



Paper Accepted*

ISSN Online 2406-0895

Original Article / Оригинални рад

Jovana Milutinović¹, Nenad Nedeljković^{1,†}, Nenad Korolija², Biljana Miličić³

Facial profile esthetics change of Class II patients treated with the Herbst appliance as perceived by orthodontists and laypersons

Процена промене фацијалне естетике код пацијената са II класом малоклузије лечених Хербст апаратом

¹University of Belgrade, School of Dental Medicine, Department of Orthodontics, Belgrade, Serbia;

²University of Belgrade, School of Electrical Engineering, Belgrade, Serbia;

³University of Belgrade, School of Dental Medicine, Department of Statistics, Belgrade, Serbia

Received: September 26, 2016

Accepted: December 12, 2016

Online First: March 21, 2017

DOI: 10.2298/SARH160926081M

* **Accepted papers** are articles in press that have gone through due peer review process and have been accepted for publication by the Editorial Board of the *Serbian Archives of Medicine*. They have not yet been copy edited and/or formatted in the publication house style, and the text may be changed before the final publication.

Although accepted papers do not yet have all the accompanying bibliographic details available, they can already be cited using the year of online publication and the DOI, as follows: the author's last name and initial of the first name, article title, journal title, online first publication month and year, and the DOI; e.g.: Petrović P, Jovanović J. The title of the article. *Srp Arh Celok Lek*. Online First, February 2017.

When the final article is assigned to volumes/issues of the journal, the Article in Press version will be removed and the final version will appear in the associated published volumes/issues of the journal. The date the article was made available online first will be carried over.

† **Correspondence to:**

Nenad NEDELJKOVIĆ

School of Dental Medicine, Gastona Gravijea 2, 11000 Belgrade, Serbia

Email: nenad.nedeljkovic@stomf.bg.ac.rs

Facial profile esthetics change of Class II patients treated with the Herbst appliance as perceived by orthodontists and laypersons

Процена промене фацијалне естетике код пацијената са II класом малоклузије лечених Хербст апаратом

SUMMARY

Introduction/Objective The recognition of differences in individual assessment of facial attractiveness could be valuable assistance in planning the orthodontic treatment.

The aim of this study was to compare facial profile attractiveness changes of the patients treated with the Herbst appliance perceived by orthodontists and laypersons.

Methods The patient sample comprised 33 young Caucasian still growing patients, aged 14-18, with skeletal Class II malocclusion treated with the Herbst and multibracket appliances. Facial profile photographs before and after the treatment were shown to 54 orthodontists and 50 laypersons. In the aesthetics oriented poll, the evaluators rated the change in facial appearance.

Results The attractiveness scores differed between the two raters groups ($p < 0.001$), with orthodontists being more generous, whereas there was no significant difference between female and male evaluators in both groups ($p > 0.05$). However, scores differed significantly in grading female and male patients ($p < 0.001$), so that female patients got higher scores; between different age groups of the evaluators ($p < 0.001$), younger evaluators graded more critically; as well as between the patients with different initial severity of malocclusion ($p < 0.001$).

Conclusion The difference in attractiveness scores differed between two groups, with laypersons being more critical than orthodontists. Higher scores were given to female patients by both groups, as well as by the evaluators in the older age group.

Keywords: esthetics; malocclusion, angle class II; orthodontic appliances

САЖЕТАК

Увод/Циљ Препознавање разлика у индивидуалној процени фацијалне атрактивности може бити од велике помоћи у планирању ортодонске терапије.

Циљ рада је био да се упореди промена атрактивности профила лица пацијената третираних Хербст апаратом од стране ортодоната и лаика.

Метод Узорак се састојао од 33 испитаника, узраста 14–18 година. Сви су имали малоклузију II класе и били су лечени Хербст апаратом у комбинацији са горњим и доњим фиксним апаратом. Њихове профилне фотографије пре и после терапије су прегледали 54 ортодоната и 50 лаика. Они су оцењивали, у виду анкете, промену фацијалне атрактивности.

Резултати Оцене фацијалне привлачности разликовале су се између две групе ($p < 0.001$): ортодонтима су давали веће оцене, а није било статистички значајне разлике између полова у обе групе ($p > 0.05$). Међутим, резултати су се значајно разликовали при оцењивању мушких и женских пацијената које су добиле веће оцене ($p < 0.001$). Резултати су се значајно разликовали између различитих старосних група оцењивача ($p < 0.001$), тако да је млађа група давала ниже оцене, тј. била критичнија у процени. Разлика је била значајна и код оцењивања пацијената са различитим степеном изражености анормалије ($p < 0.001$).

Закључак Разлика у оценама фацијалне привлачности постојала је између две групе, те су лаици били критичнији у оцењивању у односу на ортодонтима. Веће оцене добиле су пацијенткиње од стране обе групе, а старија узрасна група оцењивала је већим оценама све пацијенте.

Кључне речи: естетика; малоклузија II класе; ортодонски апарати

INTRODUCTION

Today's orthodontic patients are mainly concerned about the aesthetic outcome of the treatment, given the fact that their facial aesthetics is jeopardized by different type of malocclusion [1, 2]. The Class II malocclusion deeply affects facial harmony and changes the patient's appearance. For the majority of Class II patients, aesthetic issues such as convex profile and retruded chin are the chief complaints when seeking orthodontic treatment and thus of primary importance [3].

Among various treatments of Class II malocclusion, combined orthodontics two-phase treatment which includes the Herbst and multibracket appliances provides significant skeletal

changes, especially in adolescents and young adults, and highly improves soft-tissue profile of these patients [4–6]. This fixed functional appliance straightens the facial profile due to the sagittal mandibular growth and has high efficiency even after adolescent period. This appliance can be considered as an alternative to orthognathic surgery in adult patients, especially hesitating ones [7, 8]. Patients with less severe profile convexity problems are reluctant to accept surgical procedure, given the fact that problems like teeth alignment, large overjet, and beauty of the smile and face can be successfully treated with the fixed functional appliance. Therefore, for adult patients whose main concern is not their profile, the Herbst appliance can be considered a reliable alternative to orthognathic surgery [6].

Facial attractiveness is a complex issue, especially among adolescents who tends to be strongly concerned about their facial appearance [9]. The recognition of differences in individual assesment of facial attractiveness could be valuable assistance in planning the orthodontic treatment.

Several studies have shown that the perception of facial attractiveness differs between patients, peers, and dental professionals [10–12].

Some studies showed orthodontists being more generous than laypersons [13–17], assumingly based on their clinical experience, while others reported agreement between evaluators of different professions [18, 19]. Nevertheless, prior knowledge of the treatment procedure usually causes biased view of treatment outcome and facial improvement evaluation in a group of orthodontists [1].

The purpose of this study was to analyze the difference in aesthetic evaluations by orthodontists and laypersons of profile photographs of skeletal Class II patients who have finished the treatment with the Herbst and multibracket appliances.

METHODS

The patient sample comprised of 33 still growing patients, aged 14 to 18, skeletal Class II, division 1 and Caucasian ethnicity. All patients were successfully treated with combined two-phase therapy which included the cast splint Herbst appliance followed by multibracket appliances treatment. The treatment duration was on average 20 months, respectively. After combined two-phase treatment, all patients achieved a Class I occlusion.

The patients pre- and posttreatment profile photographs were used. The right-side profile photographs were taken in a standing position, in central occlusion. Before every recording the operator ensured that the subject's forehead, neck, and ear were clearly visible (Figure 1 and Figure 2).

All cephalometric points and measurements were carried out by one author (JM) and repeated after 6 months. Cephalometric analysis had indicated that all the patients had a skeletal Class II pattern. (Figure 3 and Figure 4).

Key cephalometric parameters are shown in Table 1.



Figure 1. Patient's profile photograph before the treatment.



Figure 2. Patient's profile photograph after the treatment.

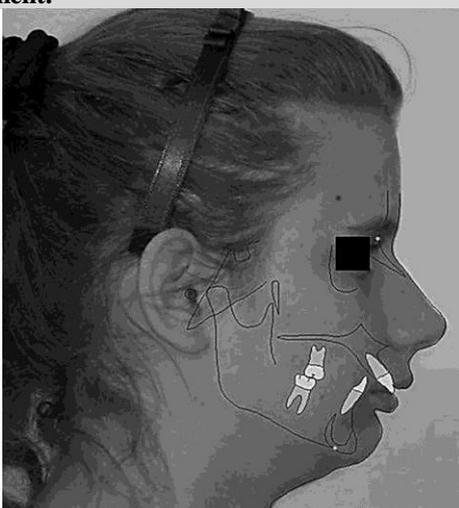


Figure 3. Profile cephalometric drawing superimposed with the patient's profile photos before the treatment.

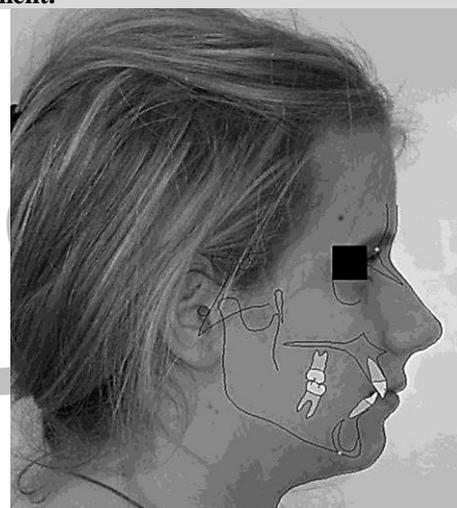


Figure 4. Profile cephalometric drawing superimposed with the patient's profile photos after the treatment.

Table 1. Key cephalometric parameters.

| | Before treatment | After treatment | <i>p</i> |
|--------------|------------------|-----------------|------------------|
| | Mean±SD | Mean±SD | |
| SNA (°) | 81.0±2.8 | 80.1±2.9 | <i>p</i> < 0.001 |
| SNB (°) | 74.7±3.3 | 76.6±3.2 | <i>p</i> < 0.001 |
| ANB (°) | 6.1±1.8 | 3.9±0.9 | <i>p</i> < 0.001 |
| SN/SpP (°) | 9.6±3.2 | 9.8±3.5 | n.s. |
| SN/MP (°) | 32.4±5.3 | 32.2±5.2 | n.s. |
| SpP/MP (°) | 22.8±4.9 | 22.4±4.7 | n.s. |
| Co-Gn (mm) | 110.6±5.0 | 113.0±4.7 | <i>p</i> < 0.001 |
| I/SpP (°) | 121.5±7.0 | 112.4±4.9 | <i>p</i> < 0.001 |
| i/MP (°) | 95.3±5.3 | 102.1±7.9 | <i>p</i> < 0.001 |
| I/i (°) | 120.8±7.8 | 123.3±9.8 | n.s. |
| CmSnLs (°) | 113.6±8.8 | 116.6±8.6 | n.s. |
| Si-LiPg (mm) | -7.6±1.7 | -5.1±1.1 | <i>p</i> < 0.001 |
| Ls-SnPg (mm) | 5.1±1.7 | 3.3±1.7 | <i>p</i> < 0.001 |
| Li-SnPg (mm) | -4.4±2.3 | -3.9±2.6 | <i>p</i> < 0.001 |
| G-Sn-Pg (°) | 159.6±5.5 | 163.4±7.1 | <i>p</i> < 0.001 |

Eleven patients had a more pronounced malocclusion before the treatment (which was determined by the prominence of ANB angle with the value of greater or equal to 7 degrees, with overjet larger than 10 mm, and the mentolabial sulcus depth over 8 mm). In order to avoid bias and evaluators presumption about patients with higher malocclusion severity, these patients were randomly infiltrated in the whole sample.

A group of 104 evaluators participated in the survey in order to judge the profiles of each patient. The evaluators were divided into two groups:

1. Orthodontists group: Comprised of 54 specialists in Orthodontics, 22 females and 32 males, mean age of 37.5 years;

2. Lay group: Comprised of 50 people with no dental knowledge, classified as lay in the area. In this group, 34 were male and 16 were female and the mean age was 22.4 years.

Before grading, each and every examinee was asked to fill a short questionnaire concerning gender, age (groups were divided in 20-34 and 35-50 years) and profession. All examinees were introduced with the grading procedure and explained that they were expected to evaluate only the change in facial attractiveness comparing before and after photographs, not the level of attractiveness in general for each subject.

The experimental procedure used in this study can be defined as follows:

(a) The examinee is shown two black and white cropped photos of the patient, one before and one after the treatment, and is asked to grade the aesthetics change, on a modified Likert scale, from 0 - no change to 5 - excellent. (Figure 1 and Figure 2).

(b) The photo pair is kept on the screen, until the examinee clicks on one of the choices (0 to 5). This kind of electronic questionnaire provides privacy for each and every examinee, and enables time and concentration during the grading of patients.

Ethical approval for this research was obtained from the Ethical Committee, Faculty of Dentistry, University of Belgrade. All patients undergoing orthodontic treatment at the Clinic of Orthodontics signed an informed consent prior to the treatment. The patients in this study have consented to their clinical information, including radiographs and photographs to be used for any research or presentations associated with the Faculty of Dentistry, University of Belgrade.

Statistical analysis

SPSS ver. 18 software (SPSS Inc., Chicago, IL, USA) was used for statistical analysis of data. Descriptive statistics for the assessment of changes in the aesthetic appearance were performed with measure of central tendency (mean and median) and measure of dispersion (standard deviation, min-max). Influence of each investigated parameter (variables concerning patient's related factors, as well as evaluator's related factors) on facial improvement scores, were analyzed using Mann-Whitney or Kruskal-Wallis tests, depending on the number of categories. Univariate and multivariate linear regression analysis were used to evaluate the relationship between facial improvement scores (dependent variable) and potential determinants. Statistical significance was defined as $p < 0.05$. Linear regression model was used to determine predictors for facial improvement scores. Differences were considered significant when p-value was < 0.05 .

RESULTS

Statistical significance was found for patient and evaluator related factors. In the Table 2 one can observe higher mean improvement for the female patients (mean=2.5±1.4), with the difference

Table 2. Patient's related factors.

| Parameters | | Facial improvement scores | | | | p |
|-------------------------|--------|---------------------------|-----|--------|---------|---------|
| | | Mean | SD | Median | Min-Max | |
| Patient's Gender | Male | 2.4 | 1.4 | 2 | 0-5 | p<0.001 |
| | Female | 2.5 | 1.4 | 3 | 0-5 | |
| Malocclusion Prominence | Lower | 2.4 | 1.4 | 3 | 0-5 | p<0.001 |
| | Higher | 2.6 | 1.4 | 3 | 0-5 | |

between patient's gender being statistically significant (p<0.001). The mean improvement scores were also higher for patients with more

pronounced malocclusion (mean=2.6±1.4), with statistically significant difference between these two groups of patients (p<0.001).

Table 3 showed the difference between evaluator's related factors, such as gender, age and profession. The facial improvement scores were influenced by evaluator's age (p<0.001), as well as evaluator's profession (p<0.001). In the group of orthodontists, the mean improvement score was

Table 3. Evaluator's related factors.

| Parameters | | Facial improvement scores | | | | p |
|------------------------|---------------|---------------------------|-----|--------|---------|---------|
| | | Mean | SD | Median | Min-Max | |
| Evaluator's Gender | Male | 2.3 | 1.5 | 2 | 0-5 | p=0.060 |
| | Female | 2.8 | 1.4 | 3 | 0-5 | |
| Evaluator's Age | 20-34 years | 2.5 | 1.4 | 3 | 0-5 | p<0.001 |
| | 35-50 years | 3.1 | 1.1 | 2 | 0-5 | |
| Evaluator's Profession | Orthodontists | 3.1 | 1.2 | 3 | 0-5 | p<0.001 |
| | Layperson | 1.9 | 1.4 | 2 | 0-5 | |

3.1±1.2, while in the second group, the layperson group, that value was 1.9±1.4.

Four out of five predictors in the regression model in the Table 4 showed to be significant: patient's gender (p<0.001), prominence of malocclusion (p<0.001), evaluator's age (p<0.005) and profession (p<0.001).

Multiple linear regression analysis was used to determine predictors that might have an effect on the attractiveness improvement scores. When univariate predictor showed significance for overall model, multivariate regression model was introduced. In the Table 4, one can observe that patient's gender, prominence of malocclusion, evaluator's age and profession appeared as independent predictors for facial attractiveness improvement scores.

Table 4. Linear and multiple regression analysis.

| | Univariate regression model | | Multivariate regression model | |
|-------------------------|-----------------------------|---------|-------------------------------|----------|
| | B* (95% CI) | p | B# (95% CI) | p |
| Patient's Gender | 0.165 (0.065-0.265) | p<0.001 | 0.200 (0.107-0.292) | p<0.001 |
| Malocclusion Prominence | 0.176 (0.078-0.275) | p<0.001 | 0.209 (0.118-0.299) | p<0.001 |
| Evaluator's Gender | 0.590 (0.490-0.689) | p<0.001 | 0.055 (-0.048-0.159) | p= 0.294 |
| Evaluator's Age | 0.605 (0.254-0.956) | p<0.001 | 0.556 (0.235-0.877) | p<0.001 |
| Evaluator's Profession | -1.197 (-1.285-(1.108)) | p<0.001 | -1.170 (-1.269-(1.071)) | p<0.001 |

* Unstandardized Coefficient B.

DISCUSSION

In this study, the patients were still growing orthodontic patients whose primary concerns were the looks of profile, frontal view of their teeth and smile. All patients were in post puberty period of

growth, which is adequate timing for using the Herbst appliance, given the fact that in this age clinicians could expect long term stability with less probability for relapse, compared to Class II treatment with removable functional appliances in growing adolescents (patients in puberty period of growth). According to Pancherz and Ruf [4], this kind of treatment has a positive effect on facial attractiveness, due to anterior movement of the chin and thus straightening the profile. Moreover, this appliance displayed an effect on skeletal and dental features, and consequently on soft tissue structures which cover them [5]. It is worth mentioning that patients with a more severe Class II skeletal problem (which highly affects profile appearance), are advised to seek surgical, rather than orthodontic treatment [6].

Dunlevy et al. [13] emphasized that opinions and grading of an aesthetical change among orthodontists and layperson often differ. Therefore, it is of high importance for orthodontists to know what will public consider as the most relevant for improving patient's face.

Many authors tried to determine whether and to what extent perception of facial appearance differ between professionals and laypersons. Some authors have reported general agreement between clinicians and the public [13–18], as opposed to some studies which showed difference between these two groups [11, 12]. This study conflicts with couple of studies that have found laypersons tended to be more generous in evaluating profiles than orthodontists [18, 19].

The difference in scoring facial change was found in both groups of evaluators, depending on the age of evaluators. Group of evaluators aged 35-50 graded facial change with higher scores than younger group, aged 20-34. This result coincide with the the study conducted by Naini et al. [20] who implied that older judges are more generous scorers than younger examiners.

This difference could also be explained with the fact that elderly people appreciate beauty and youth more than younger ones, who tends to be more critical [21]. Attractiveness scores were influenced by the gender of patients. This was the case with both raters group, and confirms data from the literature which suggest that attractiveness ratings of female patients are influenced by multiple factors [22, 23].

Nevertheless, in order to eliminate all extrinsic and intrinsic distracting factors for female patients (such as hair style, make-up, jewelry, and skin complexion) black and white cropped photographs were used (revealing only forehead, nose, chin, chin-throat length and up to the ear). Moreover, female patients got higher scores, given the fact that slightly convex profile is considered more attractive in females than males. This was in the line with the findings of von Bremen et al [6].

However, grading was not affected by the gender of evaluators in both groups. This result is consisted with other studies which also showed that there was no significant difference in attractiveness scores between female and male evaluators [24–26].

There are limitations when using the questionnaire to measure a subjective phenomenon, such as facial attractiveness. In the present study, biases results after presenting pre- and posttreatment

photographs, especially in a group of orthodontists, are expected and could explain higher rankings than in a layperson group, results that coincide with those of previous study [1].

The results of this study showed that layperson group graded changes of facial attractiveness more critically. One can only assume that the lower grades in layperson's group presents their unawareness of seriousness of this orthodontic problem and complexity of the treatment procedure. However, objective opinion could be one of the guidelines for orthodontists in their pursuit for patient's satisfaction with the treatment outcome.

The degree of patient's facial aesthetics change after the treatment viewed from layperson's perspective could provide valuable information for orthodontists. In order to avoid patient dissatisfaction after finished treatment, it is crucial for clinicians not to overestimate the treatment outcome as their perception of facial aesthetics improvement is usually biased. Therefore, this type of study might help in coinciding patient's wishes and orthodontists predictions about the outcome of the treatment.

One of the important aspects in the present study was the finding that in cases with more pronounced malocclusion, the impact of the aesthetical improvement was higher; which is contrary to what many practitioners typically expect and has been shown in another study (it is often assumed that high initial deficiency would rarely result into something that represents a considerable improvement) [27,28]. The bigger the change was, the bigger the impact on difference in average grade before and after the treatment was. However, if the initial problem is relatively small, other distracting factors may have a dominant impact on the overall aesthetics.

CONCLUSION

The results of this study showed an improvement of facial aesthetics in Class II patients after the orthodontic treatment with Herbst and multibracket appliances. This research indicates significant difference between orthodontists and laypersons judging the change in facial improvement after treatment, with orthodontists being more generous. Higher scores were given to female patients by both groups, as well as by the evaluators in the older age group. Severity of pre-treatment status noticeably influences the outcome of aesthetic evaluations, thus patients with more pronounced malocclusion got higher scores in both raters groups.

ACKNOWLEDGMENT

This study was supported by grant III41007 from the Ministry of Education, Science and Technological Development of the Republic of Serbia. The authors deny any conflict of interest related to this study.

REFERENCES

1. Ng Doreen, De Silva RK, Smit R, De Silva H, Farella M. Facial attractiveness of skeletal Class II patients before and after mandibular advancement surgery as perceived by people with different backgrounds. *Eur J Orthod.* 2013; 35: 515–20.
2. Silvola AS, Varimo M, Tolvanen M, Rusanen J, Lahti S, Pirttiniemi P. Dental esthetics and quality of life in adults with severe malocclusion before and after treatment. *Angle Orthod.* 2013; 84: 594–9.
3. Shell TL, Woods MG. Perception of facial esthetics: a comparison of similar class II cases treated with attempted growth modification or later orthognathic surgery. *Angle Orthod.* 2013; 73: 365-73.
4. Pancherz H, Ruf S. The Herbst Appliance: Research - based updated clinical possibilities. *World J Orthod.* 2000; 1: 17–31.
5. Nedeljko N, Cubrilo D, Hadzi-Mihailovic M. Changes in soft tissue profile following the treatment using a Herbst appliance - A photographic analysis. *Mil Med & Pharm J.* 2014; 71: 9–15.
6. von Bremen J, Erbe C, Pancherz H, Ruf S. Facial-profile attractiveness changes in adult patients treated with the Herbst appliance. *J Orofac Orthop.* 2014; 75: 167–74.
7. Alvares JCDC, Cancado RH, Valarelli FP, Freitas KMSD, Angheben CZ. Class II malocclusion treatment with the Herbst appliance in patients after the growth peak. *Dental Press J Orthod.* 2013; 18: 38-45.
8. Ruf S, Pancherz H. Orthognathic surgery and dentofacial orthopedics in adult Class II Division 1 treatment: mandibular sagittal split osteotomy versus Herbst appliance. *Am J Orthod Dentofacial Orthop.* 2004; 126: 140–52.
9. de Paula DF, Santos NC, da Silva ÉT, Nunes MF, Leles CR. Psychosocial impact of dental esthetics on quality of life in adolescents. *Angle Orthod.* 2009; 79: 1188–93.
10. Yin L, Jiang M, Chen W, Smale RJ, Wang Q, Tang L . Differences in facial profile and dental esthetic perceptions between young adults and orthodontists. *Am J Orthod Dentofacial Orthop.* 2014; 145: 750–6.
11. Lines PA, Lines RR, Lines CA. Profilemetrics and facial esthetics. *Am J Orthod Dentofacial Orthop.* 1978; 73: 648–57.
12. Cochrane SM, Cunningham SJ, Hunt NP. A comparison of the perception of facial profile by the general public and 3 groups of clinicians. *Int J Adult Orthod Orthognath Surg.* 1999; 14: 291–5.
13. Dunlevy HA, White RP Jr, Turvey TA. Professional and lay judgment of facial esthetic changes following orthognathic surgery. *Int J Adult Orthod Orthognath Surg.* 1987; 2: 151–8.
14. Romani KL, Agahi F, Nanda R, Zernik JH. Evaluation of horizontal and vertical differences in facial profiles by orthodontists and lay people. *Angle Orthod.* 1993; 63: 175–82.
15. Burcal RG, Laskin DM, Sperry TP. Recognition of profile change after simulated orthognathic surgery. *J Oral Maxil Surg.* 1987; 45: 666–70.
16. Shelly AD, Southard TE, Southard KA, Casco JS, Jakobsen JR, Fridrich KL, Mergen JL. Evaluation of profile esthetic change with mandibular advancement surgery. *Am J Orthod Dentofacial Orthop.* 2000; 117: 630–7.
17. Janson G, Branco NC, Morais JF, Freitas MR. Smile attractiveness in patients with Class II division 1 subdivision malocclusions treated with different tooth extraction protocols. *Eur J Orthod.* 2014; 36: 1-8.
18. Kerr WJ, O'Donnell JM. Panel perception of facial attractiveness. *Br J Orthod.* 1990; 17: 299–304.
19. de Almeida MD, Bittencourt MAV. Anteroposterior position of mandible and perceived need for orthognathic surgery. *J Oral Maxil Surg.* 2009; 67: 73–82.
20. Naini FB, Donaldson AN, Cobourne MT. Assessing the influence of mandibular prominence on perceived attractiveness in the orthognathic patient, clinician, and layperson. *Eur J Orthod.* 2012; 34: 738–46.
21. Foos PW, Clark MC. Adult age and gender differences in perceptions of facial attractiveness: beauty is in the eye of the older beholder. *J Genet Psychol.* 2011; 172: 162–75.
22. Hall D, Taylor RW, Jacobson A, Sadowsky PL, Bartolucci A. The perception of optimal profile in African Americans versus white Americans as assessed by orthodontists and the lay public. *Am J Orthod Dentofacial Orthop.* 2000; 118: 514–25.
23. Tatarunaite E, Playle R, Hood K, Shaw W, Richmond S. Facial attractiveness: a longitudinal study. *Am J Orthod Dentofacial Orthop.* 2005; 127: 676–82.
24. Knight H, Keith O. Ranking Facial Attractiveness. *Eur J Orthod.* 2005; 27: 340–8.
25. España P, Tarazona B, Paredes V. Smile esthetics from odontology students' perspectives. *Angle Orthod.* 2013; 84: 214–24.
26. Orsini MG, Huang GJ, Kiyak HA, Ramsay DS, Bollen AM, Anderson NK, Giddon DB. Methods to evaluate profile preferences for the anteroposterior position of the mandible. *Am J Orthod Dentofacial Orthop.* 2006; 130: 283–91.

27. Naini FB, Donaldson ANA, Mc Donald F, Cobourne MT. The influence of combined orthodontic-orthognathic surgical treatment on perceptions of attractiveness: a longitudinal study. *Eur J Orthod.* 2013; 35: 590–8.
28. Arpino VJ, Giddon DB, BeGole EA, Evans CA. Presurgical profile preferences of patients and clinicians. *Am J Orthod Dentofacial Orthop.* 1998; 114: 631–7.

Paper accepted