

Cephalometric Facial Soft Tissue Changes with the Twin Block Appliance in Class II division 1 Malocclusion Patients

A Systematic Review

Carlos Flores-Mir^a; Paul W. Major^b

ABSTRACT

Objective: To evaluate facial soft tissue changes after the use of the twin block appliance in Class II division 1 malocclusion patients.

Materials and Methods: Several electronic databases (PubMed, MEDLINE, MEDLINE In-Process & Other Non-Indexed Citations, Cochrane databases, EMBASE, Web of Science, and LILACS) were searched with the help of a senior health-sciences librarian. Abstracts that appeared to fulfill the initial selection criteria were selected by consensus, and the original articles were retrieved. The article references were hand-searched for possible missing articles. Clinical trials that assessed facial soft tissue changes with the use of the twin block appliance without any surgical intervention or syndromic characteristics were considered. A comparable untreated control group was required to factor out normal growth changes.

Results: Two articles fulfilled the selection criteria and quantified facial soft tissue changes. Although some statistically significant changes in the soft tissue profile were found, the magnitude of the changes may not be perceived as clinically significant. Changes produced in the upper lip seem to be controversial, although the study with sounder methodological quality did not report significant changes. No change in the anteroposterior position of the lower lip and the soft tissue menton or improvement of the facial convexity was found.

Conclusions: Three-dimensional quantification of the soft tissue changes is required to overcome current limitations in our understanding of the soft tissue changes obtained after the use of the twin block appliance in Class II division 1 malocclusion patients.

KEY WORDS: Functional appliances; Soft tissue; Profile; Facial changes; Twin block

INTRODUCTION

Different removable functional appliances have been used to treat patients with Class II division 1 malocclusions. Although one of the main reasons for lay persons to undergo orthodontic treatment is esthetic

improvement,^{1,2} of the multitude of reports evaluating the skeletal and dental changes produced by removable functional appliances, only a relatively small proportion have analyzed the soft tissue changes.

The twin block appliance is the most popular functional appliance in the United Kingdom.³ It was first introduced by Clark in 1988⁴ and consists of two separate, upper and lower, removable plates with acrylic blocks trimmed to an angle of 70 degrees. These separate plates make the twin block appliance different in comparison with other removable functional appliances, which are basically monoblocks. Theoretically, this plus a less bulky appearance would increase patient acceptance of the appliance. Patients would also have more freedom in their mandibular movements. All these considerations could conceptually produce different treatment results compared with the removable functional monoblocks.

Several studies have evaluated the soft tissue changes produced by the twin block.⁵⁻¹⁴ Although

^a Clinical Associate Professor, Orthodontic Graduate Program and Director, Craniofacial and Oral Health Evidence-based Practice Group, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, Canada.

^b Professor, Director of the Orthodontic Graduate Program and Member, Oral Health Evidence-based Practice Group, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, Canada.

Corresponding author: Dr. Carlos Flores-Mir, Faculty of Medicine and Dentistry, Room 4051A, Dentistry/Pharmacy Centre, University of Alberta, Edmonton, Alberta, Canada T6G 2N8 (e-mail: carlosflores@ualberta.ca)

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TABLE 1. Search Results From Different Electronic Databases

Database ^a	Key Words	Results	Selected	Total No. of Selected Abstracts (%) ^b
PubMed	(1) functional appliance*; (2) twin block; (3) #1 OR #2, (4) soft tissue*; (5) facial change*; (6) profile change*; (7) #4 OR #5 OR #6; (8) #3 AND #7; (9) limit #8 to humans	28	7	100
MEDLINE	(1) functional appliance\$.mp; (2) twin block.mp; (3) #1 OR #2; (4) soft tissue\$.mp; (5) facial change\$.mp; (6) profile change\$.mp; (7) #4 OR #5 OR #6; (8) #3 AND #7; (9) limit #8 to humans	28	6	85.7
MEDLINE In-Process & Other Non-indexed Citations	(1) functional appliance\$.mp; (2) twin block.mp; (3) #1 OR #2; (4) soft tissue\$.mp; (5) facial change\$.mp; (6) profile change\$.mp; (7) #4 OR #5 OR #6; (8) #3 AND #7;	1	1	14.3
EMBASE	(1) functional appliance\$.mp; (2) twin block.mp (3) #1 OR #2; (4) soft tissue\$.mp; (5) facial change\$.mp; (6) profile change\$.mp; (7) #4 OR #5 OR #6; (8) #3 AND #7;	2	0	0
All EBM reviews (Cochrane Database of Systematic Reviews, ACP Journal Club, DARE, and CCTR)	(1) functional appliance\$.mp; (2) twin block.mp (3) #1 OR #2; (4) soft tissue\$.mp; (5) facial change\$.mp; (6) profile change\$.mp; (7) #4 OR #5 OR #6; (8) #3 AND #7;	10	2	28.6
Web of Science	(1) TS = (functional appliance* OR twin block) AND (soft tissue* OR facial change* OR profile change*); DocType = Article; Language = All languages; Database(s) = SCI-EXPANDED	18	4	57.1
LILACS	twin block AND facial	0	0	0
Hand search	Reference list from selected articles		0	0

^a EBM, Evidence-Based Medicine; ACP, American College of Physicians; DARE, Database of Abstracts of Reviews of Effects; CCTR, Cochrane Database of Trial Registration.

^b Percentages do not add up to 100% because the same reference could be found in several databases.

some literature reviews^{3,15-25} and systematic reviews²⁶⁻²⁸ have focused on the effect of functional appliances on skeletal and dental structures, no systematic review has been specifically focused on the soft tissue changes produced by the twin block appliance. Such a review would permit the clinician to evaluate the quality of the available evidence and discuss the facial implications of this type of removable functional orthodontic treatment. Therefore, the objective of the present systematic review was to evaluate facial soft tissue changes by using lateral cephalograms after the use of the twin block appliance in Class II division 1 malocclusion cases.

MATERIALS AND METHODS

A computerized search was conducted of several electronic databases: MEDLINE (from 1966 to week 3 of October 2005), MEDLINE In-Process & Other Non-Indexed Citations (up to October 21, 2005), LILACS (from 1982 to October 2005), PubMed (from 1966 to week 3 of October 2005), EMBASE (from 1988 to week 43 of 2005), Web of Science (from 1945 to October 22, 2005), and all evidence-based medicine reviews (Cochrane Database of Systematic Reviews, American College of Physicians Journal Club, Database of Abstracts of Reviews of Effects, and Cochrane Database of Trial Registration; to the fourth quarter of

2005). Terms used in this literature search were "twin block," "functional appliances," "soft tissue," "profile," and "facial changes." The selection and specific use of each term inside each database search were made with the help of a senior librarian specialized in health sciences database searches (Table 1).

The following inclusion criteria were chosen to initially select potential articles from the published abstract results:

- Human clinical trials;
- Facial soft tissue changes evaluated through lateral cephalograms;
- Use of the twin block appliance to correct Class II division 1 malocclusions;
- Nonsyndromic or medically compromised patients;
- No individual case reports or series of cases; and
- No surgical intervention.

No attempts were made at this stage to identify studies that did not use adequate control groups to factor out growth changes. It was considered improbable that the abstracts would report enough information regarding control groups. This would potentially exclude some articles. Meeting abstracts were not selected but were used to trace articles when a full article was published from the data.

All the article abstracts that appeared to meet the

initial inclusion criteria were selected, and the actual articles were collected. The selection process was independently made by the two researchers. Their results were compared and discrepancies were settled through discussion; except for the LILACS database, which was only evaluated by one of the researchers because of language limitation. When an article abstract did not provide enough information to make a decision, the actual article was obtained.

The articles ultimately selected were chosen with the following additional inclusion criteria:

- A comparable control group to factor growth changes when required; and
- Only the twin block appliance was used.

The actual articles from the selected abstracts were then independently evaluated by the two researchers. A consensus was reached regarding which articles fulfilled the final selection criteria. These articles were finally included in the systematic review. Articles that did not factor out growth changes when required (growing samples) were rejected at this stage. Craniofacial growth was considered important to factor out in order to accurately assess the true magnitude of the soft tissue changes.

Failure to consider craniofacial growth changes would result in a potential overestimation of the magnitude of the changes attained. Simultaneous use of a fixed appliance was considered a confounder and a reason for exclusion. Although measurement error is needed for a correct interpretation of the clinical significance of the findings, it was not considered a reason to reject an article but was considered in the interpretation of the data.

Knowing that more methodologically sound studies may provide more reliable conclusions, a methodological scoring process was developed to identify which selected studies would be most valuable (Table 2). No attempt was made to imply that this evaluation tool has been properly validated. Previous reports²⁹⁻³¹ have shown that there is no sound evidence about the validity of the use of quality assessment of clinical trials, and these reports recommend that researchers examine the individual influence of key components on methodological quality.

The reference lists of the retrieved articles were also hand-searched for additional relevant publications that may have been missed in the database searches. In cases where extra information was required for discussion or statistical analysis but was not specifically stated in the article, contact with the authors was sought to obtain the required information.

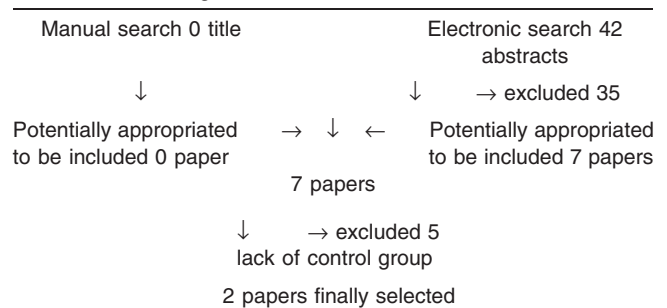
RESULTS

The search results and the final number of abstracts selected according to the initial selection criteria from

TABLE 2. Methodological Score for the Clinical Trials

I. Study Design (11 ✓)
A. Objective—objective clearly formulated (✓)
B. Population—described (✓)
C. Selection criteria—clearly described (✓); adequate (✓)
D. Sample size—considered adequate (✓); estimated before collection of data (✓)
E. Baseline characteristics—baseline characteristics (✓); similar between groups (✓)
F. Timing—prospective (✓); long-term follow-up (✓)
G. Randomization—stated (✓)
II. Study Measurements (4 ✓)
H. Measurement method—appropriate to the objective (✓)
I. Blind measurement—blinding (examiner ✓; statistician ✓)
J. Reliability—described (✓)
III. Statistical Analysis (5 ✓)
K. Dropouts—included in data analysis (✓)
L. Statistical analysis—appropriate for data (✓)
M. Confounders—included in analysis (✓)
N. Statistical significance level— <i>P</i> level stated (✓); confidence intervals (✓)
Maximum number of ✓/s = 20

TABLE 3. Flow Diagram of the Literature Search



the various databases are provided in Table 1. Comparing the database results, PubMed showed all of the finally selected articles. MEDLINE did not find one article, but the article was identified from MEDLINE-In-Process. Abstracts selected in all evidence-based medicine reviews and the Web of Science were already found in PubMed. No selected abstract was found in LILACS, which included only Latin American publications. No article was missed in the electronic database searches that appeared during the hand search of the reference lists of the selected articles.

From the seven studies^{3,5,7,9,11,13,14} that based on the abstracts seemed to be potentially useful, after reading the complete article, only two^{5,9} (29%) actually fulfilled the final selection criteria. The remaining five articles^{3,7,11,13,14} were rejected due to the lack of an adequate control group to factor out expected normal growth changes. A flow diagram of the literature search appears in Table 3.

The methodological quality checklist was applied to the selected articles (Table 4).

TABLE 4. Methodological Score^a of Selected Articles

Articles	A	B	C	D	E	F	G	H	I	J	K	L	M	N	Total No. of Checks	% of Total
Luo & Fang ⁵	✓	✓	✓✓	≠-	--	--	✓	✓	--	-	-	✓	✓	≠≠	9.5	47.5
Morris et al ⁹	✓	✓	✓✓	≠-	≠≠	✓-	✓	✓	-	✓	≠	✓	≠	≠≠	12.5	62.5

^a A–N, methodological criteria in Table 2; ✓ satisfactorily fulfilled the methodological criteria (1 check point), ≠ partially fulfilled the methodological criteria (0.5 check point), – did not fulfill the methodological criteria (0 check point).

TABLE 5. Cephalometric Measurements

Area	Cephalometric point/distance	Cephalometric Measurement	Luo ⁵	Morris ⁹
Face	Subnasale	SnPg'∧SnNBt		NS
		N'Sn∧SnPg'		NS
	Sulcus inferious	SiLLt∧SiMt		NS
		NB∧Pg'Sts		NS
	Facial heights	Gl-Sn		NS
		Sn-M' Pg'N'		NS NS
Nose	Subnasale horizontal	Sn-SNpS		NS
Upper lip	Sulcus superious horizontal	Ss-SNpS		NS
	Labrale superious horizontal	Ls-PrnPg'	-1.9	NS
		Ls-SNpS		NS
	Upper lip thickness	Ss-A		NS
	Upper lip length	Sn-Sts		NS
Lower lip	Labrale inferious horizontal	Li-PrnPg'	NS	NS
		Li-SNpS		NS
	Sulcus inferious horizontal	Si-SNpS		NS
	Lower lip thickness	Si-B		NS
Sti-M			NS	
Menton	ST pogonion horizontal	Pg'-OpS Pg'-SNpS		NS

* Definition of cephalometric points in Athanassiou (Athanassiou AE. *Orthodontic Cephalometry*. Baltimore: Mosby-Wolfe; 1995.) ∧ angle between the mentioned lines; - distance (mm) between the mentioned points or lines.

Morris et al⁹ compared 16 adolescents (6 males/10 females with a mean age of 11 years 8 months) with 20 adolescents (13 males/7 females with a mean age of 11 years 2 months) during a 9-month evaluation period. All the patients had a Class II skeletal relationship with a mandibular retrognathia, Class II molar relationships, and an overjet greater than 7 mm.

Luo and Fang⁵ compared 12 adolescents (7 males/5 females with an age range of 10 to 12 years) against 11 adolescents (6 males/5 females with an age range of 10 to 12 years) in a 12-month evaluation period. Patients included in this study had a mandibular retrognathia, Class II molar relationships, and an overjet greater than 7 mm.

No significant changes in the facial angles, nose, lower lip, and soft tissue menton were found.^{5,9} For the upper lip, no significant changes were reported⁹ except for the position of labrale superious relative to the esthetic line, which was in a more retruded position (-1.9 mm).⁵ Specific information about the measure-

ments used and the magnitude of the changes are provided in Table 5. Landmarks used in the soft tissue profile analysis are provided in Figure 1.

DISCUSSION

The present review was performed to systematically analyze the soft tissue profile changes that were produced by the twin block appliance in patients with Class II division 1 malocclusions. Despite the extensive number of published studies regarding the skeletal and dental effects produced by the twin block appliance, only a few studies evaluated the soft tissue profile changes.⁵⁻¹⁴ Only two of these studies^{5,9} compared the changes produced by the twin block appliance with a comparable untreated control group. One⁹ of these two studies was more methodologically sound and did not report any significant soft tissue profile changes.

Lack of consensus exists regarding the impact of

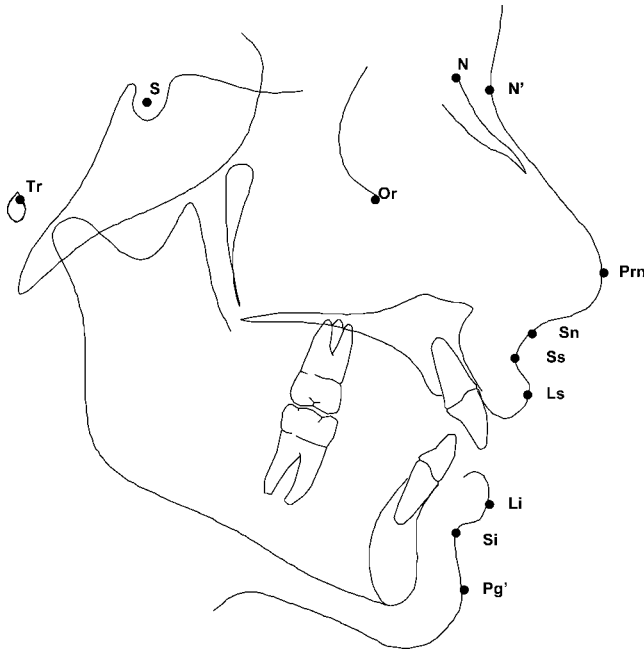


Figure 1. Cephalometric points.

functional appliances on the soft tissue profile. From a lay person's perspective changes in the anterior visible occlusion teeth-lip relationship are probably more important than changes in the posterior occlusion.³² The level of evidence in the selected reports was low. Art students, dental students, and parents of orthodontic patients did not perceive any significant soft tissue changes in subjects treated with two types of removable functional appliances (Frankel's regulator or Harvold's activator).³³ The present results support those findings. Even in the case of the retruded upper lip position reported by one of the studies,⁹ the second more methodologically sound study⁵ did not find any significant change. Even though several studies have reported significant dentoalveolar changes and some skeletal changes with the twin block appliance, it seems that those changes do not produce significant soft tissue profile changes.

A detailed esthetic judgment of the face should evaluate the patient's frontal face view during conversation, facial expressions, and smiling.³² Current conventional orthodontic frontal and lateral cephalometric analysis are not capable of producing a real 3-dimensional image of the subject's face. Use of facial photos helps to complement conventional radiographic analysis, but the subjectivity in their analysis is still a limitation. Therefore, stereo photogrammetry or laser surface scanning seem to be the best available tools to overcome these limitations.

A very limited number of studies evaluating 3-dimensional soft tissue changes after functional treatment have been published.^{7,9,34} Only one clinical trial⁹

and a report of two cases³⁵ have evaluated the 3-dimensional soft tissue changes that are produced with the twin block appliance. The main limitation of the clinical trial was that it presented the results as subjective visual changes rather than actual volumetric changes. Future studies using similar technology should also consider quantification of the volumetric changes. A recent article³⁶ evaluated the esthetic perception of different facial relationships in 2-dimensional and 3-dimensional formats. No consistency between the esthetic ratings from the 2-dimensional and 3-dimensional images was found.

An increase in vertical dimensions may likely be perceived by lay persons.³⁷ Therefore, it is important not only to evaluate the horizontal soft tissue changes but also the vertical changes. Soft tissue vertical changes compared with a control group have been reported for the bionator³⁸ and Frankel.³⁹ Only one study⁹ evaluated soft tissue facial height changes. No significant vertical changes were reported.

Several different measurements have been used to evaluate the soft tissue changes after twin block treatment. Some of them have to be considered carefully because they used reference structures that could potentially change as a result of the treatment. For example, the esthetic plane is not a good reference plane to quantify changes in the lips because simultaneous changes in the soft tissue pogonion or pronasale could create the impression of lip changes that are really nonexistent.

CONCLUSIONS

- Evidence supporting the claim for an improvement of the facial convexity with twin block treatment of Class II division I malocclusion was not found.
- Changes produced by the twin block appliance in the upper lip seem to be controversial, although the study with sounder methodological quality did not report significant changes.
- No change in the anteroposterior position of the lower lip and soft tissue menton was found.

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