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Original Article

Comparative Evaluation of Soft Tissue Profile Changes with Herbst and Twin Block Appliances in Class II Malocclusion Patients: A Perception Study

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Main Points

- Within the appliances, profile changes were perceptible with the Twin Block for the orthodontists and with Herbst and Twin Block for the general dentists. Laypersons did not perceive any profile improvement on treatment with both functional appliances.
- Between Herbst and Twin Block appliances, no difference was present in the profile perception with all 3 groups of examiners.
- The ANB angle contributed to the difference in profile perception between the appliances.

ABSTRACT

Objective: To comparatively evaluate the perception of patients' soft tissue profiles treated with Herbst and Twin Block appliances and correlate the perception with cephalometric parameters.

Methods: The record of 30 patients (15 Herbst and 15 Twin Block) treated for a period of 6 months (±1.1 months) was included in the study. A total of 60 resulting profile silhouettes (from pre- and post-functional profile photographs) were evaluated by 30 examiners and were divided into 3 groups: orthodontists, general dentists, and laypersons. The profiles were arranged in a randomized order, and the examiners rated the profiles using a visual analog scale. Paired *t*-test and independent *t*-test were performed to find a significant difference within and between the appliances, respectively. A treatment outcome correlation was done using Pearson's correlation test between the visual analog scale scores and cephalometric parameters.

Results: Within the appliances, the orthodontist perceived a difference with only the Twin Block appliance ($P = .02$). The general dentists perceived a significant difference with both Herbst ($P = .02$) and Twin Block ($P = .001$) appliances, whereas the laypersons did not perceive any profile improvement on treatment with functional appliances. However, between the appliances, no statistically significant profile difference was seen with all 3 groups of examiners. The ANB angle had a significant negative correlation ($P = .007$) to the visual analog scale scores given by the orthodontists for the Herbst appliance.

Conclusion: No perceptible difference was found in the profile enhancement between Herbst and Twin Block appliances with all 3 groups of examiners. The ANB angle contributed to the difference in profile perception between the appliances for the orthodontists.

Keywords: Herbst, Twin Block perception, visual analogue scale

INTRODUCTION

Facial aesthetics plays a pivotal role in the perception of beauty. Malocclusion and self-perceived poor facial aesthetics have shown to have strong correlations with negative self-esteem and reduced quality of life.[1,2] Skeletal Class II malocclusion with retrognathic mandible, characteristically seen with a soft tissue convex profile, is said to have an adverse emotional impact on growing children and acts as a deterrent to their social interactions.[3,4] Hence by correcting the profile, there are added psychological benefits to the patient along with a marked improvement in a patients' facial aesthetics.

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Growth modifications are attempted to alter a developing skeletal Class II relationship in young children, predominantly during the growth phase by redirecting and accelerating the patients' remaining facial growth to a favorable size or position of the jaws using functional appliances—fixed and removable.[5-8]

Twin Block is a commonly used removable functional appliance in growing patients with Class II malocclusion. Studies that have evaluated the soft tissue profile changes with Twin Block have shown that the appliance provides an effective anterior lip seal with retracted upper lip, advancement in the soft tissue pogonion with an increase in the lower facial height and decrease in the H angle.[9-11]

With a continuous mechanism of action, the fixed functional appliance—Herbst—has been used in patients whose growth is near completion. Studies that have evaluated the effects of Herbst appliance treatment on the soft tissue profile have found a reduction in facial convexity and upper lip protrusion.[12-14]

The skeletal changes are seen on both the maxilla and the mandible with the Herbst appliance[15] and restricted predominantly to the mandible with Twin Block appliance.[16] This is seen in the resultant improvement of the facial profile. Güler and Malkoç[17] have concluded that both Twin Block and Herbst appliances provide a volumetric improvement in the mandible and thus show enhancement of the soft tissue profiles of the patients. However, the soft tissue changes are generally variable in magnitude and whether the changes are appreciable clinically is questionable.

do Rego et al.[3] in their profile perception study on Herbst appliance have concluded that it brings about positive changes to the facial profile which can be perceived visually, immediately, and 2 years after treatment. However, Baysal and Uysal[18] have shown the Twin Block appliance to have a greater change in the soft tissue profile when compared to that of the Herbst appliance, quantitatively. While the efficacy of Herbst and Twin Block appliances has been extensively studied, the clinical perception of the treatment changes brought about by Herbst appliance when compared to that of Twin Block has not yet been analyzed.

Thus, a study is required to assess the perceptional changes in soft tissue profile induced by treatment with Herbst and Twin Block appliances, by comparing the facial profile silhouettes before and after treatment. Also, a correlation of the perceived difference in the profile of the patient to that of the cephalometric values obtained is required.

The aim of this study was to assess the perceptional changes in soft tissue profile induced by treatment with Herbst and Twin Block appliances by comparing facial profile silhouettes before and after treatment, as evaluated by orthodontists, general dentists, and laypersons and correlate with cephalometric parameters.

We tested the null hypothesis of no significant difference in perception of soft tissue profile changes with Herbst and Twin Block appliances.

METHODS

The study was conducted at the Department of Orthodontics, Sri Ramachandra Faculty of Dental Sciences, Chennai after approval from the University's Institutional Ethics Committee (CSP/17/JUN/59/205).

This retrospective study was based on archival records of patients treated with Twin Block and Herbst appliances between 2013 and 2020. Informed consent was obtained from all patients included in the study.

Inclusion Criteria

1. Class II skeletal pattern with ANB angle greater than 5° and Wits appraisal of 2 mm or more were included.
2. Full-step or three-quarter step Class II Division 1 dental relationship
3. Overjet of 7 mm or greater
4. No previous orthodontic treatment
5. Post-functional: Class I molar and canine relationships with 1-2 mm overjet
6. Age: 11-14 years
7. Convex profile in pre-treatment photographs

Exclusion Criteria

1. Anterior open bite
2. Patients with extreme vertical growth pattern (Go-Gn to SN greater than 36°)
3. Non-compliant patients
4. Developmental abnormalities

Sample size calculations [d = 0.5, α error = 0.05, and power of study = 85%] were based on the study by do Rego et al.[3] to detect a clinically relevant difference between the 2 appliances and indicated that a sample size of 15 patients would be required per group.

The samples were matched based upon the degree of skeletal discrepancy, age group, and treatment duration. Fifteen patients in Cervical vertebrae maturation index (CVMI) stage 3 were treated with Herbst appliance [10 boys (mean age: 13.5 years $\pm$ 1 month), 5 girls (mean age: 12.8 years $\pm$ 2 months)], and 15 patients in CVMI stage 2 were treated with Twin Block appliance [11 boys (mean age: 13.1 years $\pm$ 2 months), 4 girls (mean age: 12 years $\pm$ 1 month)], both treated for a mean treatment period of 6 months $\pm$ 1.1 months, were included in the study.

With regards to the facial pattern, in the Herbst appliance group, 11 patients had a low angle Class II (Go-Gn to SN less than 32°) and 4 patients had a high angle Class II (Go-Gn to SN greater than 32°) based on Steiner's cephalometric analysis.[19] While with the Twin Block, 14 patients had a low angle Class II and 1 patient had a high angle Class II.

In the Twin Block group, the patients were treated using a standard Twin Block appliance (Figure 1). With the Herbst appliance, the patients were treated using banded Herbst with a telescopic mechanism connecting between the maxillary and

Figure 1. Standard Twin Block

mandibular arch (Figure 2). The construction bite was taken for all patients such that on advancement of the mandible, the patient achieved a straight profile. Phase II using the fixed appliance therapy phase was begun for patients of both the groups following the completion of phase I treatment using functional appliances.

Pre-treatment and post-functional profile photographs of patients taken in the natural head position with standardized camera settings were selected. From the profile pictures, profile silhouettes (Figure 3) were generated with Adobe Photoshop Version 7 (Adobe Inc., San Jose, Calif, USA).

Randomization

Using a computer-generated program (www.randomization.com), a simple randomization allocation sequence of the 60 pre- and post-functional profile silhouettes were generated and the silhouettes were uploaded into a non-editable computerized presentation.

A total of 30 examiners [sample size calculated based on the study by von Bremen et al.[20] which involved 10 orthodontists and 10 laypersons] belonging to 3 categories: 10 orthodontists (5 men and 5 women; number of years in orthodontic practice: 12 years ± 2 months), 10 general dentists with no orthodontic training (5 men and 5 women; number of years in general dentistry practice: 11 years ± 5 months), and 10 laypersons (5 men and 5 women) with no familiarity of dentistry were shown in the presentation.

Thirty seconds was given to analyze each profile. The examiners were instructed to rate the profile using a visual analog scale (VAS) that consisted of a 10-cm line. A score of 0 denoted that the profiles looked least pleasing, whereas 10 denoted that the profile was most pleasing. The first impression was taken as the final opinion. No additional information such as the age and gender of the patients was provided to the examiners.

Pre- and post-functional lateral cephalograms of the patients were traced by 1 examiner using Dolphin imaging software version 11 (Dolphin Imaging & Management Solutions, Chatsworth, Calif, USA). All cephalograms were taken using a single cephalostat with standardized magnification. The VAS scores of the treatment outcome were correlated to that of the cephalometric parameters: anteroposterior changes (SNB, ANB, and N-Pog), mandibular plane angle (GoGn-SN), inter-incisal angle, and soft tissue convexity (G'-Sn-Pog').

Error of Method

The VAS scores of 3 examiners per group and the cephalometric data of 5 patients per group were recorded again after 3 weeks of the initial assessment. The test–retest intraexaminer reliability coefficient indicated a score of 0.8 (good reliability) for the VAS scores of all 3 groups of examiners and 0.9 (excellent reliability) for the cephalometric data collected.

Statistical Analysis

The data were analyzed with IBM Statistical Package for the Social Sciences Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). The Kolmogorov–Smirnov's test was used to check the normality of the data and showed a normal distribution of data. To find the significant difference within the groups, a paired *t*-test was performed between the pre- and post-treatment values for the Herbst and Twin Block appliances among each group of examiners. An independent *t*-test was performed

Figure 2. Banded Herbst

Figure 3. a, b. Sample of profile silhouettes of patients treated with Twin Block (*left to right*: 1-3) and Herbst (*left to right*: 4-6): (a) pre-treatment; (b) post-functional

to test the significance between Herbst and Twin Block appliances. To assess the relationship between the cephalometric parameters and the VAS, a Pearson's correlation test was used. In all the above statistical tools, the probability value level of .05 was set as significant.

RESULTS

Intragroup Comparison of Visual Analog Scale Scores

With the Herbst appliance, all 3 groups of examiners gave a higher rating for the post-functional profile silhouettes. However, a statistically significant difference to pre-treatment profile silhouettes was perceived only by the general dentists ($P = .02$).

With the Twin Block appliance, all 3 groups of examiners gave a higher rating for the post-functional profile silhouettes. On comparing the pre- and post-functional profile silhouettes, a statistically significant difference was perceived by the general dentists as well the orthodontists, with the orthodontists giving a higher rating.

For both the pre- and post-functional profile silhouettes, the laypersons gave the highest VAS scores with both the appliances (Table 1).

Intergroup Comparison of Visual Analog Scale

On comparing the perception of treatment outcome between Twin Block and Herbst appliances, no significant difference was

Table 1. Visual analog scale scores for comparison of changes in profile silhouettes before and after treatment with Herbst and Twin Block appliances

	Herbst			Twin Block		
	Pre-Treatment	Post-Treatment	*P*	Pre-Treatment	Post-Treatment	*P*
Orthodontists	4.13	4.88	.09	4.55	5.4	.02*
General dentists	3.26	4.70	.02*	3.53	4.85	.001**
Laypersons	5.28	5.78	.20	5.49	5.80	.30

*$P < .05$, **$P < .01$.
Statistical test: Intragroup comparison: Paired *t*-test.

Table 2. Perception comparison of treatment outcome between Twin Block and Herbst appliances

	Herbst	Twin Block	*P*
Orthodontists	0.42	0.78	0.50
General dentists	0.49	0.53	0.91
Laypersons	0.49	0.30	0.55

Statistical test: Intergroup comparison: Independent *t*-test.

Table 3. Intergroup comparison of pre- and post-treatment difference in cephalometric parameters

Cephalometric Parameters	Herbst	Twin Block	*P*
ANB	−1.72 ± 1.46	−2.61 ± 1.79	.148
SNB	2.87 ± 1.55	2.35 ± 1.60	.374
GoGn-SN	2.14 ± 1.62	2.72 ± 2.04	.395
Interincisal angle	−6.97 ± 11.10	−2.27 ± 8.05	.195
N-Pog (mm)	−2.66 ± 2.04	−2.81 ± 2.24	.853
G′-Sn-Pog'	−3.27 ± 2.71	−4.87 ± 2.80	.123

Statistical Test: Intergroup comparison: Independent *t*-test.

perceived between the appliances by all 3 groups of examiners (Table 2).

Intergroup Comparison of Cephalometric Parameters

On comparing the pre- and post-functional changes in cephalometric parameters, no significant difference was perceived between Herbst and Twin Block appliances for any of the parameters (Table 3).

Correlation between VAS Scores and Cephalometric Parameters

The ANB angle showed a statistically significant negative correlation with the VAS scores given by the orthodontists for the Herbst appliance ($P = .007$). The higher the ANB, the lesser the VAS scores were (Table 4).

DISCUSSION

The ideal soft tissue responses anticipated from functional therapy are a significant improvement in the facial profile contributed by the anterior movement of soft tissue pogonion, retraction of the upper lip, and an increase in the lower anterior facial height.[10] Although the efficacy and treatment response to functional appliances have been studied extensively, there is a lacuna in the literature regarding the perception of the treatment outcome achieved between the appliances.[21]

While analyzing the profile photographs of patients treated using the Herbst appliance, von Bremen et al.[20] found that laypersons had rated the facial profiles more critically when compared to orthodontists. According to de Paula et al.[22] with mandibular protraction appliance, lay evaluators found a greater difference in the profile silhouettes than orthodontists. Between Herbst and Forsus, while the post-treatment profile with Herbst appliance was preferred, no significant difference was seen in the rating between the groups suggesting minimal aesthetic improvement when compared to baseline values.[23] This is the first study to assess the clinical perception of the treatment outcome between the 2 most commonly used functional appliances—Herbst and Twin Block.

Facial silhouettes were chosen in this study due to their unbiased nature of presenting a patients' profile, and 3 varied groups of examiners were selected to detect the perspective differences. Visual analog scale scores were used due to their simplicity, convenience, and speed; the greater the amount of information available, the more cautious the examiners will be with their scores.

All 3 groups of examiners preferred the profiles achieved after treatment with both Herbst and Twin Block appliances over the pre-treatment profiles. However, this perceived improvement was not statistically significant between the Herbst and the Twin Block appliances (Table 1 and 2). There was little difference in the cephalometric parameters between the treatment outcome of

Table 4. Correlation between visual analogue scale scores of herbst and twin block appliances and cephalometric parameters

	Herbst			Twin Block		
	Orthodontist	General Dentist	Laypersons	Orthodontist	General Dentist	Laypersons
ANB	0.67 *P* = .007**	0.46 *P* = .087	0.161 *P* = .566	−0.103 *P* = .714	0.196 *P* = .485	0.021 *P* = .940
SNB	0.11 *P* = .686	−0.033 *P* = .908	−0.179 *P* = .524	0.214 *P* = .443	0.230 *P* = .410	−0.068 *P* = .810
Go-Gn-SN	0.29 *P* = .290	0.169 *P* = .548	−0.002 *P* = .995	−0.071 *P* = .801	−0.153 *P* = .585	−0.349 *P* = .203
Interincisal angle	0.33 *P* = .229	0.400 *P* = .139	0.391 *P* = .150	0.427 *P* = .113	0.167 *P* = .552	0.302 *P* = .274
N-Pog	0.17 *P* = .537	0.011 *P* = .969	−0.058 *P* = .837	0.233 *P* = .404	0.282 *P* = .308	0.009 *P* = .976
G′-Sn-Pog'	0.26 *P* = .352	0.310 *P* = .260	−0.162 *P* = .565	0.302 *P* = .274	−0.017 *P* = .951	0.102 *P* = .718

**$P < .01$.
Statistical Test: Pearson's correlation test.

both the appliances, and the difference was not statistically significant, consistent with previous findings.[18]

However, within the appliances, general dentists were able to perceive a statistically significant profile difference with both the Herbst and the Twin Block appliances. Whereas, the orthodontists were able to perceive a statistically significant difference only in the Twin Block and not with the Herbst contrary to the study done by do Rego et al.[3] Although none of the cephalometric parameters correlated with the VAS scores, the only exception was the negative correlation between the ANB angle and the VAS scores obtained for the Herbst by the orthodontist. It appears that the orthodontist is more discerning than the general dentists in their evaluation of the soft tissue profile as borne out by the ANB angle (Table 1 and 4).

While the highest ratings using the VAS scores were given by the laypersons, the perceived difference in the magnitude of changes pre- and post-treatment was small and not significant for both Herbst and Twin Block appliances (Table 1). This suggests that the laypersons are more accepting of convexity in the facial profiles prior to treatment than orthodontists and general dentists.

The limitations of our study were as follows. The quantification of the natural growth of the mandible could not be done due to the absence of an untreated control group. However, as patients of similar age groups were recruited for both Twin Block and Herbst appliance groups, the confounding factor of natural growth would be eliminated since it would be similar in both groups.

Perception of facial beauty varies with ethnic origin. Multicentered studies with standardized methodology are required to comparatively analyze the results obtained from the current study to other environments and settings. Future studies are required to assess the perception of changes produced using functional appliances according to patients, as little evidence exists regarding the patient-centric perception of treatment modalities. Also, eye-tracking systems can be used to provide quantitative measurement on which area of the profile catches the visual attention of each group of examiner.

Some clinical implications that can be drawn from our study are: Between Herbst and Twin Block, one was not superior over the other in the profile changes. However, within the appliances, profile changes with treatment were perceived both by the orthodontists and the general dentists with the Twin Block and only by the general dentists with the Herbst appliance.

Laypersons seem to be more accepting of convexity in facial profile and rated both the pre- and post-treatment silhouettes high and similar. This suggests that they were not as discerning of facial profiles when compared to orthodontists and general dentists.

CONCLUSION

- Within the appliances, general dentists found a significant difference in the profile enhancement with the Herbst appliance, and both general dentists and orthodontists found a significant difference with the Twin Block appliance. However, no significant difference was found between the 2 appliances with regards to profile enhancement with all 3 groups of examiners.
- Except for the ANB angle, which contributed to the perception difference between the 2 appliances, other cephalometric parameters had no correlation to the perception.
- Laypersons gave the highest scores for both pre- and post-functional profile silhouettes. The changes perceived between the 2 were small and statistically not significant.

Ethics Committee Approval: Ethics committee approval was received for this study from the University's Institutional Ethics Committee (CSP/17/JUN/59/205).

Informed Consent: Informed consent was obtained from all patients included in the study.

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