Soft Tissue Esthetic Changes Following a Modified Twin Block Appliance Therapy: A Prospective Study

Mohamadreza Shahamfar¹, Mohamad Hossein A Atashi², Niloofar Azima³

Abstract

Aim: Achieving a satisfactory facial esthetics is of utmost importance in the practice of orthodontics. Cl II div 1 patients often suffer from numerous adverse facial characteristics which may impair their social well-being. The objective of the current study was to evaluate the esthetic changes in such patients by using a modified twin block appliance.

Materials and methods: Seventy adolescent patients with mandibular deficiency consecutively underwent treatment with a modified twin block appliance for a mean period of 13 months. Soft tissue analyzes of Burstone and McNamara were applied to evaluate the changes before and after the treatment. The esthetic changes before and after the therapy were compared using parametric paired t tests analysis. $p$ values less than 0.05 were considered significant.

Results: Facial convexity, lip incompetence, upper lip protrusion, and columellar inclination significantly decreased ($p < 0.05$) while Merrifield’s Z-angle nasolabial angle, lower lip length, and mentolabial angle significantly increased ($p < 0.05$). Vertical facial height ratio, lower lip protrusion, upper lip length as well as nasal projection and inclination, did not change significantly ($p > 0.05$)

Conclusion: Our findings indicated that a modified form of the twin block appliance can be substantially effective in the improvement of several aspects of patients’ facial balance with minimum untoward effects.

Clinical significance: Adolescents suffering from mandibular deficiency can gain substantial facial balance with the twin block appliance. The whole face attractiveness, however, is another subject and should not be conflicted with the facial balance.

Keywords: Esthetics, Facial profile, Soft tissue, Twin block.

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Introduction

Facial esthetic improvement is a key objective in the practice of orthodontics. The contemporary paradigm of soft tissue enhancement underlines the importance of this issue.¹ The Cl II division 1 malocclusion is one of the most frequent orthodontic conditions encountered by the patients comprising 20–30% of all orthodontic patients.² The condition may pose such adverse facial characteristics that may result in negative psychological consequences and reduced self-esteem of the patients.³ These characteristics include retrusive chin, increased facial convexity angle, lip incompetence and decreased mentolabial angle.⁴

It is generally agreed that functional appliances can be used to successfully treat Cl II malocclusion in growing and cooperative patients.⁵ However, despite the plethora of reports investigating the dentoskeletal effects of various orthopedic appliances,⁶⁻⁷ the soft tissue change remains scarcely investigated.⁸⁻⁹ Furthermore, there has been no agreement between the results of previous studies on profile changes and the response of soft tissue to functional appliances is far from being fully understood.¹⁰ The previous studies on soft tissue have been mostly based on either cephalometric,⁹ laser scanning¹¹ or finite element scaling analysis.¹² Photographs of the patients, on the other hand, have been used as part of the routine standard for pre- and posttreatment documentation and are most perceivable for the patients. So the photographs can be Fairley used for judgment of soft tissue changes provided they are registered in a standard method using natural head position concept.¹³

Twin block appliance is a popular functional appliance that efficiently reduces overjet in Cl II patients.¹⁴ It provides more freedom of mandibular movement and increases patient compliance.¹⁵ The current study aimed to analyze the soft tissue facial profile changes in patients with skeletal Cl II mandibular deficiency before and after functional therapy using a modified twin block appliance and based on the silhouettes derived from the NHP photographs.

Materials and Methods

The current study was conducted in the department of orthodontics, Tabriz University of Medical Sciences. Before the study, informed patients’ consent was obtained from the patients and/or the parents and the protocol of the study was approved by the respective university research ethics committee. The study was in accordance with the Helsinki declaration of human rights. The sample size consisted of 70 patients (37 girls and 33 boys, mean age
of the soft tissue measurements are described in Table 1 and the linear and angular analyzes applied to the patients are described in Figures 4 and 5, respectively.

All measurements were tabulated for statistical analysis using SPSS16 software (SPSS Inc., Chicago, Illinois, USA) for windows and the Statistical significance was set at $p < 0.05$.

To determine the reliability of the silhouettes’ analyzes, 12 silhouettes were randomly selected and underwent re-tracing and analysis with a 1-month interval. A paired $t$ test was used to determine the difference and no significant difference was achieved ($p > 0.05$).

Mean and standard deviation of variables were obtained before and after treatment. Normal distribution of the data was verified using Kolmogorov–Smirnov analysis and the data were found normally distributed. Parametric analysis of paired $t$ test was used to compare the mean values before and after treatment.

**RESULTS**

The mean and standard deviation of soft tissue linear and angular measurements before and after treatment are described in Table 2. The results demonstrated a 2° reduction in the convexity angle while Merrifield’s $Z$-angle demonstrated an almost 8° increase. Furthermore, the soft tissue pog moved forward by a mean value of 3.18 mm. All these changes were found statistically significant ($p > 0.05$).

With regard to the relationship between the base of the nose and the upper lip, the results indicated a statistically significant increase in the nasolabial angle and a significant reduction in the upper lip protrusion ($p < 0.05$). Columellar inclination, on the other hand, showed a statistically significant reduction ($p < 0.05$).

As for the vertical dimension of the lips, the lower lip length significantly increased ($p < 0.05$) coincidentally with a statistically significant reduction in the interlabial gap ($p < 0.05$). Mentolabial angle, on the other hand, showed a significant increase after TB treatment as a result of the forward movement of soft tissue pog, contributing to the lower third facial balance.

Upper lip length and lower lip protrusion, however, did not show any significant change as did midface protrusion and the vertical height ratio ($p > 0.05$). Linear and angular measurements related to the soft tissue of the nose, including nasal projection and inclination of the nose also, did not show any significant change either ($p > 0.05$).

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**Fig. 1: Design of the appliance**
**DISCUSSION**

It is generally believed that orthodontic treatment is successful only when facial esthetics is improved. It is because that facial appearance has a crucial role in the social well-being of individuals and perception of one’s personal attributions. Several methods have been used to assess the esthetics of the facial profile.\(^9,11,12\) Some of these, include laser scanning of the face, or the use of cephalograms.\(^9,11\) In our study, we utilized patients’ silhouettes derived from photographs to evaluate the soft tissue profiles. Photographs compared to lat. Cephalograms have several advantages. Photographs are frequently the first line for both

![Figs 2A and B: Silhouette of a patient. (A) Pretreatment; (B) Posttreatment](image)

![Fig. 3: Landmarks used in the study. G, Glabella; N', soft tissue nasion; Pn, Pronasale; Sn, subnasale; Ss, sulcus superior; Ls, labrale superior; Sts, stomion superior; Sti, stomion inferior; Li, labrale inferior; Si, sulcus inferior; pog', Soft tissue pog; Me', Soft tissue menton; C, cervical point](image)

| Table 1: Definition of soft tissue linear and angular measurements used in the study |
|---|---|---|---|
| S. no. | Soft tissue measurements | Definition | Description |
| 1 | Facial convexity angle | G-Sn-Pg' (angle) | The angle formed by a line connecting glabella to subnasale and subnasale to soft tissue pog |
| 2 | Nasolabial angle | Cm-Sn-Ls (angle) | The angle formed between columella, subnasale and labrale superior |
| 3 | Lower face-Throat angle | Sn-Gn'-C (angle) | The angle formed by intersection of lines passing through subnasal to soft tissue gnathion and from that point to cervical point |
| 4 | Lower face protrusion | G-Pg' (II TH) | Horizontal distance from a line passing from glabella to soft tissue pog |
| 5 | Vertical height ratio | G-Sn/Sn-Me (P TH) | The ratio of upper to lower face |
| 6 | Z-Merrifield angle | Pog'-Ls or Li/TH | The angle formed by intersection of true horizontal and a line connecting pog' and the most protrusive lip point (may be upper or lower) |
| 7 | Midface protrusion | G-Sn (II TH) | Horizontal distance from a vertical line passing through glabella to subnasale |
| 8 | Upper lip length | Sn-Sts (P TH) | Vertical distance between and upper lip stomion and subnasale |
| 9 | Lower lip length | Sti-Me' (P TH) | Vertical distance between lower lip stomion and soft tissue menton |
| 10 | Superior labial sulcus depth | ss-SnV (II TH) | Horizontal distance between sulcus superior and subnasale-vertical line |
| 11 | Upper lip protrusion | Ls-Snpog' (II TH) | Horizontal distance between the most anterior point of upper lip to sn-pog' line |
| 12 | Lower lip protrusion | Li-Snpog' (II TH) | Horizontal distance between the most anterior point of lower lip to sn-pog' line |
| 13 | Inferior labial sulcus depth | Si-SnV (II TH) | Horizontal distance between sulcus inferior and subnasale vertical line |
| 14 | Soft tissue pogonion | Pog'-SnV (II TH) | Horizontal distance between soft tissue pog and subnasale vertical line |
| 15 | Inter labial gap | Sts-Sti (P TH) | Vertical distance between upper lip stomion and lower lip stomion |
| 16 | Mentolabial angle | Li-ILS-Pog' | The angle formed between labrale inferiuri, inferior labial sulcus and soft tissue pog |
| 17 | Nasal projection (nose) | Pn-Sn (II TH) | Horizontal distance between subnasale to the tip of the nose |
| 18 | Columellar Inclination | Sn-Cm/TH | The angle between true horizontal and a line passing through columella and subnasale |
| 19 | Inclination of nose | N'-Pn/TV | The angle between true vertical line and a line passing through pronasale to soft tissue nasion |
Esthetic Changes with a Modified Twin Block Appliance

Clinicians and patients for the judgment of esthetic changes. Furthermore, they are low cost and have no risk of X-ray exposure. All the photographs were taken with patients head in the NHP position since the NHP reflects the real appearance of the patients as they are in everyday life with acceptable reproducibility. The reason that silhouettes were used, was to eliminate the drawbacks of the previous methods, have the advantages of them, and at the same time, eliminate all the extrinsic and intrinsic confounding factors, e.g., hairstyle, makeup and skin characteristics in the evaluation of the facial balance. However, it should be noted that the silhouettes do not necessarily reflect the attractiveness of the whole face since the same profile outline shape could produce a different attractiveness in the different faces under the influence of extrinsic variables. So when evaluating a profile, the facial balance should not be conflicted with facial attractiveness, since the latter, is highly dependent on extrinsic factors not necessarily identical to gold standards of orthodontics.

Twin block appliance is one of the most popular functional appliances used in the orthodontic practice. It provides more compliance of the patients, is less voluminous, and permits talking...
as well.22,23 A modified form of the appliance with an acrylic cap on the lower incisors was utilized to minimize lower incisor protrusion. This was done to minimize the contribution of incisor protrusion in the overjet correction. This modification might have contributed to the relatively stable inclination of the lower lip. This was in contrast to several previous studies that reported lower lip protrusion with twin block appliance.8,10,12 This was important since some previous reports suggested extraction in the second phase of treatment (fixed orthodontic therapy) to correct the protrusion, which in our study was not found obligatory.24

We found no vertical facial dimension change. This is a favorable effect since any vertical lengthening can dilute the effect of the forward movement and is considered an untoward side effect. This is in contrast with some previous findings which reported vertical facial height increase.8,25,26 Our results showed that strict control of the bite blocks can be effective in the control of the vertical dimension. However, this should be interpreted with caution because soft tissue facial height might be affected by the varying compliance of patients, varying thickness of the soft tissue, and the method of evaluation as well.

In our study, we found several significant positive improvements in the silhouette. Reduction in the convexity angle, the subsequent increase in the Z angle and the advancement of soft tissue pog, all contributed to the esthetic improvement of the silhouettes and were similar to the results of several previous investigations.8,11,27 The upper lip protrusion and the superior labial sulcus depth, significantly decreased while no change was observed in the upper lip's length. As for the lower lip, a significant increase in its length was observed. These findings support the results of several previous investigations.10–12 The possible reason for the lower lip length increase might be the tension reduction in the lower lip followed by mandibular advancement which in turn leads to a reduction in the interlabial gap and eventually improves lip competence. Also, a significant reduction of the inferior labial sulcus depth was found in our study which is comparable with the results of Singh et al., who in their finite element study found a flattening of mentolabial groove following TB treatment.11 This is important since, in Cl II div 1 malocclusion, the lower lips are distorted behind the upper incisors resulting in a deep mentolabial sulcus and acute mentolabial angle. In our study, we found a significant increase in the mentolabial angle following TB therapy. Two reasons have been suggested for this phenomenon:28 first the reduction of overjet and the second the change in the tonicity and posture of perioral muscles. However, this finding is not unanimous in the literature and contrasts with a previous report.11 The difference, however, might be related to the varying designs of the appliances too. We suggest that the modified acrylic cap on the lower incisors has contributed to the stable inclination of lower lips and in this way contributed to the mentolabial balance improvement.

In our study, we found a backward movement of the superior labial sulcus. This might have been related to the impetrous effect of TB therapy over the maxillary dentition region. This is further augmented by a significant reduction in the upper lip protrusion. These findings support the results of a previous report on hard and soft tissue indicating a retrusive force over the maxillary dentition region.11 This might be considered a side effect to the TB therapy.11,28

A drawback to the current study was that no untreated groups were compared, so the findings should be interpreted with caution.

**Conclusion**

The principal finding of our study was that TB treatment resulted in several significant positive improvements in the facial esthetics of the patients with minimum untoward effects. These positive changes included the forward movement of soft tissue pog, improved mentolabial fold, improved lip competence, and reduction of facial convexity. However, facial balance is a different concept than facial attractiveness and they should not be held identical.

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