

Optimization of early orthodontic therapy: the potential of preformed elastomeric eruption guidance appliances (EGA) in addressing class ii malocclusions

Mario Palermi¹
Fabio Massimo Sciarra¹
Gianluca del Vecchio²
Sabina Saccomanno¹

¹ Dentistry Unit, Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy

² Private Practice, Caserta, Italy

Corresponding author: Mario Palermi
e-mail: palermi.m@gmail.com

Abstract

Abstract: The therapeutic management of malocclusion in mixed dentition represents a crucial challenge in orthodontics. This study aims to illustrate the therapeutic approach adopted in a second class I division case, characterized by increased overjet (OVJ) and overbite (OVB), multiple dental rotations and contracted upper arch, by the use of preformed elastodontic guided eruption appliance (EGA).

Materials and Methods: The initial clinical diagnosis revealed the need for early intervention to improve OVJ and correct the sagittal and vertical relationships of the dento-alveolar process. A 10.5-year-old male patient with Division 1 Class II malocclusion was treated using two different EGA devices, both mixed and permanent dentition, for a total period of two years, with an average usage of about 10 hours per day.

Results: The results obtained were significant, with complete resolution of malocclusion at the end of treatment. The active and passive forces generated by the shape of the device contributed to the correction of dental rotations and the improvement of verticality, reducing the OVB. Early use of such devices has been shown to significantly reduce the risks of dental trauma, while requiring low patient compliance and minimal psychological and psycho-social impact.

Conclusions: The adoption of EGA has proven to be an effective therapeutic option in the early treatment of Division II malocclusion 1. The sequential approach with two different devices has helped to optimize the therapeutic results, reducing the need for more invasive orthodontic interventions at a later stage. However, it is essential to stress the importance of accurate diagnosis, appropriate planning and active collaboration of the patient to ensure the success of this interceptive approach.

Key words: Elastodontics, Elastodontic Device, Elastodontic appliance, EGA, Interceptive therapy, Growing patient, Early treatment.

Introduction

Malocclusion is a condition characterized by the alteration of dental-alveolar relationships, which can be evident already in mixed dentition with an increase in overbite (OVB) and overjet (OVJ) and may persist in permanent dentition, increasing the risk of dental trauma such as, for example, the fracture of the upper incisors¹. This phenomenon is particularly seen in second-class malocclusions of 1 division, characterized by increased overjet and overbite, often associated with hypodivergent growth patterns and dental rotations caused by insufficient eruptive guides. At the skeletal level, sagittal alterations may occur, such as mandibular hypoplasia or upper maxillary hyperplasia, which contribute to the clinical situation described².

To address these issues, interceptive orthodontic therapy is often the first choice in the treatment of malocclusion of growing subjects^{1,3}. However, it is crucial to understand that

Authors

Mario Palermi - SDentistry Unit, Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy

Fabio Massimo Sciarra - Dentistry Unit, Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy

Gianluca del Vecchio - Private Practice, Caserta, Italy

in almost all patients there will be a need, subsequently, for a second therapeutic phase by means of fixed orthodontics or with transparent aligners, to optimize the therapeutic results, solve inter-arch and intra-arch and achieve proper occlusion^{4,5}. The orthodontist, after a careful diagnosis that considers various factors such as the facial model and the age of the patient, will have to identify the most appropriate treatment for each case, also considering the collaboration of the patient himself^{3,6}. Managing the aesthetic impact of malocclusion is of considerable importance for the growing patient, not only to ensure dental health, but also to preserve psychological well-being^{1,7}.

The purpose of this study is to demonstrate how the use of preformed elastodontic guided eruption appliance (EGA) allows the improvement of OVB and OVJ parameters and has a stable corrective action on dental elements.

Materials and methods

Case report

A 10-years old male Caucasian patient was brought to visit by parents concerned about the proclination and rotation of the upper incisors. There were no abnormalities in his medical history, and he had never received orthodontic treatment before.

Clinical observation.

On the extraoral examination, the patient had a convex facial profile, balanced facial proportion, regular nasolabial angle, and marked sub-labial fossa. The joint examination showed no clinical signs.

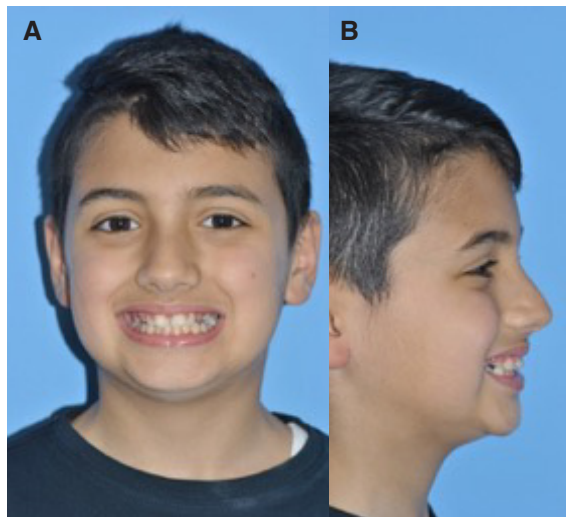


Figure 1 (A-B). Pre-treatment documentation: extraoral photographs of the face, front view, and right lateral view.

During the last stage of the mixed teething, the visit occurred. From a sagittal point of view, a class II tendency was observed at both molar and canine levels, with a OVJ increased by 5 mm. On the transverse side, there was a slight contraction of the upper arch and a slight deviation of the midline to the left, which however disappeared during the opening of the mouth. This showed that the problem was not of a skeletal nature, but func-

tional. As for the vertical plane, an accentuation of the Spee curve was observed in the lower arch, whereas the upper arch had an inverse Spee curve. Parents were also made aware of the need to improve the oral hygiene of the young patient.



Figure 2 (A-C). Pre-treatment documentation: intraoral photographs of the dental arches in occlusion, including front, right lateral, and left lateral views.

Diagnostic values

For a more detailed evaluation, orthopantomography and cephalometric analysis were performed using a latero-lateral telerradiograph. To conduct digital cephalometric measurements, a JPG format X-ray image was uploaded to the OneCeph application (Google Play Store, Google Inc, Mountain View, California) on an Android smartphone (Motorola Moto E13, Motorola Inc, Schaumburg, Illinois)⁸. The image was calibrated using a reference scale. Subsequently, the same operator identified the necessary skeletal and dental reference points for analysis. Upon completion of the reference point identification, the OneCeph application performed linear and angular measurements, yielding the following values.



Figure 3 (A-B). Pre-treatment documentation: patient's orthopantomography and cephalometric analysis on his latero-lateral teleradiography

Table 1. Pre-treatment cephalometric analysis values

Parameter	Measurement	Norm
SNA	78.6°	82°
SNB	75.4°	80°
ANB	3.2°	2°
AB on OP (Wits)	2.9mm	-1.1 ± 2.0
Maxillary Convexity	2.9mm	2.4mm
Maxillary Rotation	13.0°	8° ± 3°
SNMP	30.2°	32°
FMA	16.5°	25°
Basal Plane Angle	17.9°	25°
Articular Angle (S-Ar-Go)	144.6°	143° ± 6°
Ramus Height (Ar-Go)	36.4mm	44 ± 5
PFH : AFH (S-Go : N- Me)	Ant : Post = 65.0%	65% [Clock < 65, Anti- clock > 65]
Saddle Angle (N-S-Ar)	123.7°	123° ± 5°
Pog to N Perpendicular	-3.7mm	Small:-7±1 Med: -2±2 Large: 0±2
Go-Pog	67.8mm	83.7 ± 4.7
IIA	125.2°	126.0°
UISN_Angular	108.8°	104° ± 6°
LINB_Linear	2.2mm	4mm
Upper Incisor Protrusion	7.8mm	2.7mm (-1 to 5)
FMIA	66.1°	65°
IMPA	97.3°	90°
UpperLip	-0.8mm	0mm
LowerLip	0.0mm	0mm

Prognosis

The prognosis of Class II depends on both genetic and environmental factors. If environmental factors have a greater influence, orthodontic therapy can provide better control and more effective results⁹. Proper

occlusion, with appropriate values of vertical overlap (OVJ) and horizontal overlap (OVH), is essential to compensate for and promote orthognatic growth. A hypodivergent growth pattern is generally considered a positive prognostic factor¹⁰.

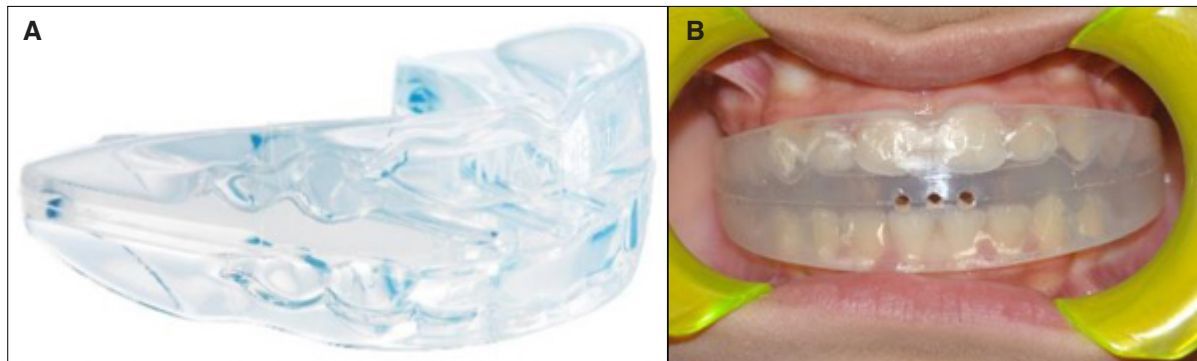


Figure 4 (A-B). Type of EGA and its use within the oral cavity.

Treatment plan

Therapeutic objectives for treatment were different: expand the contracted upper arch, improve the class II relationship, align the midlines, correct dental rotations, reduce increased OVJ and OVB, and improve the facial profile. The therapy selected for this patient involved the use of a specific functional equipment. A preformed elastodontic guided eruption appliance (EGA) was chosen, specifically a LM-Activator Low Short (produced by LM-Instruments Oy, Parainen, Finland).

This appliance has a lower thickness in the back than the front and, even if preformed, can be customized by choosing the most suitable sizes. For the first year, a LM Activator Low Short 45 was selected. The device was used, as per protocol of use, mainly at night and for a few hours in the afternoon^{11,12}. For the first two weeks, the patient was advised to wear it only two hours in the afternoon, to facilitate adaptation to the new appliance. During these afternoon hours, the use of the equipment was discontinuous, while at night it was kept constant.

Orthodontic examination appointments were set every three months to monitor proper use.

During the second year, the therapy was modified using the same type of device, but with a larger size: LM Activator High Short 50, to accompany the growth of the dental arch^{11,12}.

Results

The patient showed signs of a double occlusion a year later, one with an OVJ that was still elevated and the other with an OVJ of 2 mm. The OVB had improved, and dental rotations had decreased, suggesting that the device was performing. The upper arch was no longer contracted, the rotations were corrected and the OVJ and OVB were fixed two years after the treatment began. While class relations in class I stabilized, the midline deviation also improved. Furthermore, there was an improvement in the patient's harmonious facial profile.



Figure 5 (A-C). Documentation of ongoing treatment: intraoral photographs in occlusion of the dental arches taken at 12 months post-treatment, encompassing front, right lateral, and left lateral perspectives.

Follow-up

To maintain the achieved results and promote the correct intermaxillary growth, the patient continued to use a LM-Activator Low-Long 55. This approach was aimed at supporting the correct intermaxillary relationship and the three-dimensional growth of dentoalveolar processes. The correction of occlusal planes has been ensured over time.

Approximately four years and five months post-therapy, the patient was re-evaluated at the age of 16 years and 11 months. Follow-up results demonstrated a stable occlusion, with Class I relationships observed in both canines and molars across both dental arches.

Aesthetically, the patient's smile was harmonious with good smile exposure, though slight incisor crowding was noted in both arches. The patient's profile remained convex.

Cephalometric measurements indicated significant improvements in key reference values. The ANB angle improved to 2.1° , and the Wits appraisal (AOBO) reached 2.2 mm. Maxillary rotation was recorded at 11.5° , while the basal plane angle was 19.4° . The upper incisor to SN angle (UISN) increased to 103.4° , and the IMPA was measured at 95.4° .

These results suggest, as also described by scientific literature, that interceptive treatment with EGA contributed positively to occlusal stability and smile aesthetics, with noted improvements in cephalometric parameters¹⁰⁻¹³.



Figure 6 (A-G). Follow-up post-treatment documentation: extraoral and intraoral photographs, including frontal and right lateral views of the face and dental arches in occlusion, alongside frontal, right lateral, and left lateral intraoral perspectives.



Figure 7 (a-b). Follow-up post-treatment documentation: patient's orthopantomography and cephalometric analysis on his latero-lateral teleradiography.

Table 2. Post-treatment follow-up cephalometric analysis values

Parameter	Measurement	Norm
SNA	80,7°	82°
SNB	78,6°	80°
ANB	2,1°	2°
AB on OP (Wits)	2,2mm	-1.1 ± 2.0
Maxillary Convexity	3,0mm	2.4mm
Maxillary Rotation	11,5°	8° ± 3°
SNMP	28,6°	32°
FMA	15,8°	25°
Basal Plane Angle	19,4°	25°
Articular Angle (S-Ar-Go)	150,6°	143° ± 6°
Ramus Height (Ar-Go)	46,9mm	44 ± 5
PFH : AFH (S-Go : N- Me)	Ant : Post = 67,6%	65% [Clock < 65, Anti- clock > 65]
Saddle Angle (N-S-Ar)	121,1°	123° ± 5°
Pog to N Perpendicular	2,5mm	Small:-7±1 Med: -2±2 Large: 0±2
Go-Pog	75,5mm	83.7 ± 4.7
IIA	131,9°	126.0°
UISN_Angular	103,4°	104° ± 6°
LINB_Linear	2,6mm	4mm
Upper Incisor Protrusion	5,1mm	2.7mm (-1 to 5)
FMIA	68,8°	65°
IMPA	95,4°	90°
UpperLip	-1,3mm	0mm
LowerLip	-1,3mm	0mm

Discussion

The primary objective of the orthodontist, while examining a growing patient, is to assess the development of occlusion to determine whether it is physiological or, on the

contrary, may be indicative of a potential malocclusion. Indeed, it is essential to have an in-depth understanding of facial growth, dental and skeletal development, as well as proportional variations^{1,14}. Additionally, it is crucial

to examine the direction of dentofacial growth associated with the overall physical development and maturation of the pediatric patient¹⁵. Hence, it is the responsibility of the orthodontist to diagnose potential anomalies, including abnormalities in dental arches, alterations in occlusion and jaw relationships and pathological occlusal interferences^{16,17}.

The purpose of interceptive orthodontic therapy is to identify and address the factors contributing to malocclusions, promote harmonious growth and development of maxillaries and minimize the duration of future treatment during permanent dentition^{3,18}.

Typically, the interceptive orthodontic treatment can include one or two phases, followed by definitive treatment during permanent dentition, which can be carried out with fixed appliance or clear aligners^{9,19}.

Treatment timing is a contentious issue in orthodontics¹. During the first phase, in mixed dentition, Angle's class relationships, overbite and overjet relationships are assessed. Early intervention aims to prevent the development of malocclusion and facilitate proper growth of permanent teeth²⁰.

Interceptive and functional orthodontic devices are designed to avoid interfering with the physiological changes associated with the pubertal growth peaks, which are correlated with the eruption of permanent teeth. Consequently, they do not alter the dynamic nature of occlusal adjustments⁶.

The overjet increase, which can result from rotations of the anterior teeth exerts adverse effects on the growth pattern, potentially compromising the development of skeletal issues. Under such circumstances, mandibular retrusion during growth may persist. As a consequence, upper incisors protrusions and mandible's retrognathic position can predispose to dental traumas. An increase in overjet leads to a subsequent increase in overbite: as a result of insufficient contact with the opposing arch, the lower incisors will overerupt until they make contact with the palatal mucosa^{2,21}. This situation necessitates early intervention to establish a proper occlusal relationship for long-term maintenance. Additionally, the familial predisposition to skeletal Class II can genetically influence the development of this malocclusion in the patient³. To enhance sagittal and vertical dimensions in a patient, achieving proper eruption of posterior teeth is crucial to positively influence mandibular growth. However, the timing and extent of dental eruption may vary, depending on individual factors such as mandibular resting position and interocclusal free space^{1,22}.

Orthodontic functional appliances employ various mechanisms of action, yet they share the common effect of orthopedically guiding dental eruption and movement. Consequently, the treatment goal is to foster proper mandibular growth in children and correct basal bone growth in all three spatial planes. The principle of functional orthodontics centers on achieving morphological modifications through functional actions, including physiotherapy, exercises, and oral muscle training^{23,24}.

Preformed elastomeric eruption guidance appliances (EGA) are generally employed in interceptive orthodontic therapy to early treat Class II malocclusions. They can be considered dental positioners, due to their capacity to achieve guided movements during dental eruption^{10,13}. These appliances are particularly indicated for patients aged 6 to 12 years old presenting with Class II division 1 malocclusions, characterized by deep bite

and increased overjet during the early mixed dentition¹¹. They adhere to similar indications as other functional appliances and primarily comprise a singular elastic structure with intercuspation for both upper and lower teeth²⁵. Early treatment with EGA devices aims to obtain an ideal sagittal condition by controlling vertical dimension and harnessing eruption forces^{11,12}. These appliances are designed to guide dental eruption and retain permanent teeth in their correct positions throughout the mixed dentition phase, thereby facilitating the attainment of an ideal occlusion through the application of moderate and constant orthodontic forces^{10,25}.

Initially, the teeth are guided towards proper alignment during their eruptive phase. Subsequently, efforts are directed towards achieving optimal spatial positioning within the occlusal plane²⁶.

As mentioned

region elicits a comparable effect to the Lip Bumper orthodontic device in terms of labial proprioception. Muscle activity is stimulated by oral proprioceptors activated by the soft and transparent biocompatible silicone material. The material thickness located at the lateral zones, unlike Frankel-type appliances, is distanced from the fornix, creating a screen that provides a proprioceptive function to the patient's lips, cheeks, and tongue throughout device usage. Consequently, this facilitates a continuous tissue conditioning^{25,30}.

Once all therapeutic objectives associated with the active phase of treatment have been achieved, the device can subsequently serve passively as a retainer¹⁰.

The primary effects observed in patients on the sagittal plane include mandibular advancement, primarily attributed to positive outcomes at the temporomandibular joint (TMJ) level. This stimulation results in bilateral condylar growth, fostering harmonious spatial arrangement¹¹.

On the frontal plane, an increase in facial height is observed, attributed to the extrusive effect on the anterior group and the intrusive effect on the posterior group^{13,25}. On the transverse plane, the primary effects pertain to inter-arch relationships and arch width. Specifically, preformed elastomeric EGA devices facilitate a guiding action during tooth eruption, leading to an optimal inter-occlusal relation. Furthermore, literature supports physiological expansion of dental arches when forces exerted by vestibular and labial musculature are controlled by apposite shields^{10-12,26}.

Ultimately, EGAs can serve as retainers, ensuring the stable maintenance of tooth position at the occlusal plane achieved until the completion of dental transition¹². Patient cooperation plays a crucial role in achieving optimal results, with the device ideally worn during nighttime hours and for approximately 4-6 hours during the day, as strongly recommended in the literature¹⁰⁻¹².

The utilization of these devices, distinguished by their comfort and convenience in daily use, fosters increased compliance among young patients while allowing for uninterrupted oral hygiene practices^{10,25}. This therapeutic approach represents a substantial advancement in enhancing the quality of orthodontic treatment, particularly for patients afflicted with Class II malocclusion, by providing an effective and comfortable solution¹¹.

The utilization of EGAs can prove highly advantageous in early intervention strategies, as it mitigates or potentially obviates the necessity for subsequent orthodontic interventions during the permanent dentition phase. This, in turn, facilitates a notable reduction in treatment expenditures^{10-13,25-26}.

Conclusions

The orthodontic treatment of Class II malocclusions with deep overbite and increased overjet using elastomeric guidance appliances is aimed at correcting tooth position, with a focus on the frontal and sagittal planes and occlusal alignment. Therapeutic objectives entail the early and highly effective improvement of deep overbite and incisal relationships, contingent upon full patient cooperation. This therapeutic approach substantially diminishes the duration of subsequent orthodontic treatment phases, involving multibracket fixed appliances or clear aligners. Moreover, in certain instances, it can enable the resolution of malocclusion within a single

interceptive orthodontic phase. Preformed elastomeric orthodontic appliances demonstrate particular efficacy in this context, yielding satisfactory outcomes when applied during the mixed dentition phase. The assessment of treatment timing holds paramount importance, with tools such as skeletal growth indicators assuming a pivotal role. Finally, precise diagnosis, meticulous planning, and optimal patient cooperation remain indispensable for the success of the treatment, consistent with every interceptive approach. In conclusion, precise diagnosis, meticulous planning, and high levels of patient cooperation remain essential for the success of the treatment, consistent with any interceptive orthodontic approach.

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