the skeletal and soft tissue structures. Subtelny's analysis can show differences in growth rate and timing of the facial profile structures at certain ages, and thus longitudinal characteristics and differences in the growth of skeletal and soft tissue profile structures can be identified.[12]

The average degree of skeletal profile convexity is 171.26°, with an average of 171.61° on female cephalograms and 170.92° on male cephalograms of 6- to 12-year-olds. Al-Zubaidi studied the skeletal profile convexity on samples aged 11-14 and 18-25.[14] In the age group of 11-14 years, Al-Zubaidi obtained an average skeletal profile convexity of 175.86° in females and 174.53° in males, while the results in the 18-25 years age group were 175.13° in females and 178.70° in males.[14] The difference in results may be due to the mandible that continues to grow until the age of 16 years in females and 18-20 years in males, while the growth of the calvaria and maxilla is completed by the age of 7 and 12 years, respectively.[15] The maxilla will mature earlier than the mandible, showing a higher skeletal profile convexity during childhood, making it difficult to distinguish class I and II skeletal patterns at this age.[16] Longitudinal studies have shown that during puberty and adolescence, horizontal growth of the mandible doubles and exceeds that of the maxilla, which results in the straightening of the facial profile.[16] Cephalocaudal principle refers to an increase in body proportions from the head-to-toe direction since the fetus, infancy, and along with growth.[17] The maxilla and mandible are less developed than the cranium during birth.[17] The maxilla located under the cranium then grows faster and its growth ends earlier than the mandible.[17] The forward growth of the mandible will decrease the skeletal profile convexity along with the increase of age.[18] The maxilla will become less prominent relative to the skeletal profile with the increase of age, and different parts of the skeletal profile vary in growth rates and timing.[19]

In this study, female and male cephalograms had an average soft tissue profile convexity of 167.02° and 165.34°, respectively, which could indicate that males had a more convex soft tissue profile than females from the samples collected. A female's face will appear more mature than a male's during childhood, but as age progresses, a male's profile will become straighter with a more prominent chin.[19] A study by Godt on samples with an average age of 13 years found that patients with class I skeletal malocclusion had an average soft tissue profile convexity of 165.73°.[20] A study by Farchani on Javanese people aged over 20 years found that the degree of soft tissue profile convexity in males was 163.47° and in females was 165.37°.[21] Subtelny stated that the degree of soft tissue profile convexity tends to be stable after the age of 6 years or only decreases slightly with age. The degree of soft tissue profile convexity only changes minimally from 6 months to 18 years of age when the nose was not taken into account in the measurement of the soft tissue profile convexity.[19]

In contrast to the soft tissue profile convexity, the total soft tissue profile convexity includes the nose in its measurement, hence the distinct difference between the degrees of soft tissue and total soft tissue profile convexity. In this study, the average total soft tissue profile convexity was 144.83°, with an average of 145.03° on female cephalograms and 144.64° on male cephalograms. A greater degree of total soft tissue profile convexity in female cephalograms may indicate that females have a less prominent facial profile than males. The nose plays a vital role in the overall facial profile. The septum cartilage, nasal bone, and mid-face continue to grow along with age until the age of 18. The growth of the nose in a frontal direction has a greater proportion in comparison with the other facial soft tissue structures.[19]

Based on the discussion of the three variables in this study, the variables measured experienced different changes along with growth. The mandible increases anteriorly as it grows, resulting in a less convex degree of skeletal profile convexity.[18] The total soft tissue profile convexity that includes the nose is stated to become more convex during growth.[22] However, the soft tissue profile convexity tends to be stable or experience minimal changes with age.[23] The changes and growth in skeletal and soft tissue structures measured in this study were neither parallel nor analogous. Soft tissue and total soft tissue profile convexity can also be influenced by the thickness of soft tissue, which varies from the skeletal surface to the facial soft tissue, thus showing soft tissue profiles that deviate from the skeletal profile and varies in individuals.[23] A variety in the soft tissues' thickness, length, and tone can affect the soft tissue profile convexity.[23] In addition, dental malocclusion with a large overjet can also affect the soft tissue profile convexity.[24] Other factors affecting the facial profile are gender and ethnic or racial group.[25] The Deutro Melayu race tends to have a more prominent maxilla which shows a more convex facial profile.[26]

Females and males may experience different craniofacial growth and facial profile convexity between genders.[6] Based on Taner's study about differences in craniofacial growth between females and males aged 10-11.5 years with class I malocclusion, the maxilla was more protrusive in males than females, while the sagittal position of the mandible is almost alike in both females and males.[6] The length and height of the mandible were also found to be greater in males.[6] Differences in facial characteristics between females and males could also be caused by sexual dimorphism.[27] Sexual dimorphism is the differences in sizes and shapes between females and males of the same species. Sexual dimorphism affects the face during puberty when the shape and size of a female's and male's face increase with age and create different secondary sexual characteristics such as a feminine or masculine face.[27] Males may have a bigger mandible, more prominent malar bone, and thinner lips and cheeks than females.[27] A study by Butovskaya found that the mandible and nasal bones, which plays a role in the facial profile, are the areas most affected by sexual dimorphism.[28]

A limitation of this study is that it was done on a small sample size due to limited time. Notwithstanding this limitation, this study could contribute to a deeper understanding of orthodontic treatment planning for patients aged 6 to 12 years. Furthermore, researchers could base this study on a larger sample size to get more accurate results. Future research could further study the correlations between skeletal profile convexity, soft tissue profile convexity, and total soft tissue profile convexity.

CONCLUSION

This study set out to describe the facial profile convexity using Subtelny's analysis in orthodontic cephalograms of 40 patients aged 6 to 12 years at Faculty of Dentistry Dental Hospital of Trisakti University. This study has identified an average skeletal profile convexity of 171.26°, soft tissue profile convexity of 166.18°, and total soft tissue profile convexity of 144.83°. The degrees of facial profile convexity could be influenced by age, gender, and differences in growth and changes of different skeletal and soft tissue profile structures.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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