SCIENTIFIC EVIDENCE THAT BIOBLOC ORTHOTROPICS® HAS A POSITIVE IMPACT ON FACIAL DEVELOPMENT

This study is the “companion” study to the airway study published in the Journal of Craniomandibular Practice in April, 2007. Using the same group of Dr. Hang’s patients who had received Biobloc Orthotropic® treatment, Dr. Dave Singh analyzed the soft-tissue profiles to assess what changes could be attributed to Biobloc Orthotropic® treatment.

Dr. Singh used 14 landmarks on lateral head photographs to help assess the direction of growth in patients treated with Biobloc Orthotropics® and an untreated control group. It was found that patients treated with Biobloc Orthotropics® had a more consistent growth direction of approximately 45 degrees. The untreated group had facial growth that was less consistent and more vertical (longer faces).

The conclusion, therefore, was that “soft tissue facial changes associated with Biobloc (Orthotropic®) treatment are consistent with a more balanced facial profile.” For the first time in the history of the orthodontic profession the results of this study contradict the long held belief that vertical growth (unfavorable) cannot be conservatively (non-surgically) altered to horizontal (favorable) growth.
Soft Tissue Facial Changes Using
Biobloc

Appliances: Geometric Morphometrics

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ABSTRACT: The aim of this study is to determine how the Biobloc appliance affects the growth of soft tissue facial components. 14 landmarks in pre-, post- and no-treatment standardized lateral photographs were digitized in 41 cases (30 cases in the pre- and post-treatment group, and 11 cases in the control group). Using finite-element analysis it was found that soft tissue facial changes in patients treated with Biobloc appliances showed a consistent growth guidance direction of approximately 45 degrees. For the untreated group, the facial growth direction was less consistent and more vertical. It is concluded that soft tissue facial changes associated with Biobloc treatment are consistent with a more balanced facial profile.

Introduction

Functional appliances have been used since the 1920s to guide the growth and development of the skeletal components of the face, putatively using the forces of the musculature and the corresponding soft tissues. Vig and Vig indicated that there is a relatively poor understanding of functional appliance therapy, even though many previous cephalometric studies have analyzed two-dimensional (2-D) skeletal, dental and facial changes produced by functional orthodontic treatments.

Figure 1a – Palatal view of Stage IV Biobloc appliance.

1. Maxillary anterior labial bow for retention
2. Hang's Clasps on maxillary first molars for retention
4. Anterior lock to engage mandible and prevent hinge opening
5. Posterior lock to engage mandible and prevent hinge opening
6. Palatal support bar.

Generally speaking, an orthodontist's first concern is correction of the malocclusion. Thus, most previous studies on functional appliances focus on changes in the skeletal and dental components, secondarily focusing on facial changes; but the patient's primary concern often is their facial appearance. For these reasons, it is important to know what effects any appliance, such as the Biobloc (Fig. 1), which purports to develop the face, has on the facial soft
tissues. Indeed studies on functional appliances have generally found a considerable retraction of the maxillary dentition.

**Figure 1b** – Poster view of Stage IV Biobloc appliance.

3. Mandibular incisor support wires
4. Anterior lock to engage mandible and prevent hinge opening
5. Posterior lock to engage mandible and prevent hinge opening
6. Palatal support bar
7. Maxillary incisor support wires

Given the fact that McNamara\(^4\) noted that protrusion of maxillary teeth in Class II cases was not a common finding, and that maxillary teeth were more likely retruded than protruded if they were not ideally placed, such retraction might be expected to result in a poorer facial balance. But, when Johnston\(^5\) compared functional appliance treatment to traditional orthodontic treatment with braces and headgear, he found little difference between the outcomes; both resulted in moderate midfacial dentoalveolar retraction.

The overall aim of Biobloc therapy is to achieve facial balance and to correct poor oral posture at rest. More importantly, it aims to redirect jaw growth anteriorly in a more horizontal direction so that a better oral posture and soft tissue facial profile is developed. The Biobloc technique involves both orthopedic and functional elements. The technique consists of several appliances used in sequence. The first appliances attaches to the maxilla and has an expansion screw to widen the maxilla, as well as a palatal archwire to advance the anterior maxillary teeth. The maxillary anterior teeth are often advanced by 5-10 mm in all Angle classes of malocclusion, according to a protocol designed by Mew.\(^4\) The second appliance, which also attaches to the maxillary teeth, postures the mandible forward and has flanges extending inferiorly into the lingual vestibule of the mandible that prevent mandibular retrusion – because the flanges elicit a pain response from the patient if the mandible is retruded. As well, as the two arches are not tightly locked together via acrylic contacting the teeth, there is little or no retractive effect to the maxilla. Details of the clinical technique can be obtained from Mew.\(^6\)

Talass et al.\(^7\) report that orthodontists need to be able to predict soft tissue facial changes that may result from orthodontic treatment, but soft tissue facial features such as the eyes are not visible on radiographs. Earlier, nasolabial changes and upper lip responses to upper incisor retraction were investigated\(^8\) using cephalometric radiographs. However, some lip features are not imaged fully using lateral cephalometric radiography, but frontal and lateral photographs may provide further information on soft tissue facial changes.\(^9\) Therefore, in the present study, lateral photographs were used to provide 2-D facial data and, furthermore, we used geometric morphometrics to depict changes in size, shape and directionality.
In our previous study, upper airway enhancement was identified in children that were treated with the Biobloc technique. Thus, the aim of this present study is to determine how the Biobloc appliance affects the growth of other soft tissue facial components. The null hypothesis to be tested is that there are no differences in facial soft tissues changes in children treated with the Biobloc appliance when compared to an untreated control group. Rejection of the null hypothesis will be based upon statistical differences in the magnitude and direction of any changes identified.

Materials and Methods

After obtaining informed consent, digital, standardized, lateral photographs of 79 consecutive children were obtained from an orthodontic office (WMH). These photographs were sorted into pre-, post- and no-treatment (control) groups. The Biobloc treated sample had a mean age of 12.9 ± 1.5 years and the overall mean treatment time was 21.3 ± 6.2 months. The control group had a mean age of 10.7 ± 1.7 years, consisting of children who were unable, unwilling or not ready to undergo Biobloc treatment. Therefore, the Biobloc sample was decomposed to provide an age- and sex-matched sample for the untreated controls. For both groups, the exclusion criteria for the study were a history of previous orthodontic treatment, oral and/or maxillofacial surgery, any facial injury that resulted in hospital attendance, or any other congenital craniofacial malformation. Inclusion criteria were an Indicator Line measurement (distance from the tip of the nose to the incisal edge of the upper incisor) more than 5 mm in excess of the norm for a given age, as defined by Mew, and an intact buccal segment in the primary dentition. The x, y co-ordinates of 14 landmarks (Fig. 2), which encompassed the lateral soft tissue facial profiles, were digitized in duplicate on all photographs to calibrate digitization errors, using appropriate software.

For analysis, Procrustes superimposition was implemented on a personal computer to normalize and register all configurations were determined for both groups, and subjected to finite-element scaling analysis (FESA), incorporating a spline interpolation. FESA can be used to depict clinical transformations in terms of allometry (size-related shape-change) and anisotropy (directionality of shape-change). The change in form between the reference configuration and the final configuration is viewed as a continuous deformation, which can be quantified based on major and minor strains (principal strains). If the two strains are equal, the form change is characterized by a simple increase or decrease in size. However, if one principal strain changes in a greater proportion, transformation occurs in both size and shape. The product of the strains indicates a change in size if the result is not equal to 1. For example, a product >1 represents an increase in size equal to the remainder; 1.30 indicates a
0. Auriculare: junction of pinna of ear with cheek
1. Cervico-mental junction of submental region and anterior border of neck
2. Soft menton: most anterior point directly opposite menton
3. Soft gnathion: most anterior point directly opposite gnathion
4. Soft pogonion: most anterior point directly opposite pogonion
5. Labiomental groove: maximum midsagittal concavity below the lower lip
6. Labrale inferius: maximum midsagittal convexity of the lower lip
7. Labial commissure: lateral angle of the mouth
8. Labrale superius: maximum midsagittal convexity of the upper lip
9. Columella: point of intersection of nose with philtrum of upper lip
10. Soft rhinion: most prominent point on anterior tip of the nose
11. Soft nasion: maximum concavity overlying the frontonasal suture
12. Soft glabella: most prominent midsagittal point on the forehead
13. Lateral canthus: lateral-most point on the lateral canthus of eye

30% increase. On the other hand, changes in shape are determined by the ratio of the principal extensions, where a value not equal to 1 represents an observable change in shape. The products and ratios can be resolved for individual landmarks within the configuration and these can be linearized using a log-linear scale. A pseudocolor-coded scale was used to provide a graphic display of size-change, shape-change and the directionality of the change, using appropriate software.

ResultsFrom the total sample of 79 cases, only those that had all 14 landmarks in pre-, post- and no-treatment photographs were retained. After careful screening, there were 41 cases remaining (30 cases in the pre- and post-treatment group, and 11 cases in the no-treatment group that had photographs corresponding to the pre-and post-treatment ones). Duplicate digitization of the data indicated that digitization errors were not significant (p > 0.05). Statistical tests also revealed a significant difference in age for the Biobloc and control groups. Therefore, the Biobloc sample was decimated to provide an age- and sex-matched sample for the untreated controls.

Overall, the FESA results indicated that Biobloc treatment had consistent effects on the face towards more favorable facial balance (Figs. 3-6). The findings for the Biobloc group were statistically significant (p < 0.01) but statistical differences were not found for the control group in the maxillofacial region. For the

Figure 3a – Facial profile of a typical patient prior to Biobloc treatment.
Biobloc treated cases, a consistent growth guidance direction of approximately 45 degrees was evident for the anterior face (Fig. 4a). For the untreated control group, the growth direction was less consistent and showed some evidence of vertical growth (Fig. 4b).

In addition, marked shape-change was evident for the Biobloc group, extending across the maxillofacial region (Fig. 5a) compared to the untreated group (Fig. 5b), which showed little shape-change in the anterior face, except in the labial region.

As well, the Biobloc group showed relative size increases in nasal and mandibular regions (15-20%, Fig. 6a), consistent with a more balanced facial profile compared to the control group, which showed size decreases in labial regions (15%, Fig. 6b).

Discussion

Improvement in soft tissue facial appearance is an integral objective of orthodontic treatment, yet research of this goal has been somewhat neglected in the past. Indeed, conventional cephalometry, relying solely upon skeletal analysis, often assumes that facial balance will be obtained if the skeletal/dental cephalometric values are manipulated to normal values. However, the inadequacy of using a hard-tissue cephalometric analysis alone for treatment planning has been noted and it has been concluded that a good occlusion might not necessarily yield good facial balance. It has been stated also that the advent of cephalometric diagnosis inadvertently transferred attention away from the facial soft tissues to skeletal structures, even though correction to hard tissue norms may not result in either facial balance or long-term stability. Therefore, while orthodontic treatments have the capacity of improving facial features, there is a responsibility to avoid any deterioration.

Class II malocclusion is a complex condition that may be corrected, using different modes of treatments, such as fixed, Andresen, Twin Block, Herbst, Biobloc or headgear appliances. Biobloc appliances have different effects compared to functional appliances in the correction of Class II malocclusion. While the overjet was reduced by incisor angulation and by maxillary and mandibular dental base correction when using functional appliances, the overjet was reduced by changed in the mandibular dental base alone for Biobloc appliances. Some orthodontic treatments may involve the extraction of teeth, but Biobloc treatment aims to avoid this option, and thus it is claimed that Biobloc appliances putatively produce an enhanced soft tissue facial profile in the correction of malocclusions. However, some believe that studies of 'alternative orthodontic treatments' have failed to
illustrate better facial appearances, but this assertion might possibly be due to a lack of scientific rigor in the methods of investigation employed. Indeed, others suggest that conventional cephalometric techniques are inadequate for precise analyses of facial growth and orthodontic changes. Therefore, the aim of this study was to determine how Biobloc appliances affect growth of the facial soft tissue components, using robust geometric techniques.
Information on factors influencing the direction of facial growth and development is essential for long-term, successful orthodontic outcomes. The lateral photographs used in this study provided 2-D facial data. We used geometric morphometrics to depict relative changes in size shape and directionality. Although a comparatively small sample was employed in this present study, the control and Biobloc treatment groups were re-tested after matching for age and sex, and the findings remained consistent. As well, duplicate digitization of the data indicated that digitization errors were not significant (p > 0.05). Therefore, the findings of this study are warranted.

Comparing Biobloc cases and untreated controls over a similar time period, this present study demonstrates that in the Biobloc group, the vector of growth guidance was redirected in a more horizontal rather than a more vertical axis, which supports the view of the influence of posture on mandibular growth. Moreover, it has recently been reported that the mean growth direction at gnathion for a sample treated with Biobloc appliances was more horizontal (46º) compared to a sample treated with fixed appliances, which showed more vertical development. In this present study, using geometric rather than cephalometric analysis, we also found a more horizontal direction of facial development (approx. 45º, Fig 4a) compared to a more vertical development in age- and sex-matched control cases (Fig. 4b).

For shape-change, Biobloc appliance cases showed marked changes in the midface but the mental and nasal tip showed little change in shape (Fig. 5a). In contrast, the control group showed little change in midfacial shape, except in the labial region (Fig. 5b). Similarly, a local increase in size (15-20%) was found in the mandibular and nasal regions in Biobloc cases (Fig. 6a), whereas controls showed non-significant relative size-decrease in the mental region (12%) allied with a 15% increase in the angle of the mandible region (Fig 6b), indicating that maxillo-mandibular development is altered by Biobloc treatment.

In summary, the Biobloc findings of this present study used geometric morphometric analyses to depict soft-tissue changes similar to studies of functional appliances and the findings of this study corresponded to other Biobloc treatment that used conventional analytical techniques. Taken together, these findings suggest that Biobloc treatment has a tendency to produce a less flat facial profile upon the successful conclusion of treatment consistent with a more facial balanced profile compared to untreated subjects. The consequences of the present findings provide a premise for future 3-D skeletal and dental studies.

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References