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Original Article

Esthetic preferences of orthodontists, dentists, and plastic surgeons for balanced facial profiles

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Abstract

Purpose: The aim of this investigation was to determine whether the facial esthetics of subjects rated as "attractive" can be related to specific cephalometric soft tissue parameters.

Methods: The profile silhouettes of 100 subjects (45 males and 55 females) were rated by 60 esthetics specialists (20 orthodontists, 20 dentists, and 20 plastic surgeons) using a Likert scale, and 30 of the subjects were selected as being "attractive". The cephalometric measurements of the attractive group were then compared with norms for the general Caucasian population.

Results: The effects of specific measured parameters on profile beauty grades were assessed using the median test, and the following variables were found to show significant correlations between the Caucasian norms and the attractive profile group: the ratio of the upper to lower face height ($P = 0.011$), the ratio of the subnasale – labrale inferius (Sn-Li) and labrale inferius – menton (Li-Me`) lines ($P = 0.011$), the distance between the chin and the subnasale perpendicular ($P = 0.002$), upper lip thickness ($P = 0.021$), soft tissue chin thickness ($P = 0.021$), vertical height ratio ($P = 0.021$), and nasolabial angle ($P = 0.021$).

Conclusion: A straight profile with a fuller and more protruded upper lip, a higher nasal tip, and a smaller lower facial third are considered to be the most attractive facial features, and may be useful for improvement of facial esthetics.

Keywords: attractiveness, cephalometric, esthetic, perception, soft tissue profile

Introduction

The aim of orthodontic treatment is to maintain or improve facial esthetics, especially the soft tissue profile, which corresponds to changes caused by the movements of the underlying hard tissue, along with skeletal and dentoalveolar changes [1]. Recently there has been a tendency for patients to pay more attention to the esthetic outcome of orthodontic treatment, rather than function and occlusion [2]. Facial attractiveness has always been a topic of debate among specialists who aim to change facial traits and patients seeking treatment that can alter their facial appearance [3]. The concept of facial beauty is strongly connected with culture, media influence, fashion, and racial and ethnic factors [4-6]. Moreover, several studies have shown that people who are considered "attractive" are consistently rated as nicer, smarter (more intelligent), and healthier regardless of age, race, or ethnicity [7-9].

Soft tissue cephalometric and photographic analysis is widely used in orthodontics for assessment of facial harmony and attractiveness [10,11]. Evaluation of changes in soft tissue is one of the most important aspects of orthodontic planning and treatment [12]. Numerous authors have provided reference values for cephalometric analyses [10,13]. Ricketts (1960), Legan and Burstone (1980), Holdaway (1983), and Epker et al. (1998) have developed methods for detailed analysis of soft tissue that have been widely accepted in clinical orthodontics [13]. However, data on existing correlations between standard cephalometric values and their relationship to perceived facial beauty are still insufficient [14].

Numerous studies have shown that perceptions of facial attractiveness vary widely, especially between professional estheticians and laypeople [2,15,16]. It might be expected that the results of polls regarding facial esthetics among specialists in esthetic dentistry, orthodontists, and plastic surgeons, would be reliable and of significant clinical value. Despite the importance of facial esthetics, few previous investigations have been conducted among judges, professionals and laypeople [11,16]. The present study of a Serbian population (with Caucasian European ancestry) was conducted to clarify the factors that are considered to contribute to facial attractiveness, and to reveal any specific "attractiveness-related" parameters that might differ from reference values for the general Caucasian population.

Materials and Methods

The present study subjects were 100 selected patients seeking orthodontic treatment at the Faculty of Stomatology in Pančevo, University Business Academy in Novi Sad, Serbia. All of the patients provided signed informed consent to participate. The study was approved by the institutional Ethics Committee (protocol number: 363/2-2022, date of approval: 16 April 2022) and was performed in accordance with the ethical principles for medical research involving human subjects stipulated by the Declaration of Helsinki.

The inclusion criteria for patients were: Serbian (Caucasian) ethnicity, skeletal Class I, dental Class I molar and canine relationship with a normal overjet and overbite, no prior orthodontic or prosthodontic treatment, no history of previous tooth extraction (excluding third molars), no previous esthetic surgery in facial areas (such as rhinoplasty or lip augmentation), and with balanced facial profiles (evaluated subjectively by participating orthodontists). The sample comprised 45 males and 55 females with a mean age of 21.1 years (range 18-25.2 years). This age range was considered appropriate for appraisal of attractiveness, given the fact that most patients seeking orthodontic treatment for esthetic reasons are young adults, and that facial traits have developed completely by this stage. Complete documentation was available for all patients, including X-rays (OPG, lateral cephalograms) and profile and enface photographs. For this research, profile photographs were used for conducting a poll regarding esthetics.

To avoid any bias caused by facial traits such as skin texture, blemishes, eye color, eyebrow size and position, and in some cases make up/jewelry, the soft tissue profile photographs of the patients were converted to black silhouettes against a white background using Adobe Photoshop. First, the facial profiles considered attractive were selected on the basis of an esthetics-oriented poll involving 20 general dentists, 20 orthodontists, and 20 plastic surgeons who graded the profile silhouettes using a 1-5 Likert scale, where grade 1 represented a non-attractive profile, and grade 5 a very attractive profile [17].

A total of 30 silhouettes, considered by all three groups of professionals to have an average grade higher than or equal to 4, were used as an "attractive" group, and their cephalometric parameters were analyzed and

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Table 1 Comparison of soft-tissue cephalometric values for reference Caucasian norms (Epker & Fish) with the attractive profile group, by means of median test [18,28]

Parameter	Unit	Median	Mode	95% CI lower	95% CI upper	Min	Max	Orthodontic norms	*P*
Ratio of upper and lower facial height	%	113.00	110.00	106.52	126.01	94.00	149.00	100.00	0.011*
Ratio of upper and lower lip length	%	46.00	43.00	41.85	49.59	34.00	55.00	50.00	0.226
Ratio of the lines Sn-Li[1] and Li-Me`[2]	%	74.00	78.00	66.49	84.23	60.00	104.00	100.00	0.011*
Distance of upper lip to SnPerp	mm	−1.00	−5.00	−3.91	0.83	−7.00	5.00	0.00	0.343
Distance of lower lip to SnPerp	mm	4.00	−1.00	0.86	5.68	−1.00	9.00	2.00	1.000
Distance of chin to SnPerp	mm	8.00	5.00	5.91	9.17	4.00	12.00	4.00	0.002*

[1]Subnasale-labrale inferius. [2]Labrale inferius-menton. *Statistical significance ($P \leq 0.05$). One-sample median test; $P \leq 0.05$

Table 2 Comparison of soft-tissue cephalometric values for reference Caucasian norms (Holdaway) with the attractive profile group, by means of median test [18]

Parameter	Unit	Median	Mode	95% CI lower	95% CI upper	Min	Max	Orthodontic norms	*P*
Soft tissue facial angle	°	92.00	88.00	88.99	95.19	83.00	99.00	91	0.343
Nose prominence	mm	20.00	16.00	16.29	26.42	8.00	34.00	19	1.000
Soft tissue subnasale to H-line	mm	6.00	6.00	1.912	8.63	−5.00	14.00	5	0.548
Upper lip thickness	mm	14.00	14.00	13.49	17.95	12.00	23.00	13	0.021*
Soft tissue chin thickness	mm	13.00	13.00	11.97	17.11	10.00	22.00	11	0.021*
Lower lip to H-line	mm	1.00	2.00	−0.99	2.08	−3.00	4.00	0	0.753

*Statistical significance ($P \leq 0.05$). One-sample median test, $P \leq 0.05$

Table 3 Comparison of soft-tissue cephalometric values for reference Caucasian norms (Legan-Burstone) with the attractive profile group, by means of median test [18,28]

Parameter	Unit	Median	Mode	95% CI lower	95% CI upper	Min	Max	Orthodontic norms	*P*
Facial convexity angle	°	12.00	10.00	10.16	15.46	6.00	21.00	12	1.000
Maxillary prognathism	mm	6.00	2.00	3.95	7.31	2.00	9.00	6	1.000
Mandibular prognathism	mm	5.00	−5.00	−1.64	8.37	−6.00	14.00	0	0.548
Vertical height ratio	%	114.00	118.00	108.56	128.88	98.00	146.00	100	0.011*
Nasolabial angle	°	117.00	99.00	104.48	120.06	96.00	129.00	102	0.040*
Upper lip protrusion	mm	5.00	6.00	1.88	7.02	−3.00	10.00	3	0.226
Lower lip protrusion	mm	3.00	1.00	−0.31	4.67	−5.00	8.00	2	0.753

*Statistical significance ($P \leq 0.05$). One-sample median test, $P \leq 0.05$

Table 4 Comparison of soft-tissue cephalometric values for reference Caucasian norms (esthetic soft tissue profile analysis, Ricketts) with the attractive profile group, by means of median test [18]

Parameter	Unit	Median	Mode	95% CI lower	95% CI upper	Min	Max	Orthodontic norms	*P*
Ratio of median face to anterior facial height	%	49.00	49.00	45.73	50.26	42.00	54.00	45	0.109
Ratio of lower face to anterior facial height	%	51.00	51.00	49.73	54.26	46.00	58.00	55	0.109
Ratio of forehead third and facial height	%	32.00	31.00	29.13	34.86	21.00	37.00	33	0.753
Ratio of nasal third and facial height	%	32.00	32.00	30.71	34.91	28.00	39.00	33	0.507
Ratio of jaw third and facial height	%	35.00	32.00	33.19	37.53	31.00	40.00	33	0.226
Soft tissue profile	°	164.00	164.00	160.48	166.06	156.00	171.00	161	0.343
Soft tissue convexity	%	131.00	127.00	127.16	140.10	125.00	159.00	133	1.000
Nasolabial angle	°	117.00	99.00	104.48	120.06	96.00	129.00	100	0.021*
Upper lip protrusion	mm	−0.70	−2.00	−2.88	−0.07	−6.40	1.50	−2	0.548
Lower lip protrusion	mm	−3.40	−4.00	−4.84	−2.45	−7.10	−1.20	−4	0.179
Upper lip length	mm	25.80	27.00	23.16	27.54	18.80	29.60	24	0.109

*Statistical significance ($P \leq 0.05$). One-sample median test; $P \leq 0.05$

compared with the reference norms. The average age of this "attractive" group was 19.8 years (range 18.8-22 years). Cephalometric analyses were conducted using the OnyxCeph program (Image Instruments, Chemnitz, Germany) after identified anatomical points had been marked with an indicator using a mouse. Before marking the anatomical points, calibration was performed. The ruler on the cephalostat was calibrated, thus ensuring standardization of all cephalograms. Measurements were automatically derived from the program after marking the anatomical points. All landmark tracing and measurements were performed twice by the same operator (JM) with a two-week interval to minimize the possibility of error.

For soft tissue analysis (derived from the OnyxCeph software) the following approaches were used: Legan and Burstone (facial form and lip position and form parameters), Epker and Fish, Holdaway, Ricketts (esthetic problem), and esthetic soft tissue profile parameters. These cephalometric parameters were used to corroborate evaluations of soft tissue disharmony by comparison with measured values from reference norms. Classical norms were derived from a population with European or American ancestry. The reference norms imply that Caucasians should have an equal upper and lower facial height, twice the stomion-menton distance relative to the subnasale-stomion distance, the upper lip should be situated on the subnasale perpendicular, and the lower lip and chin should be behind the same line. Furthermore, reference norms also imply an equal glabella-subnasale and subnasale-menton distance (vertical height ratio), an upper and lower lip anterior to the subnasale-pogonion line, and a slightly obtuse nasolabial angle. In addition, the ratios of the forehead, nasal and jaw thirds should be equal. The upper and lower lip should be posterior to the Ricketts esthetic line. These norms are suggested for normal (but not necessarily "attractive") Caucasians [10,13,14]. As such, they were considered the standard norm for the present set of patients. Detailed reference values are included among the orthodontic norms in Tables 1-4.

Statistical analysis

The descriptive statistics (median, mode, minimum, maximum) are shown in the tables. The sample size was pre-calculated based on a preliminary study to obtain a test power of 0.95 for the majority of the traits used. The Kolmogorov-Smirnov Goodness of Fit Test was used to test for normality of the data. Variability measures (standard deviations) and 95% confidence intervals (CIs) were calculated for the esthetically pleasing group (n = 30). The Wilcoxon-Mann-Whitney test, a non-parametric analog to the

independent samples *t*-test, was used to assess the significance of gender differences in soft tissue profile traits.

One-sample median test was used to assess whether the median values of soft tissue profile traits differed significantly from the reference norms for cephalometric analysis proposed for Caucasians. *P*-values for the test were determined for each measured trait. The level of significance was set at $P < 0.05$. For evaluation of intra-observer reliability, the intra-class coefficient (ICC) was calculated.

Results

Intra-observer agreement was found to be excellent (ICC = 0.983). The Kolmogorov-Smirnov Test ($P = 0.0037$) rejected the null hypothesis that the data had a normal distribution, and therefore nonparametric tests were used for further analysis.

The mean age of the total sample was 21.1 years, whereas the mean age of the "attractive" group was 19.8 years. There were 16 females and 14 males in the "attractive" group, and 39 females and 31 males in the rest of the sample. The results of the Mann-Whitney test indicated no significant difference in the profile attractiveness scores between males and females ($P = 0.0781$).

For cephalometric analysis, the measurements for the attractive group were compared with the reference norms (for Caucasian ethnicity). The following parameters were larger in the attractive group: the ratio of the middle to lower face height or glabella-subnasale: subnasale-menton ratio (Gl`- Sn : Sn-Me`), the distance from the lower lip to the subnasale perpendicular, the distance from the chin to the subnasale perpendicular (Table 1), nose prominence according to Holdaway, upper lip strain, soft tissue chin thickness (Table 2), glabella subnasale : subnasale-menton or vertical height ratio, nasolabial angle, upper lip protrusion, lower lip protrusion (indicating more protruded lips in the attractive group compared with the norms) (Table 3), and upper lip length (Table 4).

The following measurements were smaller in the attractive group compared with the reference values: the ratio of the upper and lower lip length or subnasale-stomion: stomion-menton ratio (Sn-Sto : Sto-Me`), the ratio of the lines Sn-Li and Li-Me`, and the distance from the upper lip to the subnasale perpendicular (Table 1).

These findings demonstrated that the evaluators preferred silhouettes with a more protruded upper lip, a straight profile (due to chin position), a smaller distance between the subnasale point and the lower lip, a greater distance between the stomion and menton, and between the lower lip and the menton, a thicker upper lip, and an increased nasolabial angle in terms of a steep columella, i.e., a higher position of the lower nasal tangent.

Cephalometric norms did not differ significantly from the following measurements in the attractive group: ratio of the upper and lower lip length, distance of the lower lip to the subnasale perpendicular, the distance from the upper lip to the subnasale perpendicular, the distance from the lower lip to the subnasale perpendicular (Table 1), the soft tissue facial angle, nose prominence, soft tissue subnasale to H-line, the distance of the lower lip to the H-line (Table 2), facial convexity, maxillary and mandibular prognathism, upper and lower lip protrusion (Table 3), division of the face into equal thirds, the soft tissue profile, soft tissue convexity, upper and lower lip protrusion, and upper lip length (Table 4).

Discussion

This research attempted to determine whether there is a correlation perceived esthetic facial beauty and reference cephalometric norms for soft tissues, and to clarify the extent to which matching these norms might contribute to esthetic improvement. Soft tissue features can be transformed from unattractive to attractive by orthodontic treatment, orthognathic surgery, or plastic surgery [18].

Previous investigations of profile attractiveness have used facial photographs. Several authors [19,20] have considered that facial photographs are more reliable for analysis of esthetic preference. On the other hand, other authors have suggested that profile silhouettes eliminate distracting factors from the face and thus avoid bias among raters [21-23]. To overcome these concerns and disadvantages related to esthetic evaluation of facial profiles, facial silhouettes were used for attractiveness ranking in the present study.

In orthodontics, symmetry and harmony are widely accepted and considered to be major factors contributing to facial beauty. Division of the face into equal horizontal thirds is a concept dating back to the ancient Greeks. The attractive group selected in the present study had balanced facial thirds, with a slightly shortened lower third. This was in accord with the study by Ding [24]. On the other hand, in a study of North American Caucasians, Farkas et al. [25] considered that a lower facial third larger than the upper and middle thirds was attractive.

Soft tissue profile angles, both excluding and including the nose, corresponded almost ideally with the reference values. Moreover, in the present study, the soft tissue profile and soft tissue convexity angles were smaller in the attractive group. These findings were in contrast to those for Iranian subjects, where a convex profile was considered more esthetically pleasing to layperson judges [18]. In the present study, higher scores were assigned for a less convex and more straight profile. This accorded with several studies in which straight profiles were considered more esthetically pleasing [11,16,26], but differed from the study by Matoula and Pancherz [27], who suggested that convex profiles were more desirable and, with fuller lips, often associated with youth. The difference in evaluation might be a result of ethnic and cultural variations, since previous investigations have shown that convexity is preferable for female profiles in Iranian, Turkish, and even German populations [28].

Over the last few decades, fuller and more prominent lips have become more important for facial esthetics, and along with a smaller nose and a straighter profile [18]. Lip prominence, particularly in profile view, is considered to be a significant esthetic parameter [29]. Lip position is arguably a feature associated with ethnic differences. Therefore, a single ethnicity – in the present case Caucasian – needs to be investigated in order to avoid any incongruity in attractiveness ranking that might occur when Japanese, African American, or Hispanic American subjects are compared [18]. Previous investigations [30,31] have suggested that relatively fuller lips are a more attractive feature. The Ricketts esthetic norm is recommended for appraisal of lip form, and reference norms consider lips posterior to the esthetic line to be more appealing. In the present study, upper lips that were more protruded (closer to E-line) and lower lips that were more retruded were considered more attractive. Naini et al. [29] reported that more protruded lips relative to the E-line were generally preferable in terms of perceived attractiveness.

The present study showed that patients with a less prominent nose were ranked as significantly more attractive. Similarly to nose prominence, the soft tissue convexity angle including the nose showed decreased values in the attractive group. This agreed with the results of Fastuca et al. [32] and Alhammadi [11], who suggested that attractive faces had a smaller nose along with fuller and more protruded lips. In other reports as well, it has been suggested that a prominent nose impacts negatively on attractiveness [28].

In the attractive group, the nasolabial angle was more obtuse than in Korean and Chinese individuals [33]. However, similar results have been reported for White American and Yemeni subjects ranked as attractive [34]. A more obtuse nasolabial angle and its positive correlation with facial beauty have been demonstrated in Brazilian, Chinese, and Saudi culture [28]. This is consistent with a study by Choi et al. [35] in which a higher nasal tip with a fuller upper lip was considered significantly more important for female facial esthetics, along with protruded lips. However, several studies have shown that variations in the nasolabial angle can result in reduced perception of attractiveness. Bin Ayub et al. [36] found that a decreased nasolabial angle was the least desirable esthetic parameter, according to orthodontists and esthetics specialists, except for otorhinolaryngologists, who found that an increased angle was more attractive.

According to soft tissue analyses involving Epker Fish and Legan Burstone relations for the lower facial third, attractive individuals showed similarity in terms of the vertical position of the lips and chin [18,23]. Moreover, the lower facial third division in the upper and lower part in the attractive group also showed high similarity with reference values. A decreased lower facial third was found to be more desirable in terms of higher attractiveness scores. Moreover, it was observed that a greater nose-lip distance and a smaller lip-chin distance were preferable for white American and Turkish females, whereas for Iranian females this proportion was closer to 1 [28]. In the present study, attractive Serbian subjects showed proportions smaller than 1.

This study had several possible limitations. First, only facial esthet-

ics professionals (orthodontists, general dentists, and plastic surgeons) were involved in the ranking of attractiveness. Profile esthetics might be perceived differently among various groups (especially laypeople). Some studies have implied that professionals might be biased as a result of their educational background [28], while others have stressed that laypeople might better reflect cultural influence when assessing facial attractiveness [18,37]. Nevertheless, some authors have reported general agreement among professionals and laypeople in terms of perception of facial appearance [3,32].

Nonetheless, it was observed in this study that professional judges ranked attractiveness with lower grades, since 30% of the subjects (30/100) were assigned high attractiveness scores. Therefore, the present results should be interpreted with caution, primarily because of the relatively small number of subjects among the whole sample who were ranked as attractive. However, these results are consistent with those of previous studies that used polls to evaluate facial esthetics [15,18], where orthodontists assigned lower attractiveness scores than did laypeople. Furthermore, the number of subjects ranked as attractive could have been a possible study limitation. On the other hand, a larger sample might have given rise to fatigue, and thus biased the evaluators.

Despite these limitations, the present study had several strengths. First, it appears to be the first study to have compared Serbian subjects with Caucasian cephalometric norms. Although the Serbian population is considered Caucasian, some of the results showed a difference in reference norms, which might imply a different ethnic background in this part of Europe. In addition, 60 judges ranked attractiveness in a sample of 100 individuals. This appears to be the highest number of professional judges yet involved in such a study, suggesting the reliability of the results.

In conclusion, this study has shown that there were no significant differences between cephalometric norms and perception of attractiveness for the upper facial third. However, a significant difference between reference Caucasian norms and values in the attractive profile group was found for parameters determining the lower facial third (ratio of upper and lower facial height and lower facial third subdivision), nasolabial angle, and upper lip and chin position. Therefore, it can be concluded that subjects with a straight profile, a fuller and more protruded upper lip, a higher nasal tip, and a smaller lower facial third are considered to be the most subjectively attractive.

Conflicts of interest

None declared.

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