Long-term evaluation of the efficacy on the podalic support and postural control of a new elastic functional orthopaedic device for the correction of Class III malocclusion

E. Bardellini, M. G. Gulino, S. Fontana, J. Merlo, M. Febbrari, A. Majorana

University of Brescia, Italy

e-mail: elena.bardellini@unibs.it

DOI 10.23804/ejpd.2019.20.03.06

Abstract

Aim Correlations between occlusion and posture are open to new perspectives, which include treatment of functional alterations traditionally approached separately. The aim of this study is to evaluate whether the treatment of Class III malocclusion, through an innovative elastic functional orthopaedic device, allows an overall improvement of the podalic support.

Methods A 5½-year-old patient with Angle Class III malocclusion and c anterior ross bite in deciduous dentition has been treated for 7 years with a functional orthopaedic device (MSB Class III). Assessment of frontal and lateral postural plumb line was performed with stabilo-baro-podometric platform analysis, in order to record the podalic support discrepancy between feet, both in static phase and in dynamic phase. The patient has been posturally re-evaluated at nine and twelve years old.

Results The functional device allowed the restoration of the correct intermaxillary relationship, favourably conditioning also the posture. In particular, the correction of the valgus flat foot and a significative reduction of the podalic support discrepancy between feet has been obtained.

Conclusions A global approach to the patient can successfully address both malocclusion and postural alterations.

KEYWORD Malocclusion, Posture, Functional orthopaedics, Stabilometric-baropodometric platform.

Introduction

The hypothesis of correlations between occlusion and posture has recently been officially recognised by the scientific community, and a global approach to such disorders is considered an effective treatment [National Posturology Guidelines, Italy, 2017]. Functional alterations (i.e. lingual interposition, finger or tongue sucking, postural alterations, oral breathing, etc.) are recognized as the environmental factors mostly implicated in the diagnosis of malocclusion, due to their effect on the intraoral and extraoral muscles, with consequent morpho-functional changes at the dental-alveolar and/or skeletal level [Ackerman et al., 2009; Agenter et al., 2009; Ciavarella et al., 2010].

Class III malocclusions are often correlated to a low and anterior posture of the tongue, with consequent risk of mandibular protrusion [Iwasaki et al., 2017].

Since the jaw, through the hyoid bone, is functionally connected to the cranial structures and to those of the cervical district (through fascial and muscle-ligaments components), its malposition could induce an unbalancing effect on the whole postural order [Rocabado, 1983].

The repositioning of the tongue through a functional appliance could help a correct growth and development of the patient, and the restoration of functional swallowing and breathing [Tollaro et al., 1996; Suárez et al., 2014].

The aim of this study is to present a long term-evaluation, for a total of 7 years, of the posture of a child treated with an elastic functional orthopaedic device.

Materials and methods

A 5½-year-old girl in deciduous dentition presented Angle Class III bilateral malocclusion, with anterior cross bite. Treatment started with a functional orthopaedic device (Mouth Slow Balance, MSB, Class III).

Postural examination with plumb line and stabilo-baropodometric platform analysis in static and dinamic posture were performed.

Functional orthopaedic device

The functional orthopaedic device MSB Class III (MSB) is suitable for the treatment of Class III malocclusion in deciduous or mixed dentition (Fig. 1). The device is an evolution of the Bionator, built on an individualised bite and obtained through a three-dimensional dynamic-functional squaring [Oda et al., 2016]. This squaring determinates the inter-maxillary position, thus identifying the vertical dimension. Transferring some of the skull landmarks of the patient (i.e. most extruded incisive, centric cuspids of the right and left upper molars, opisthion) it is possible to establish a plane with antero-posterior orientation, consistent with a physiological Mc Gregor angle of 101° ±5°. The orientation of this plane allows the patient to maintain the individual erect position [Rocabado, 1983]. In order to develop models models with that orientation, the plinth is squared transferring the planes drawn by these points into a 3D model. The construction bite is obtained filling with wax the space between the two arches, space obtained by putting back the models' base on a horizontal plane with which they form an angle of 90°.

The MSB III device is composed of an inferior labial archwire, with the buccinator loop from arch to arch of 1 mm diameter, a palatal omega of 1.2 mm diameter, a lingual springer of 0.9 mm diameter, a double back-incisive springer of 0.9mm diameter. The resin body includes the upper and lower maxilla, where the guide planes follow the inclination and the thickness of the construction bite.

Due to its conformation and to the elevated elasticity in the three spatial directions, and the minor discomfort for the tongue, this device allows lingual repositioning while swallowing; a transversal and antero-posterior expansion of the maxilla, both during swallowing and through therapist activation; a concomitant expansion of the lower arch, while respecting the relationships between cuspids and maxillary pit; a proprioceptive stimulus of mandibular retrusion, through the III Class vestibular archwire, positioned to the equator of the lower teeth.

Stabilo-baropodometric platform

The stabilometric and baropodometric evaluation of static and dynamic podalic support is instrumental (Biopostural System® - CE-0124). The system uses a platform of 40x40 cm (1600 strenght sensors) with resistive technology for acquisition through high frequency. The software provides a three-dimensional clinical-postural evaluation of the patient. Furthermore, it is able to assess the correlation between "Type of Foot" and "Posture", through an inferential algorithm.

Computerized cephalometry

For computerized cephalometry an orthodontic software solution (OrthoTP® Software) is used, developed thanks to the collaboration of different teams composed by technical and clinical experts. It allows the cephalometric analysis of the patient using different radiographic analises in the various projections (lateral, antero-posterior, postero-anterior, axial, panoramic tomography of the jaw), integrating more than 30 methods for studying the orthopaedic functional occlusion.

Standardised postural station

It consists of a positioning station for the photographic postural clinical analysis and Romberg and Fukuda tests [Fukuda, 1961], completed with laser for vertical and horizontal references, digital camera and carpet with graphic references for patient positioning (350 cm x 100 cm).

Together with the OrthoTP® software, it measures body parameters according to the evaluation of the postural tone and the analysis of Barrè, and for the Postural tests objectivity.

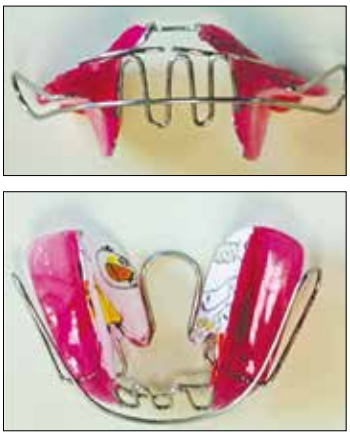

FIG. 1 The MBS (Mouth Slow Balance) Class III device.

Results

The 5½-year-old girl with bilateral Angle Class III malocclusion, with anterior cross bite was evaluated. Plaster models were obtained, which confirmed the dental malocclusion; cephalometric analysis on the lateral cephalometric X-ray was made, showing a Class I skeletal type with retrognancy of the upper maxilla and skeletal deep bite. Postural examination with the plumb line was performed, showing posteriorly a right postural torsion, an inclination of the scapular and pelvic lines, valgus knee and foot, laterally bent cervical line, with eyes pointed downwards and anteverted pelvis.

The stabilo-baropodometric platform analysis in static position indicated a flat and valgus foot and a podalic support discrepancy between feet (42.2% on the right foot and 57.8% on the left foot), suggesting a displacement of the body centre of gravity on the left (Fig. 2).

The treatment consisted in an elastic functional orthopaedic device, the MSB III, suitable for the treatment of Class III malocclusion in deciduous or mixed dentition.

The purpose was to correct the mandibular-cranial postural relationship during swallowing [National Posturology Guidelines, Italy, 2017].

The device was activated every fifteen days. At the age of 9 the patient was re-evaluated: the anterior cross bite was resolved, while she was still maintaining a slight bilateral tendency to Class III. A selective grinding and deciduous canine stripping was performed, following Planas' neuro-occlusal rehabilitation (NOR) principles [Planas, 1992].

The functional device was then modified: the labial archwire previously positioned to the equator of the inferior teeth, was brought in Class I.

The patient was posturally re-examinated with the plumb line: posteriorly an improvement of body torsion was noticed with levelling of the scapular and pelvic lines and a reduction of the valgus knee and flat foot; laterally,

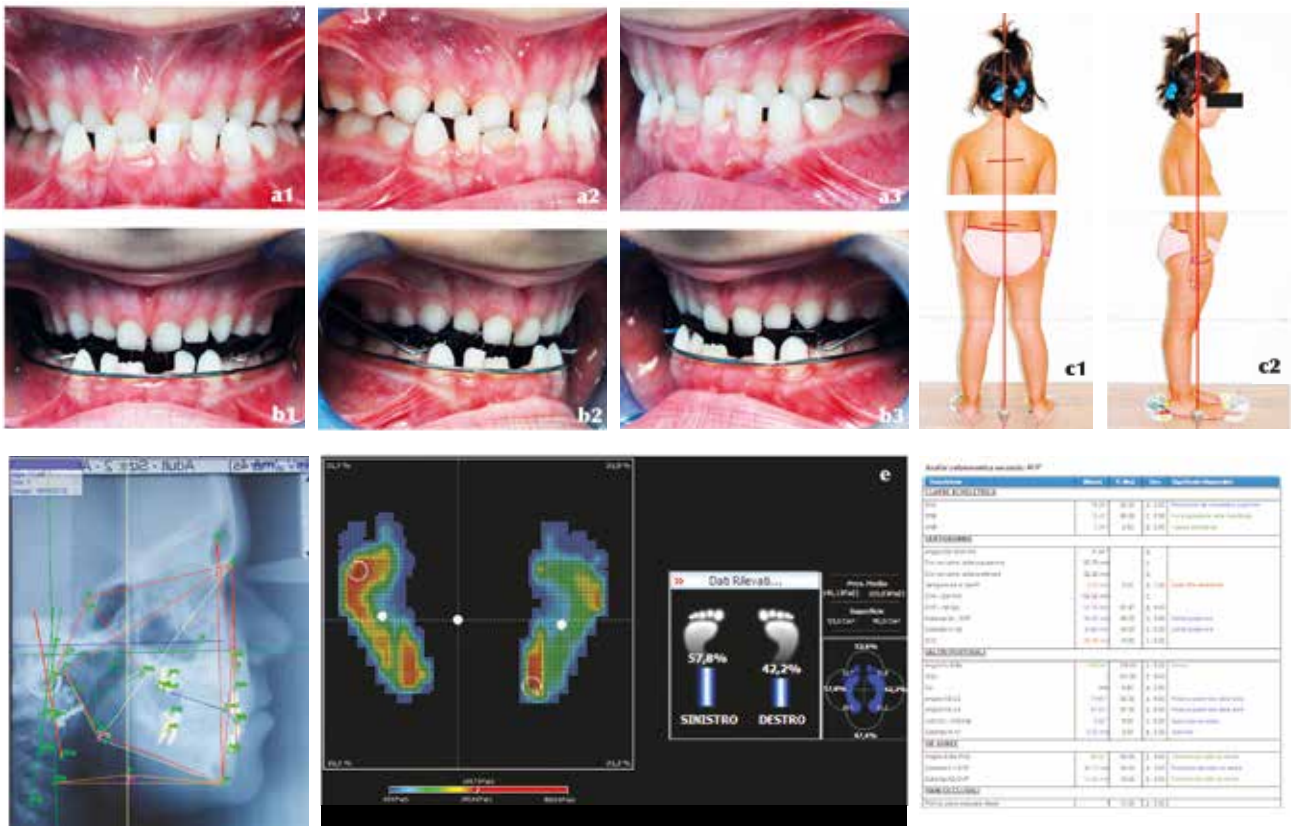

FIG. 2 Patient at 5 years.
Anterior cross bite in deciduous dentition (front, a1; left a2; right a3); the functional orthopaedic device "MBS III" in place (front, b1; left b2; right b3).
Evaluation of the plumb line (posteriorly, c1 laterally, c2). Cephalometric analysis on the lateral-lateral cephalometric X-ray (d).
Sstabilo-baropodometric platform analysis in static position (e).

with the eyes toward the horizon, correction of the cervical bending was observed as well as the correction of the anteverted pelvis in a physiological curve of lumbar lordosis.

The stabilo-baropodometric platform analysis confirmed a reduction of the flat and valgus foot, with descrease of the support discrepancy between the feet: 49.9% on the right foot and 50.1% on the left one (Fig. 3).

Currently the patient is 12 years old and applies the functional device during night-time only; the Class IIII malocclusion appears compensated (Fig. 4). Final plaster models were obtained and lateral cephalimetric analysis showed a Class I skeletal class, and resolution of the skeletal deep bite. The postural examination with the plumb line evidenced posteriorly a slight worsening of the scapular line, and laterally a correct posture was reached.

The stabilo-baropodometric platform analysis showed a complete correction of the flat and valgus foot, with a negligible discrepancy of podalic support (49.9% on the right foot and 50.1% on the left foot).

Discussion and conclusion

The correlation between dental occlusion and neuro-muscular-fascial system (postural system) has been a matter of medical interest for a long time [Silvestrini-Biavati et al., 2013]. Though they have long been subject to criticism, as mainly characterised by a clinical-empirical approach, the evolution of technologies and knowledge has improved the quantity and quality of scientific papers supporting the correlations between occlusion and posture, officially recognized in the 2017 National Guidelines for Posturology [National Posturology Guidelines, Italy, 2017]. The first studies were conducted by Makofsky [1989], who formulated the sliding cranium theory: an anterior glide of the skull would correspond to an extension of the atlanto-occipital joint, with a concomitant mandibular retrusion and change of posterior dental contacts and viceversa. This theory has been accepted by different authors [Bedoya et al., 2014] and supported by a recent study from Liu et al. [2016]. Many others have shown that there is an involvement of the whole muscoloskeletal system, from the cervical district through the "kinetic muscle chains" [Simons et al., 1999]. In our patient, the early malocclusion treatment by means of the elastic device, has favourably conditioned the growth vectors of the maxillary bones, with the recovery of the proper functionality for chewing, breathing, swallowing and the improvement of the whole body posture.

In the light of this case, a global approach can successfully address both the skeletal malocclusion and the

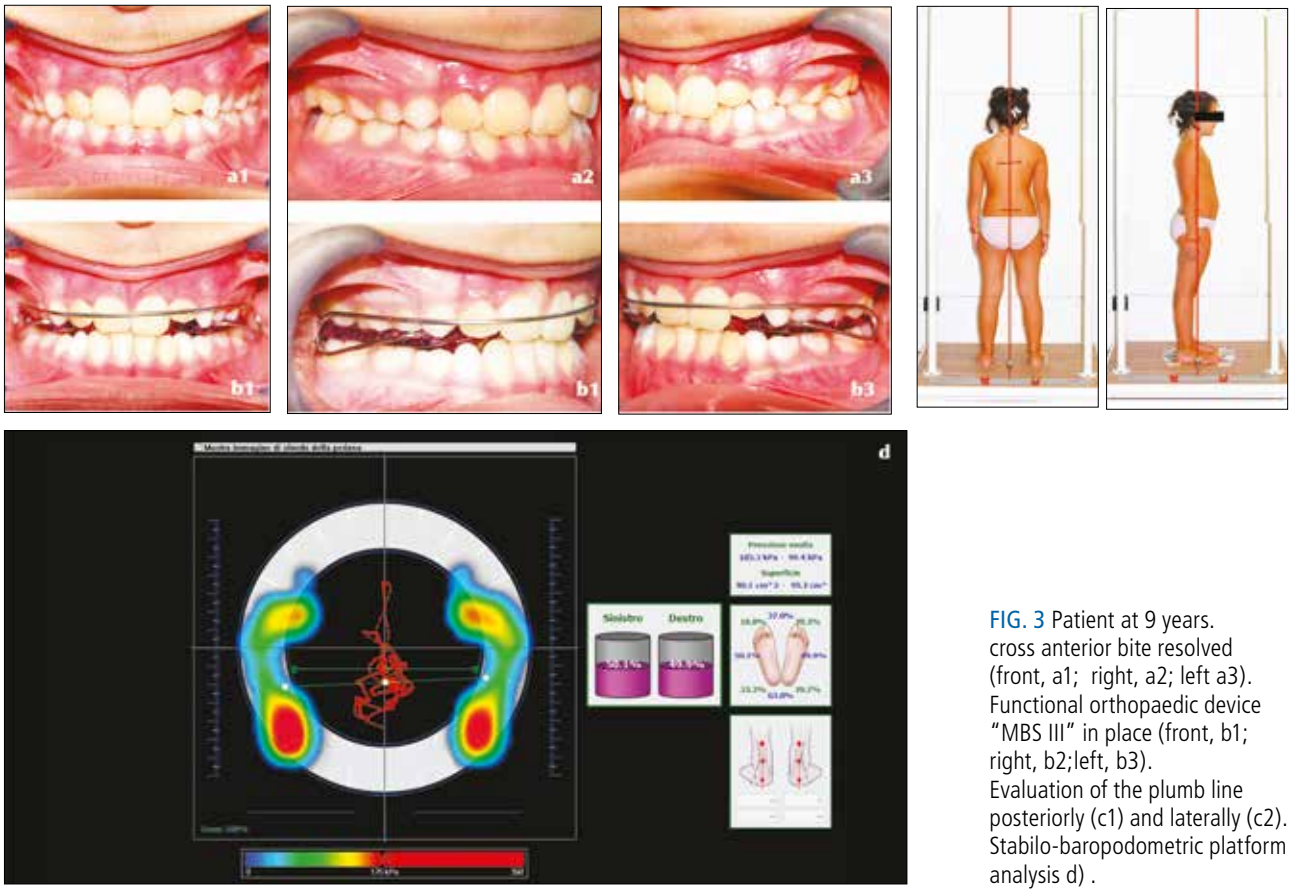

FIG. 3 Patient at 9 years.
cross anterior bite resolved (front, a1; right, a2; left a3).
Functional orthopaedic device "MBS III" in place (front, b1; right, b2;left, b3).
Evaluation of the plumb line posteriorly (c1) and laterally (c2).
Stabilo-baropodometric platform analysis d) .

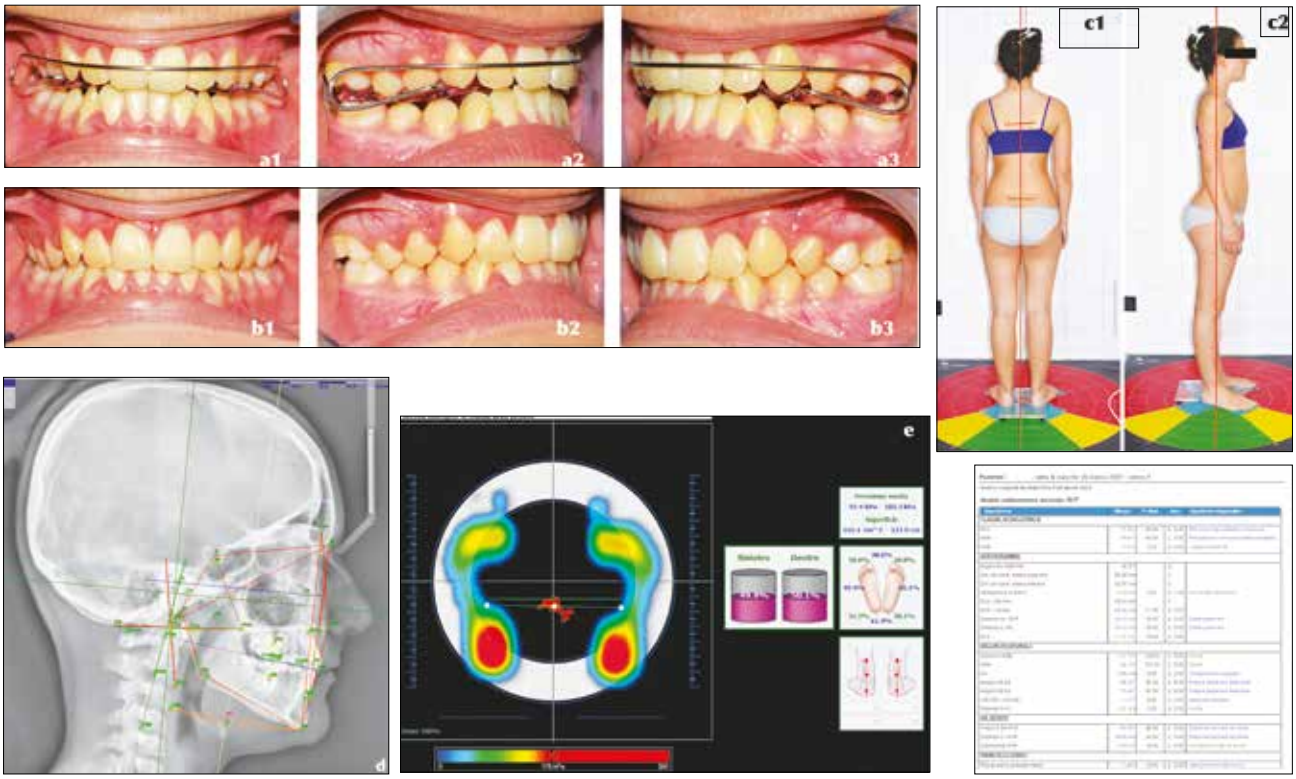

FIG. 4 Patient at 12 years.
Functional orthopaedic device "MBS III" in place (front, a1; right, a2; left, a3).
III Class malocclusion compensated (front, b1; right, b2; left, b3). evaluation of the laser line in posteriorly (c1) and laterally (c2).
Cephalometric analysis (d). Stabilo-baropodometric platform analysis (e).

postural alterations. Further studies are certainly needed to substantiate a holistic approach as a definite treatment for malocclusions and postural related problems.

References

» Ackerman JL, Kean MR, Proffit WR. The interaction of function and stability in the dentition. Aust Orthod J 2009; 25 (2):169-172.
» Agenter MK, Harris EF, Blair RN. Influence of tooth crown size on malocclusion. Am J Orthod Dentofacial Orthop 2009; 136 (6): 795–804.
» Bedoya A, Landa Nieto Z, Zuluaga LL, Rocabado M. Morphometry of the Cranial base and the Cranial-Cervical-Mandibular System in young patients with type II, division 1 malocclusion, using tomographic cone beam. Cranio 2014; 32 (3): 199–207.
» Ciavarella D, Mastrovincenzo M, Sabatucci A, Parziale V, Chimenti C. Effect of the Enveloppe Linguale Nocturne on atypical swallowing: surface electromyography and computerised postural test evaluation. Eur J Paediatric Dent 2010; 11 (3): 141-145.
» Fukuda T. Studies on human dynamic postures from the viewpoint of postural reflexes. Acta oto-laryngol 1961; 161: 1–52.
» Iwasaki T, Sato H, Suga H, Takemoto Y, Inada E, Saitoh I, et al. Relationships among nasal resistance, adenoids, tonsils, and tongue posture and maxillofacial form in Class II and Class III children. Am J Orthod Dentofacial Orthop 2017; 151 (5):929-940.
» Liu Y, Sun X, Chen Y, Hu M, Hou X, Liu C. Relationships of sagittal skeletal discrepancy, natural head position, and craniocervical posture in young Chinese children. Cranio 2016; 34 (3):155–162.
» Makofsky H. The Effect of Head Posture on Muscle Contact Position. The Sliding Cranium Theory. Cranio 1989; 7 (4): 286–292.
» National Posturology Guidelines, Italy, 2017 http://www.salute.gov.it/imgs/C_17_pubblicazioni_2717_allegato.pdf
» Oda H, Sandou M, Lin CM, Kamata M, Kawata T. Clarifying the mechanism of effect of the Bionator for treatment of maxillary protrusion: a percentile growth study. Eur J Paediatr Dent 2016; 17(3):213-219
» Planas P. Equilibrium and neuro-occlusal rehabilitation. Orthod Fr 1992; 63 (2):435-441
» Rocabado MJ. Biomechanical relationship of the cranial, cervical, and hyoid regions. Craniomandibular Pract 1983; 1(3):61-66.
» Silvestrini- Biavati A, Angiero F, Gambino A, Ugolini A. Do changes in sphenooccipital synchondrosis after rapid maxillary expansion affect the maxillomandibular complex? Eur J Paediatric Dent 2013; 14 (1): 63-67.
» Simons DG, Travell JG, Simons LS, Cummings BD. Myofascial pain and dysfunction. Upper half of body. 2nd edn. Williams and Wilkins, Baltimore, 1999.
» Suárez C, Antonarakis GS, Pham D. Occlusal characteristics in subjects with or without the ability to roll the tongue. Eur J Paediatric Dent 2014; 15 (2): 147-150.
» Tollaro I, Baccetti T, Franchi L. Floating norms for the assessment of craniofacial pattern in the deciduous dentition. Eur J Orthod 1996; 18 (4): 359–365.