

STRESZCZENIE W JĘZYKU ANGIELSKIM

The assessment of the soft tissue facial profile in relation to the facial morphology

INTRODUCTION

The assessment of a patient's facial profile is important in the diagnosis and planning of orthodontic treatment. Soft tissues can vary significantly in thickness, potentially masking the presence of significant dentofacial defects. In recent years, there has been an increasing interest in the morphology of the soft tissues facial profile (STFP) in the diagnosis of orthodontic patients. The analysis of the cephalometric radiographs head's is commonly used to evaluate the characteristics of the STFP. The literature reports conflicting findings regarding the STFP thickness in relation to the existing skeletal malocclusion in adults. However, there is limited evidence on the STFP in growing patients and age-related changes. Currently, orthodontists increasingly use artificial intelligence (AI) algorithms in cephalometric analysis. Despite a rapid development in AI's in different medical fields in recent years, clinicians still have concerns about the reliability of measurements obtained through automated cephalometric point marking by AI. Additionally, AI algorithms have a limited number of soft tissue measurements, although STFP morphology can significantly influence the planning of orthodontic treatment.

AIM

The aims of the study were:

1. to summarize the data from current literature regarding the influence of factors such as skeletal class or patient gender on the thickness of the STFP,
2. to assess the use and effectiveness of AI algorithms in orthodontic diagnostics based on studies assessing different types of AI algorithms,
3. to evaluate the relationship between STFP thickness and the skeletal malocclusion,
4. to compare the STFP thickness in different age groups,
5. to compare the STFP thickness in males and females.

MATERIAL AND METHODS

In the first publication, a literature review from 2002-2020 was conducted using the PubMed database, summarizing information on existing relationships between STFP morphology and the type of skeletal malocclusion and gender of the subjects. Due to existing discrepancies in the literature, the scarce evidence regarding the assessment of the STFP in children, and the lack of a similar study in the Polish population, a decision was made to conduct an own study.

In the second publication, a literature review was conducted to summarize information on the accuracy of AI algorithms in orthodontic diagnostics based on the cephalometric analysis. The PubMed, Medline, Scopus, and Dentistry & Oral Sciences Source databases from 2009-2023 were searched.

The third paper was a retrospective study evaluating the relationships between the thickness of the STFP and skeletal malocclusion, age, and gender. The study included Caucasian patients aged 7-35 who presented for orthodontic treatment at the Department of Orthodontics of the Medical University of Warsaw from 2019-22. The patients had cephalometric radiographs taken before starting orthodontic treatment. Exclusion criteria included patients with dentofacial deformities and facial traumas, previous prosthetic or surgical treatment, soft tissue augmentation procedures, lip incompetence, and poor-quality radiographs. The cephalometric analysis was performed in all enrolled patients which included the analysis of the STFP. Patients were assigned to one of the six study groups based on age and existing skeletal relationships (ANB angle). The minimum number of patients in each group was set at 60 with an equal gender distribution. The STFP analysis included ten linear measurements.

Statistical Analysis

In the retrospective study, the STFP thickness at different measurement sites was compared between groups. Due to the unknown mean and standard deviation of the assessed parameters for the population from which the evaluated samples were derived, the Lilliefors test was used for normality analysis. The analysis showed a lack of conformity with the normal distribution for most assessed parameters; therefore, non-parametric tests were used: the Mann-Whitney U test and the Kruskal-Wallis ANOVA test. Statistical analysis was performed using PQStat v. 1.6.8 software. A significance threshold of $p < 0.05$ was assumed. Twenty randomly selected radiographs were re-analyzed at four-week intervals. The results were then compared with the

results of the previous cephalometric analysis. The intraclass correlation coefficient (ICC) was used to determine the correlation between the first and second measurements. High repeatability of measurements was found ($p < 0.001$), with ICC values > 0.90 for most parameters, except for (U1-St and B-Lms), where values were 0.89 and 0.87, respectively.

RESULTS

The literature review on the differences in STFP thickness showed the presence of sexual dimorphism. In men, the thickness of the lips, soft tissues in the subnasal area, labiomental fold, and chin were significantly higher than in women. Additionally, there was a tendency for STFP to compensate for the underdevelopment of the maxilla or mandible or their retrusive position.

The database review on the effectiveness of AI algorithms used for cephalometric analysis confirmed that most AI algorithms used for automatic detection of cephalometric points were relatively accurate. However, the effectiveness of using AI in cephalometry varies depending on the algorithm or application, which should be considered when interpreting the results.

The retrospective study involved 300 patients who were assigned to five groups. Group 6 (growing patients with skeletal Class III) was not included in the study as the assumed group size was not achieved. Significant differences in the thickness of the STFP were found depending on the type of skeletal malocclusion. In adults with skeletal Class III, the thickness of the subnasal tissues was significantly increased compared to patients with skeletal Class I and Class. The thickness of the lower lip in patients with skeletal Class II was significantly increased compared to other groups. Children and adolescents with skeletal Class II had thicker lower lips compared to the group with skeletal Class I. Most measurements of the STFP were significantly smaller in children and adolescents compared to adults. The thickness of the STFP in males was significantly greater in all age groups compared to females.

CONCLUSIONS

1. There is a relationship between the thickness of the STFP and the presence of skeletal malocclusion and gender, which is important in planning orthodontic treatment in patients with skeletal abnormalities.
2. AI algorithms can be successfully used in orthodontic diagnostics, but their effectiveness depends on the quality of the data entered the analysis, the number and quality of cephalometric radiographs, and the type of AI algorithms or applications.
3. There is a relationship between the thickness of the STFP and the skeletal malocclusion, with compensation present in the area of insufficient anterior growth of the maxilla or mandible.
4. The thickness of the STFP varies depending on the age of the patients and is increased in adults.
5. Sexual dimorphism in the thickness of the STFP was found, with greater thickness in male subjects compared to females, both in adults and children and adolescents