



# Comparison of Frankel Regulator and Cervera Appliance in Functional Treatment of Class II Malocclusions: A Systematic Review

**Peer review status:**

No

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**Article ID:** WMC005223

**Article Type:** Systematic Review

**Submitted on:** 14-Nov-2016, 02:48:43 AM GMT **Published on:** 15-Nov-2016, 09:58:48 AM GMT

**Article URL:** [http://www.webmedcentral.com/article\\_view/5223](http://www.webmedcentral.com/article_view/5223)

**Subject Categories:** ORTHODONTICS

**Keywords:** Frankel regulator, Cervera appliance, Orthodontics, Class II Treatment, Functional Appliances

**How to cite the article:** Fantasia E, D'emidio M, Rodi G, Padalino G, Lombardelli E. Comparison of Frankel Regulator and Cervera Appliance in Functional Treatment of Class II Malocclusions: A Systematic Review. WebmedCentral ORTHODONTICS 2016;7(11):WMC005223

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**Source(s) of Funding:**

No found has been taken.

# Comparison of Frankel Regulator and Cervera Appliance in Functional Treatment of Class II Malocclusions: A Systematic Review

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## Abstract

**Background:** The Class II Malocclusion is the most frequent dento-skeletal anomaly that involves one third of all orthodontic patients. So many appliances have been described in the literature for treating this malocclusion, in particular when it's indicated to obtain a mandibular advancement. The aim of this study is to compare the dental and skeletal effects of Frankel II Regulator and Cervera Appliance. **Materials and Methods:** A detailed research of literature published on PubMed (Medline), Lilacs and Scopus, till October 2016, has been performed selecting sixteen articles. The treatment approaches have been evaluated for effectiveness, efficiency and distance follow up. **Results:** The literature confirms that both Frankel Regulator and Cervera Appliance are two fundamental devices in the functional treatment of Class II Malocclusions. They are based both on Moss' functional matrices principle, so the modification of the neuro-muscular engram induces the stabilization of skeletal and dento-alveolar proportions as the correction of class II malocclusion. Although the Frankel Regulator can be considered the precursor of the actual Cervera appliance, the second device has demonstrated more effectiveness and efficiency in functional treatment as the possibility to correct facial asymmetries. Despite their considerable validity, it's important to remember that all these devices are strictly dependent on patients' compliance because they are removable appliances. **Conclusions:** The functional regulator induces counterclockwise rotation rather than vertical or sagittal changes in the maxilla, in the way that it affects the angulation of the cranial base.

## Introduction

Class II malocclusion is a common clinical problem in orthodontics, with approximately 15%-30% of North American children and 20%-30% of all orthodontic patients having this type of dento-skeletal imbalance<sup>1</sup> and represents approximately 50% of all orthodontic treatment in a European representative sample<sup>2</sup>.

In orthodontics, it's possible to recognize three types of Class II malocclusion: the skeletal type, the dento-alveolar type, and the pure dental type. These alterations require dental or skeletal approaches depending on the type of treatment.<sup>3</sup> When the problems of this malocclusion are predominantly skeletal, they will be corrected by functional or mechanical orthopedic appliances, requiring much patient compliance.<sup>4-6</sup> If this doesn't occur the treatment time will increase and the risk of a failure of the orthodontic therapy too<sup>5</sup>.

Between the different kind of treatment strategies for Class II malocclusions, only the functional approach maintained an effective validity for moving jaws. It is based on the muscular and presumable skeletal regulation through Frankel's II appliance, which has been the most widely used treatments for Class II malocclusions in prepuberal children. This functional approach is based on the idea that the functional regulator (FR) induces a stimulatory effect on lower jaw growth in Class II patients<sup>7-10</sup> or whether it just forces an accommodating anterior positional change<sup>11</sup> has not yet been fully clarified. Several literature works have described the results of Frankel regulator to analyse if it produces a real growing of mandibular jaw and following the long-term effects in case-control studies<sup>8,9</sup>. Along these lines, some authors<sup>12</sup> observed a statistically significant increase in mandibular length due to FR treatment. Nevertheless, in an interesting article McNamara et al.<sup>13</sup> has questioned whether Class II corrective results were just the expression of an anterior positional change rather than an effect of increased mandibular length.

At the same time, the Frankel Regulator II can express its potential effects also on the upper jaw, because of its direct stimulation and thanks to the distribution of elastic muscular forces derived from the TMJ as the lower jaw. The most recent studies on normal craniofacial growth showed a downwards and forwards maxillary growth pattern with substantial interindividual variation<sup>14,15</sup>. However the FR effects on the maxilla are actually contradictory. Despite the previous observations, some studies supported the idea that anterior maxillary growth is restricted during treatment,<sup>16-19</sup> while others have noticed a downwards

redirection of upper jaw growth inducing a clockwise slope in the palatal plane<sup>9,18-21</sup>. This theoretical discussion associated to the development of

Whether the FR induces a stimulatory effect on cranial base growth on Class II-type I patients or whether it causes changes in the cranial base slope in growing patients has not yet been determined.

## Materials and Methods

In the course of years, several orthodontic works have been published on international literature about the incidence of Class II Malocclusion and its treatment planning. Starting from the Andresen monoblock, many appliances have been performed to correct this anomaly and, in particular, one of the most used was the Frankel regulator. For this reason, a detailed research of international literature on the use of these orthodontic devices and on all the differences between them has been performed using the principal medical databases: PubMed (Medline), Lilacs and Scopus. The keywords used were: *Frankel Regulator*, *Cervera*, *Class II Malocclusion* and *Orthodontic Functional Appliances*; to identify all articles reporting on the topic till November 2016. No restrictions of time and languages have been fixed. The results have been filtered and valued following our eligibility criteria and then organized following the PRISMA method<sup>14</sup>. The search identified 9,780 abstracts, which were reviewed manually and each article of interest was marked for further review. The full text of the marked studies was retrieved and studies that satisfied our eligibility criteria were included in this review. At the end only 19 full articles have been selected.

## Review

### Functional Appliances

The second skeletal class is not a disease but there is a possible link with the instability of the stomatognathic equilibrium. Functional and structural problems (in the three planes of space) should be investigated in order to have a correct diagnostic process and for defining the flowchart of treatment as the priority of this one. The diagnosis of second skeletal class is done with cephalometric radiographs in latero-lateral view, and so when the measurement of the ANB angle and Ao-Bo are greater than 2° and 2mm respectively.

A patient with the same value of ANB of 11 years through mandibular advancement devices and retrusion of the maxilla can solve the skeletal

problems with functional orthodontic appliances.

They are a big group of orthodontic appliances that have direct effects on skeleton, muscles, soft tissues and only indirect consequences on teeth, because they are generally movable with some limited rest teeth. So this kind of devices have been realised “to fall” in the mouth of the patient to activate the neuro-muscular pattern and rehabilitate the correct functions.

The best choice for the use of them, it's the age between 9 and 15 years in males and between 8 and 14 in femmes, corresponding with the growing peak of younger people. In this way the stimulation of orthodontic devices will be great and so their efficacy. However, it's important to remember that each patient has a proper skeletal age that is not always in line with the anamnestic data, so a radiographic evaluation is critical to monitor the patient's growth. The jaw expresses maximum growth in the shortest possible time at the peak of pubertal growth. Thus we need to put the mandibular advancement devices at the beginning of this peak. For aesthetic requirements, functional and to avoid trauma of upper incisor.

The patient should dress the device 24 hours a day and the results are related with the cooperation of the patient. In fact, the failures described in the literature of removable equipment are mainly due to lack of cooperation of paziente. This should be evaluated by the orthodontic clinician first to begin a treatment, we know that here are patients who cannot put a removable appliance because they are not followed, in this case clinician should reach with controls, motivation and education constant in time an optimal level of cooperation.

### The Frankel Regulator “Philosophy”

FRANKEL, is a functional device, based on functional orthopedics principles and, in union with muscle gymnastics, creates maxillary morphological changes, restoring the malocclusion. Considering the Andresen resinous monoblock as the precursor of all the other functional appliances the Frankel has been described as a “light” monoblock with a great part of resin and a limited quantity of wires used for the stabilization on the diastoric teeth. It's probably the bulkiest and uncomfortable functional device but it's nowadays the best choice for many skeletal anomalies, as the facial asymmetries.

Moss study shown how with a modification of function there is a myofunctional re-education in a growing patient that can lead to a skeletal changes in the bone structures. Literature described results of mandibular advancement, transverse expansion increases and an

improvement in muscle tone with the achievement of an adequate lip seal.

The Frankel II Regulator consists of two vestibular shields, lower lip shields, a vestibular arch, lingual arch, canine loops and a protrusion arch wire

The vestibular shields are used to limit the pressure of buccinator muscle to get a slight cross-expansion of the palate. It is passive expansion that is not given to the application of an orthopedic or dentoalveolar force but is thanks to the elimination of external muscular pressures 2-3mm deviating from the dental area and the alveolar mucosa to reduce irritation of the soft tissues and to allow a right limiting the effects of buccinator muscles. They must also be parallel to alveolar process.

The lip shields must have a thickness of 0.9mm and have the function to limiting the pressure in hyperactivity of the mental muscle. They are positioned in the deep of the fornix to obtain an effective distraction of the perinatal tissue with closed lips, determining the alveolar bone resorption in the internal part of the mandible, while there is osteoblastic proliferation in the external one.

The lingual arch extends from the first premolar or first molar passes lingual to the lower incisors and canines to the contralateral premolar or molar. At the level of the incisors and canines is coated with acrylic resin. The function is to keep the jaw in advancement moreover a spring could be placed in order to keep anterior the lower incisor. The vestibular arc is passive and stays on the buccal surface of the upper incisors four steps above the lips bend and ends in the vestibular acrylic shields. The arch can be activated in cases of second-class I division. The canine loop is a portion of wire straight with a bend at the end near the upper canine area that have to be activated, whether is the need to drive the eruption of canines. In the Class II malocclusions second division it's possible to observe the presence of the protrusion arch that is palatal to the upper four incisors to proclinate them and so to unlock the mandible.

The palatal arch extends from the distal portion of the upper molar to right, up to the height of the palate forms a loop facing the front teeth and go down to reach the acrylic shield contralateral distal to the first molar. It can be activated or not.

The impression is taken in alginate in a position of crown to crown relationships between the upper and lower central incisors. However, if there is an overjet great than 7 mm in a second skeletal class of important mandibular retrusion we cannot advance the jaw for 7 mm, because in this way the patient is not

able to stay with the device in this position. So you there is the necessity to build it in two units: the first advance of 3-4mm and then the second 3-4 mm.

Better practice with the patient in front of a mirror in the insertion of the distal portion of the first shield. Then the patient, with his mouth open and relaxed pushes the sideways function controller and later held ajar her cheek-side with his finger, so that we can introduce the shield also buccal from this side.

The patient is asked to close his mouth and biting. It 'important to control the position of the mouth is closed according to the construction bite, so we have an increased vertical dimension, the cause could be that the buccal shields are too long, particularly in the distal area. The clinician must real care with the finger the top edge of the shield to locate those responsible points. The upper edge must then be shortened with great caution. Retouched areas will undoubtedly again be well-rounded and polished.

#### **Cervera Appliance**

The Cervera device was introduced in the 1985 thanks to the modification of the idea of functional regulator of Frankel. It's based on the presence of a metal plate that can be only anterior, posterior or total, where the teeth stay to activate the appliance. It was designed in particular to treat all the patients with Class II malocclusion and deep bite, where the Frankel is not indicated, or we can use the Cervera in presence of severe asymmetries. This appliance, in fact maintain all the parts of Frankel as vestibular shields, lower lips shields, palatal arch, but instead of the metallic wires on occlusal surfaces of teeth it has a metallic bite to control the position of teeth. In this way the Cervera has been used efficacy for the canting of occlusal plane, the deviation of inter-incisal lines, and to treat also severe forms of cross/scissor bites thanks to the possibility of modulate the device, adding other auxiliaries. The great versatility of Cervera makes possible to realize other variants for the anterior open bite that has named Bracco variants, thanks to the name of its inventor. Because of its big size that can oppose to its use, there are also single forms of metallic bites named Equi Arches (B and C) that can be mounted on first molars tubes modulating functional effects with a fixed multibrackets appliances.

The comparison in literature between Frankel and Cervera appliances demonstrated how the last device makes possible to correct severe forms of Class II malocclusions, with an average 6-7 mm of overjet in 9-12 months, considering the timing of treatment for Frankel Regulator of at least 18 months for the

moderate form of malocclusions. Besides FR, the Cervera appliance can be used also in dysfunctional patients, or in hyperdivergent patients that, it's important to remember, is a contraindication for almost all the functional devices because of the difficulties to control the vertical facial growth.

## Conclusion(s)

The detailed research of literature has confirmed that nowadays the best way to treat the Class II Malocclusions, in particular in young patients is represented by the use of functional appliances. The Frankel Regulator II remains an important device for the neuro-muscular rehabilitation, because of its slow change in the muscular engrams, and so it's also a great contention in the final part of therapy. However, many authors in last period reported more efficacy treatments with the Cervera appliances, because of its versatility in different kinds of malocclusions as also, the modularity, which means the possibility of use it also with the fixed therapy, reducing the necessity of patient's compliance.

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