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Esthetic perception of facial profile after treatment with the Thurow appliance

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Abstract: The objective of this article was to investigate the perception of esthetic changes in the facial profile of bilateral Class II patients treated with the Modified Thurow Appliance for extraoral treatment. Silhouettes were traced of profiles of patients who initially presented a bilateral Class II molar relationship and who, post-treatment, presented molars in a Class I relationship. Three groups were formed: the first composed of patients with maxillary protrusion (SNA >84°), the second with maxillary retrusion (SNA <80°), and the third with a well-positioned maxilla (SNA 80-84°). A panel of 200 lay evaluators judged the profile esthetics by a randomized drawing of the silhouettes. The multiple analysis results showed that the profile esthetic scores for the three positions of the maxilla were greatly influenced by significant interactions with the characteristics (like sex and age) of the evaluators: retrusive maxilla (Score *Age Group, $p < 0.001$), normal maxilla (Score *Sex, $p = 0.024$; Score *Age Group, $p = 0.050$) and protrusive maxilla (Score *Age Group, $p < 0.001$). It was observed that the profile of Class II patients with protrusion, normal relationship and retrusion of the maxilla, improved in their esthetic post-treatment result; however, the evaluators showed greater satisfaction with the groups of protrusion and normal position of the maxilla. The Modified Thurow Appliance provided significant improvements in the esthetics of the profile of patients who presented protrusion and normal position of the maxilla. However, its use was not the best treatment option for patients with maxillary retrusion.

Keywords: Perception; Face; Malocclusion.

Introduction

Angle's Class II malocclusion is characterized by a dental discrepancy in which the mesial groove of the lower first permanent molar articulates posterior to the mesiobuccal cusp of the first permanent maxillary molar. It can also be characterized by a maxillomandibular skeletal discrepancy in the anteroposterior direction, by maxillary protrusion, by mandibular retrusion or by a combination of these factors. The incidence of this malocclusion ranges from 35% to 42%, and may attain up to 50% of the clinical cases treated by orthodontists.[1,2]

An infinite variety of appliances are available for the orthopedic correction of Class II malocclusion; these include both intraoral and extraoral appliances.[3,4,5,6] Among the intraoral orthopedic appliances,

those of Herbst,[7] Bionator,[8] Planas[9] and other types are mentioned in the literature. In regard to extraoral orthopedic appliances, there are those made with an outer facial arch attached to rings cemented to the molars, and there is also the Thurow Appliance, where the outer facial arch is attached to acrylic resin adapted to the occlusal surfaces of the teeth.[10]

Treatment with the Thurow Appliance is made by restricting anterior growth of the maxilla, or redirecting facial growth, and is indicated precisely when the malocclusion is determined predominantly by maxillary protrusion.[10,11] However, these devices are also used with skeletal Malocclusion Class II in growing individuals presenting a well-positioned or retropositioned maxilla.[12] However, it is interesting to query what the esthetic repercussions would be of using these appliances in different maxillary positions?

In this sense, the authors' purpose in the present study was to evaluate the perception of laypersons with respect to silhouettes of Class II patients with different maxillary positions, treated with the Modified Thurow Appliance.

Methodology

Research was conducted in the archives of the orthodontic documentation of the Pediatric Dental Clinic of the dentistry course at the State University of Southeast Bahia, in order to identify the records of patients treated with the Modified Thurow Appliance, who presented different anteroposterior positions of the maxilla. The inclusion criteria for the sample were: patients treated with the Modified Thurow Appliance, treated with pre- and post-treatment orthodontic models, and having pre- and post-treatment lateral cephalometric radiographs that came from the same radiology center. The accepted patients had a Class II molar relationship bilaterally (< 5 mm) on pre-treatment, and a good Class I molar relationship on post-treatment, with angle SN.GoGn ≤ 35 on pre- and post-treatment, similar skeletal maturation (hand-wrist radiographic evaluation) on pre- and post-treatment, mixed dentition on pre- and post-treatment, and absence of open bite and crossbite on pre- and post-treatment. All the patients were treated without extractions and without using a fixed orthodontic appliance afterwards.

The research participants were divided into three groups, based on the anteroposterior position of the maxilla. Ten patients were identified as initially having maxillary protrusion (SNA > 84°), ten initially having maxillary retrusion (SNA < 80°), and ten fitting into the normal group (SNA 80-84°). The Modified Thurow Appliance components included an occlusal self-polymerizing acrylic resin (OrtoCril, Sao Paulo, Brazil) base plate covering the entire palate up to contact of the occlusal surfaces of the primary molars and the permanent 1st molar. The appliance also had an expander screw (Morelli Ortodontia, São Paulo, Brazil) centralized in the palate at the level of the primary second molars, and Adams' cribs, for retention, on both upper first permanent molars. In addition, high traction and cervical traction were used on the patients, with a high or low mandibular plane, respectively.

The sample size was calculated considering the minimal difference between the means of treatment of 1 mm for any of the linear distances (Class II right or Class II left) and a standard deviation of 0.5 mm. Considering a one-sided significance level of 0.01 and a power of 85%, at least 10 patients per group were required. This experiment was approved by the Human Research Ethics Committee, CEP/CAAE: 0154.0.454.000-11.

The initial and final cephalometric tracings of all the patients were made on matte acetate cephalometric tracing film (3M Unitek, Monrovia, USA). Linear and angular measurements (Kappa = 0.8) were traced with a variation of 0.5 mm and 0.5°, respectively: the mandibular plane (SnGoGn), Line SN, Line SNA, Line SNB, angles ANB, 1.NA, 1.NB, IMPA and linear measurements 1-NA and 1-NB, and evaluation of the profile (LS-S E LI-S). Overbite and overjet were evaluated, as well as how far (the linear horizontal distance between the mesiobuccal sulcus of the mandibular first molar and the tip of the maxillary first molar cusp) the right and left first molars moved in the anteroposterior direction, that is, how much the Thurow appliance moved the tooth until its position was corrected from Class II to Class I, as assessed in the initial and final models (Table 1). The correction of the magnification factor of the images was performed

Table 1. Pre-treatment and post-treatment linear and angular measurements of patients used for constructing the profile silhouettes.

Variable	Patients with maxillary protrusion	Patients with normal maxilla	Patients with maxillary retrusion
	Mean	Mean	Mean
SNA (°)			
Pre-treatment	87	82	75.5
Post-treatment	82.5	80	74.5
Difference	-4.5	-2	-1
SNB (°)			
Pre-treatment	79.5	77.5	70.5
Post-treatment	79.5	77.5	71
Difference	0	0	0.5
ANB (°)			
Pre-treatment	7.5	4.5	5
Post-treatment	3	2.5	3.5
Difference	-4.5	-2	-1.5
SnGoGn (°)			
Pre-treatment	34	33	33.5
Post-treatment	34	33	33.5
Difference	0	0	0
1.NA (°)			
Pre-treatment	33.5	30	28.5
Post-treatment	24.5	23	21
Difference	-9	-7	-7.5
Overjet			
Pre-treatment	7	6.5	5.5
Post-treatment	2.5	3	2
Difference	-4.5	-3.5	-3.5
Overbite			
Pre-treatment	6	9.5	6.5
Post-treatment	2.5	2.5	2
Difference	-3.5	-7.0	-4.5
Class II right (mm)			
Pre-treatment	3	3	2.5
Post-treatment	0	0	0
Difference	-3	-3	-2.5
Class II left (mm)			
Pre-treatment	3	3	3
Post-treatment	0	0	0
Difference	-3	-3	-3

considering the degree of magnification recorded for all the radiographs, *i.e.*, 8%.

According to the previously described methodology, pre- and post-treatment lateral cephalometric tracings were used to produce dark silhouettes, identified only by numbers. The tracings were scanned by the GT 2400 appliance (Hewlett-Packard Ltd., Tokyo, Japan), defined for the gray scale with a resolution of 500 dpi, and saved as TIFF images in the Adobe Photoshop CS3 program (Adobe Systems, San Jose, USA). Each traced line was rotated so that the Horizontal Frankfurt (FH) Plane would be parallel to the ground.

For the purpose of creating the profile presentation for the judges, the silhouettes were transferred to the PowerPoint program, version 2010 (Microsoft Corporation, Redmond, USA) in random order. Each image of the silhouette was classified with a sequential number to help the evaluators, and these numbers were crossed with the specific initial or final profile, at intervals of 10 seconds for each silhouette profile to be evaluated (Figure 1).

The panel of evaluators consisted of 200 laypersons (Table 2). The ages assessed represented the majority of patients who initially seek orthodontic treatment. The groups were stratified to allow full identification with a group of like individuals,[13] in order to maintain the cognitive specificities of the age groups and quality of results.[14] The evaluators were invited to assess each silhouette profile and attribute an attractiveness score, using the Likert scale from 0 (not very attractive) to 7 (very attractive).

The analysis of variance (ANOVA) for the mixed model of repeated measures was used to determine the differences in the evaluations of the pre- and post-treatment esthetic profile scores for the three clinical profiles assessed: maxillary protrusion, maxilla in a normal position and maxillary retrusion. ANOVA was also used to evaluate the effect of the evaluator's characteristics, such as sex and age group. The level of significance adopted was 5%. All the analyses were performed with the SPSS 15.0 for Windows (SPSS Inc., Chicago, USA) statistical software program.

Results

In the case of the retrusive maxilla, the esthetic profile evaluation scores were lower for the post-treatment silhouettes, indicating the evaluators' dissatisfaction with the final result of the treatment. In contrast, in the case of the well-positioned and the protrusive maxilla, the esthetic profile evaluation scores were higher for the post-treatment silhouettes, indicating that the evaluators considered the final result of the treatment as attractive (Table 3).

Multiple analysis showed that the esthetic profile scores for the three maxilla positions were influenced by significant interactions with the evaluators' characteristics (like sex and age): retrusive maxilla (Score *Age Group, $p < 0.001$), normal maxilla (Score *Sex, $p = 0.024$; Score *Age Group, $p = 0.05$) and protrusive maxilla (Score *Age Group, $p < 0.001$).

The results indicated a significant main effect of sex in combination with the evaluators' age group on the scores of the esthetic profile for the maxilla in a position of retrusion (Table 4). The interaction between sex and age group showed that among the evaluators from 8 to 12 and from 18 to 22 years of age, the participants of the female sex gave higher

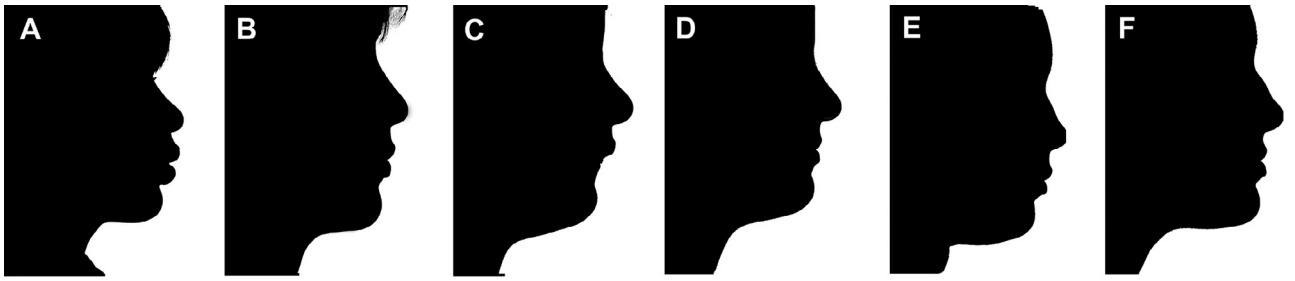

Figure 1. Silhouettes of representative patients whose esthetic changes most closely matched the average group changes: A) protrusive maxillas, before treatment and B) after treatment; C) normally positioned maxillas, before treatment and D) after treatment; E) retrusive maxillas, before treatment and F) after treatment.

Table 2. Description of the evaluators.

Variables	n	%
Sex		
Male	100	50.0
Female	100	50.0
Age Groups		
8 to 12 years	50	25.0
13 to 17 years	50	25.0
18 to 22 years	50	25.0
23 to 27 years	50	25.0

scores. However, among the evaluators from 13 to 17 and from 23 to 27 years of age, participants of the male sex gave higher scores.

The evaluations varied in respect to the maxilla in the normal position, when considering sex and age group (Table 4). In general, the highest scores were given by evaluators of the male sex and age group from 8 to 12 years. There was no statistical difference among the scores of the evaluators of the three older age groups (13 to 17 years, 18 to 22 years and 23 to 27 years).

The evaluations in respect to the maxilla in the protrusion position varied only when considering the age group (Table 4). According to the previously described methodology, pre- and post-treatment lateral cephalometric tracings were used to produce dark silhouettes, identified only by numbers. There was no statistical difference among the scores given by the evaluators of the three older age groups (13 to 17 years, 18 to 22 years and 23 to 27 years).

Discussion

Recently, it has been observed that much attention is being given to the perception of laypersons, as well as of dental professionals, in regard to esthetic evaluations.[15,16] The results of this study indicate that the individuals who evaluated the silhouettes presented to them were capable of observing the differences existing among these images, as demonstrated by their assessment scores.[17]

Table 3. Differences in the evaluations between the pre-treatment and post-treatment silhouettes.

Maxillary Position	Mean	SD	IC95%	*p*-value
Retrusion				
Pre-treatment	4.26	1.25	4.05 - 4.48	
Post-treatment	3.53	1.12	3.34 - 3.73	
Difference	-0.73	1.14	-0.96 - -0.50	< 0.001
Normal				
Pre-treatment	2.03	1.17	1.80 - 2.27	
Post-treatment	3.84	1.08	3.60 - 4.08	
Difference	1.81	1.06	1.52 - 2.10	< 0.001
Protrusion				
Pre-treatment	2.34	1.16	2.08 - 2.60	
Post-treatment	4.41	1.22	4.21 - 4.61	
Difference	2.07	1.08	1.81 - 2.33	< 0.001

SD: standard deviation; IC95%: interval of confidence of 95% of the mean.

Table 4. Effects of evaluators' characteristics on evaluations of the silhouettes.

Characteristics	Maxillary Position (*p*-values)		
	Retrusion	Normal	Protrusion
Sex	0.396	< 0.05	0.164
Age Group	0.691	< 0.001	< 0.001
Sex * Age Group	< 0.05	0.641	0.329

Clinically, orthodontists diverge in regard to the use of photographs, silhouettes and cephalometric tracings to evaluate the esthetics of the facial profile. Nevertheless, by observing silhouettes, one is able to eliminate factors that influence attractiveness in the eye of the observer, such as sex, age, skin color, shape and color of hair, and style and color of eyes, factors that may be noted when using photographs.[15,18,19,20] However, by eliminating attributes like sex, other features of the face may be excessively emphasized, for example, the size and shape of the nose, or difference in the interlabial gap.[15]

Variants such as the sex and age group of the evaluators indicated a significant effect on the esthetic profile scores given in the study. The evaluators of the female sex in the age range from 8 to 12 years and from 18 to 22 years were the ones who attributed the highest attractiveness scores during the evaluation of maxillary retrusion. In contrast, the evaluators of the male sex in the age range from 8 to 12 years attributed higher attractiveness scores when assessing the maxilla in the normal position. Note that there was no statistical difference for the other age groups, i.e., from 13 to 17, 18 to 22 and 23 to 27 years of age. This is in contrast to a study in which men were more critical than women and attributed lower scores.[21]

There was variation in regard to age group only for maxillary protrusion, where the higher scores were given by the evaluators from 8 to 12 years old. Previous studies in which esthetic profiles relating to maxillary protrusion were evaluated also detected no significant differences between men and women.[15,22]

The maxillary anteroposterior position is directly related to the esthetic profile. Normally, North Americans prefer straight profiles to concave or convex profiles.[23,24,25] In patients with extreme protrusion or retrusion, the maxillary position has a negative influence on esthetics, particularly because it will affect the balance between the maxillae when seen in profile. Therefore, surgical correction may be an option.[23]

According to the data found, differences between the pre- and post-treatment evaluations occurred in the three profile silhouettes assessed; however, the evaluation was more significant for the patients with maxillary protrusion, who obtained the highest attractiveness scores in the assessment, similar to the group of patients with normal maxillary position.

In the treatment of Class II patients with maxillary retrusion, the attractiveness scores were lower in the post-treatment assessment, indicating that the evaluators were dissatisfied with the final esthetic result, and that the treatment given was not the best treatment option for these cases. This shows that the decision of what treatment should be given must also be based on the individual characteristics of the patient, the diagnosis and the desired result, and not only on the esthetic results. The results obtained were found to differ from those of a previous study, in which the use of the Thurow extraoral appliance was successful in enhancing the profile esthetics of Class II patients with different maxillary anteroposterior positions.[23]

The esthetic improvements in the facial profile of the groups with protrusion and normal maxillary position, treated with the Modified Thurow Appliance, normally included better chin projection, reduction in the interlabial gap, and reduction in the depth of the labiomental sulcus, factors also observed in the treatment of patients with the same malocclusion and maxillary anteroposterior positions as those treated with the extraoral appliance.[3,23]

In view of the results found, the Modified Thurow Appliance can be considered a good option in the treatment of Class II malocclusions with protrusive and well-positioned maxillae, making this an important ally for the orthodontist, because it is a low cost and easy-to-fabricate device.

Conclusions

Based on the higher scores attributed by laypersons in their perception of the profile of patients with normal maxillary position and maxillary protrusion, it can be considered that: when patients with Class II malocclusion, who are at growing age, and who present either protrusion of the maxilla or normal position of the maxilla, are treated with the Modified Thurow Appliance, they achieve better esthetic results when compared with Class II patients with maxillary retrusion. However, the decision to use the Thurow appliance must be based on the different aspects of diagnosis and treatment results, and not only on esthetic results.

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