

## ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

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

Jovana Milutinović<sup>1</sup>, Nenad Nedeljković<sup>1</sup>, Nenad Korolija<sup>2</sup>, Biljana Miličić<sup>3</sup>

<sup>1</sup>University of Belgrade, Faculty of Dental Medicine, Department of Orthodontics, Belgrade, Serbia;

<sup>2</sup>University of Belgrade, School of Electrical Engineering, Belgrade, Serbia;

<sup>3</sup>University of Belgrade, Faculty of Dental Medicine, Department of Statistics, Belgrade, Serbia



## 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 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 years, 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 esthetics oriented poll, the evaluators rated the change in facial appearance.

**Results** The attractiveness scores differed between the two rater 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; younger evaluators graded more critically between different age groups of the evaluators ( $p < 0.001$ ), 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

## INTRODUCTION

Today's orthodontic patients are mainly concerned about the esthetic outcome of the treatment, given the fact that their facial esthetics is jeopardized by a 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, esthetic issues such as convex profile and re-truded chin are the chief complaints when seeking orthodontic treatment and thus of primary importance [3].

Among various treatments of the 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 the soft-tissue profile of these patients [4, 5, 6]. This fixed functional appliance straightens the facial profile due to the sagittal mandibular growth and has high efficiency even after the 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 tend to be strongly concerned about their facial appearance [9]. The recognition of differences in individual assessment 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, 11, 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 treat-

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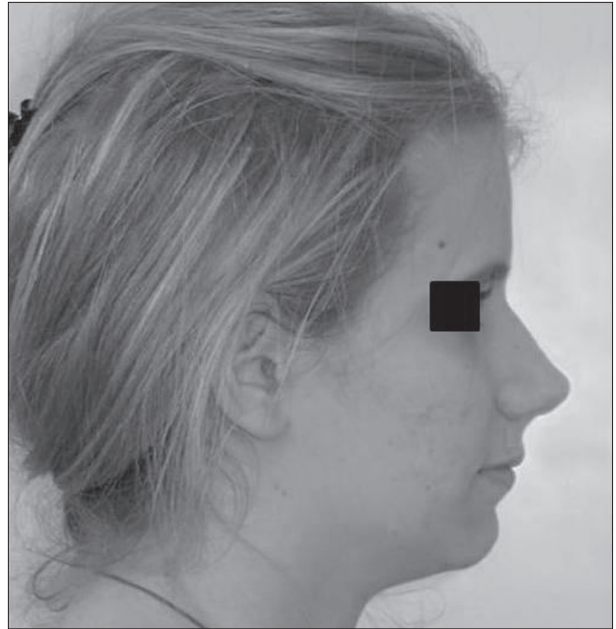
Correspondence to:

Nenad NEDELJKOVIĆ  
University of Belgrade  
Faculty of Dental Medicine  
Department of Orthodontics  
Gastona Gravijea 2  
11000 Belgrade  
Serbia

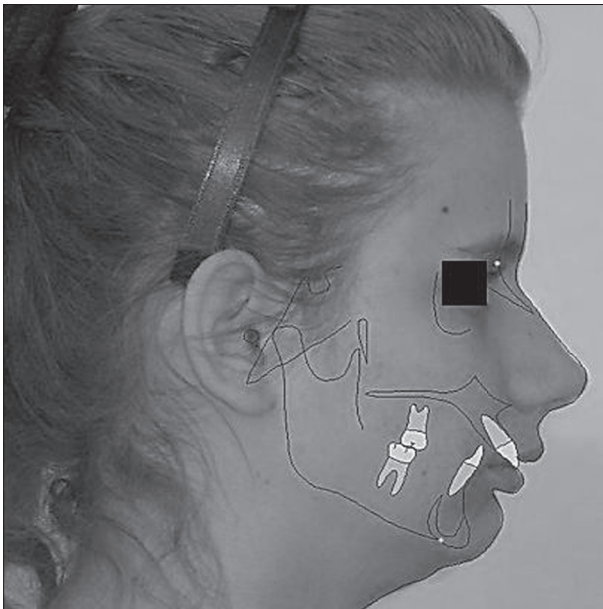
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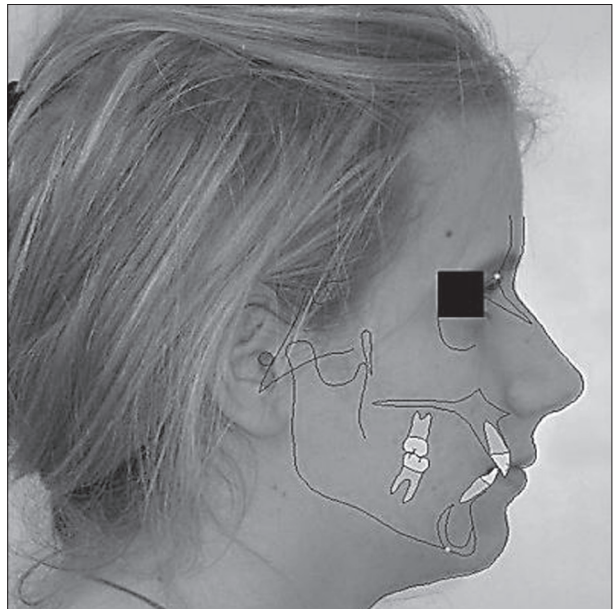
**Figure 1.** A patient's profile photograph before the treatment



**Figure 2.** A patient's profile photograph after the treatment



**Figure 3.** Profile cephalometric drawing superimposed on a patient's profile photo before the treatment



**Figure 4.** Profile cephalometric drawing superimposed on a patient's profile photo after the treatment

ment procedure usually causes biased view of treatment outcome and facial improvement evaluation in the group of orthodontists [1].

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

## METHODS

The patient sample comprised 33 still-growing patients, aged 14–18 years, skeletal class II, division 1, and Caucasian ethnicity. All the patients were successfully treated

with a 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 the combined two-phase treatment, all the patients achieved the 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 (Figures 1 and 2).

All cephalometric points and measurements were carried out by one author (JM) and repeated after six months. The cephalometric analysis had indicated that all the patients had a skeletal class II pattern. (Figures 3 and 4). Key cephalometric parameters are shown in Table 1.

**Table 1.** Key cephalometric parameters

Parameter	Definitions	Before treatment Mean $\pm$ SD	After treatment Mean $\pm$ SD	p
SNA ( $^{\circ}$ )	Upper jaw position in sagittal plane	81.0 $\pm$ 2.8	80.1 $\pm$ 2.9	p < 0.001
SNB ( $^{\circ}$ )	Lower jaw position in sagittal plane	74.7 $\pm$ 3.3	76.6 $\pm$ 3.2	p < 0.001
ANB ( $^{\circ}$ )	Sagittal upper–lower jaw relationship	6.1 $\pm$ 1.8	3.9 $\pm$ 0.9	p < 0.001
SN/SpP ( $^{\circ}$ )	Upper jaw position in vertical plane	9.6 $\pm$ 3.2	9.8 $\pm$ 3.5	p = ns
SN/MP ( $^{\circ}$ )	Lower jaw position in vertical plane	32.4 $\pm$ 5.3	32.2 $\pm$ 5.2	p = ns
SpP/MP ( $^{\circ}$ )	Vertical upper–lower jaw relationship	22.8 $\pm$ 4.9	22.4 $\pm$ 4.7	p = ns
Co-Gn (mm)	Condyle–gnathion length	110.6 $\pm$ 5.0	113.0 $\pm$ 4.7	p < 0.001
I/SpP ( $^{\circ}$ )	Upper incisor protrusion	121.5 $\pm$ 7.0	112.4 $\pm$ 4.9	p < 0.001
i/MP ( $^{\circ}$ )	Lower incisor protrusion	95.3 $\pm$ 5.3	102.1 $\pm$ 7.9	p < 0.001
I/i ( $^{\circ}$ )	Interincisal angle	120.8 $\pm$ 7.8	123.3 $\pm$ 9.8	p = ns
CmSnLs ( $^{\circ}$ )	Nasolabial angle	113.6 $\pm$ 8.8	116.6 $\pm$ 8.6	p = ns
Si-LiPg (mm)	Mentolabial sulcus depth	-7.6 $\pm$ 1.7	-5.1 $\pm$ 1.1	p < 0.001
Ls-SnPg (mm)	Upper lip protrusion	5.1 $\pm$ 1.7	3.3 $\pm$ 1.7	p < 0.001
Li-SnPg (mm)	Lower lip protrusion	-4.4 $\pm$ 2.3	-3.9 $\pm$ 2.6	p < 0.001
G-Sn-Pg ( $^{\circ}$ )	Facial convexity angle	159.6 $\pm$ 5.5	163.4 $\pm$ 7.1	p < 0.001

Eleven patients had a more pronounced malocclusion before the treatment (which was determined by the prominence of ANB (A point–nasion–B point) angle with the value of greater than or equal to  $7^{\circ}$ , with overjet larger than 10 mm, and the mentolabial sulcus depth of over 8 mm). In order to avoid bias and evaluators' presumption about patients with higher malocclusion severity, these patients were randomly infiltrated into the 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) Orthodontist group comprised 54 specialists in orthodontics, 22 females and 32 males, mean age of 37.5 years;
- 2) Lay group comprised 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 examinee was asked to fill out a short questionnaire concerning gender, age (groups were divided according to 20–34- and 35–50-year ranges) and profession. All examinees were introduced with the grading procedure and it was explained to them 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 esthetics change, on a modified Likert scale, from '0 – no change' to '5 – excellent'.
- (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 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 the patients undergoing orthodontic treatment at the Clinic of Orthodontics signed 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 the statistical analysis of data. Descriptive statistics for the assessment of changes in the esthetic appearance were performed with the measure of central tendency (mean and median) and the measure of dispersion (standard deviation, min-max). Influence of each investigated parameter (variables concerning a patient's related factors, as well as an 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 analyses 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 of facial improvement scores. Differences were considered significant when the p-value was < 0.05.

### RESULTS

Statistical significance was found for patient- and evaluator-related factors. In Table 2 one can observe higher mean improvement for female patients (mean = 2.5  $\pm$  1.4), with the difference between patients' gender being statistically significant (p < 0.001). The mean improvement scores were also higher for patients with more pro-

**Table 2.** Patients' related factors

Parameters		Facial improvement scores				p
		Mean	SD	Median	Min-max	
Patients' 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	

**Table 3.** Evaluators' related factors

Parameters		Facial improvement scores				p
		Mean	SD	Median	Min-max	
Evaluators' gender	Male	2.3	1.5	2	0–5	p = 0.060
	Female	2.8	1.4	3	0–5	
Evaluators' age	20–34 years	2.5	1.4	3	0–5	p < 0.001
	35–50 years	3.1	1.1	2	0–5	
Evaluators' profession	Orthodontist	3.1	1.2	3	0–5	p < 0.001
	Layperson	1.9	1.4	2	0–5	

**Table 4.** Linear and multiple regression analysis

Parameters	Univariate regression model		Multivariate regression model	
	B* (95% CI)	Significance	B* (95% CI)	p
Patients' 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
Evaluators' gender	0.590 (0.490–0.689)	p < 0.001	0.055 (-0.048–0.159)	p = 0.294
Evaluators' age	0.605 (0.254–0.956)	p < 0.001	0.556 (0.235–0.877)	p < 0.001
Evaluators' profession	-1.197 (-1.285–(-1.108))	p < 0.001	-1.170 (-1.269–(-1.071))	p < 0.001

\*Unstandardized coefficient B

nounced malocclusion (mean =  $2.6 \pm 1.4$ ), with statistically significant difference between these two groups of patients ( $p < 0.001$ ).

Table 3 shows the difference between the evaluators' related factors, such as gender, age, and profession. The facial improvement scores were influenced by the evaluators' age ( $p < 0.001$ ), as well as profession ( $p < 0.001$ ). In the group of orthodontists, the mean improvement score was  $3.1 \pm 1.2$ , while in the layperson group this value was  $1.9 \pm 1.4$ .

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

### Predictors of facial improvement scores

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, the multivariate regression model was introduced. In Table 4, one can observe that patients' gender, prominence of malocclusion, and evaluators' age and profession appeared as independent predictors of facial attractiveness improvement scores.

## 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 the patients were in the 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 of relapse, compared to class II treatment with removable functional appliances in growing adolescents (patients in the 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 esthetical change among orthodontists and layperson often differ. Therefore, it is of high importance for orthodontists to know what the public will consider as most relevant for improving a patient's face.

Many authors tried to determine whether and to what extent perception of facial appearance differs between professionals and laypersons. Some authors have reported general agreement between clinicians and the public [13–18], as opposed to some studies which showed differences between these two groups [11, 12]. This study conflicts with a couple of studies that have found that 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. The group of evaluators aged 35–50 graded facial change with higher scores than the younger group, aged 20–34. This result coincides with 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 by the fact that elderly people appreciate beauty and youth more than younger ones, who tend 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 hairstyle, make-up, jewelry, and skin complexion) black-and-white cropped photographs were used (revealing only forehead, nose, chin, chin–throat length, 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, the grading was not affected by the gender of evaluators in either group. This result is consistent with other studies, which also showed that there was no significant difference in attractiveness scores between female and male evaluators [24, 25, 26].

There are limitations to using a questionnaire to measure a subjective phenomenon, such as facial attractiveness. In the present study, biases results after presenting pre- and posttreatment photographs, especially in the group of orthodontists, are expected and could explain higher rankings than in the layperson group, which coincides with results from a 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 the layperson group present their unawareness of seriousness of this orthodontic problem and the complexity of the treatment procedure. However, an objective opinion could be one of the guidelines for orthodontists in their pursuit of patient's satisfaction with the treatment outcome.

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The degree of patient's facial esthetics change after the treatment viewed from a 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 esthetics improvement is usually biased. Therefore, this type of study might help in coinciding the patient's wishes and the orthodontist's predictions on the outcome of the treatment.

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

## CONCLUSION

The results of this study showed an improvement of facial esthetics in class II malocclusion patients after the orthodontic treatment with Herbst and multibracket appliances. This research indicates a 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. The severity of pre-treatment status noticeably influences the outcome of esthetic evaluations; thus, patients with a more pronounced malocclusion got higher scores in both rater groups.

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## Процена промене фаџијалне естетике код болесника са II класом малоклузије лечених Хербстовим апаратом

Јована Милутиновић<sup>1</sup>, Ненад Недељковић<sup>1</sup>, Ненад Королија<sup>2</sup>, Биљана Миличић<sup>3</sup>

<sup>1</sup>Универзитет у Београду, Стоматолошки факултет, Клиника за ортопедију вилица, Београд, Србија;

<sup>2</sup>Универзитет у Београду, Електротехнички факултет, Београд, Србија;

<sup>3</sup>Универзитет у Београду, Стоматолошки факултет, Одељење за статистику, Београд, Србија

### САЖЕТАК

**Увод/Циљ** Препознавање разлика у индивидуалној процени фаџијалне атрактивности може бити од велике помоћи у планирању ортодонтске терапије.

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

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

**Резултати** Оцене фаџијалне привлачности разликовале су се између две групе ( $p < 0,001$ ), тако што су ортоданти дава-

ли веће оцене, док није било статистички значајне разлике између полова у обе групе ( $p > 0,05$ ). Међутим, резултати су се значајно разликовали при оцењивању мушких и женских болесника ( $p < 0,001$ ), те су болеснице добиле веће оцене. Такође, резултати су се значајно разликовали између различитих старосних група оцењивача ( $p < 0,001$ ), тако да је млађа група давала ниже оцене, те била критичнија у процени. Разлика је била значајна и код оцењивања болесника са различитим степеном изражености аномалије ( $p < 0,001$ ).

**Закључак** Разлика у оценама фаџијалне привлачности постојала је између две групе, те су лаици били критичнији у оцењивању у односу на ортодонта. Веће оцене добиле су болеснице од стране обе групе, а старија узрасна група оцењивала је већим оценама све болеснике.

**Кључне речи:** естетика; малоклузија II класе; ортодонтски апарати