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## Frenkel 2 and Bionator: dental and skeletal effects. A systematic review.

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# Frenkel 2 and Bionator: dental and skeletal effects. A systematic review.

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## Abstract

It is known that a Class II division 1 malocclusion is generally considered a heterogeneous generic malocclusion, with individuals presenting either with a prognathic maxilla and a normal mandible, or a normal maxilla and a retrognathic mandible, or even a combination of both. It has been observed that usually one of the predominant characteristics of Class II patients is a poorly developed mandible, which is an indication for functional appliance treatment. Frenkel and Bionator are two functional devices used in the treatment of malocclusion from mandibular deficit. These devices have little effect on maxillary growth but favor the growth and the mandibular advance. Finally, they have a dentoalveolar effect that improves dental relationships in the case of second class I divisions.

## Introduction

Second class malocclusion is characterized by an alteration of the skeletal and dental relationship between the maxillary and the jaw. According to the literature, four major factors are involved in determination of a second class malocclusion:

1. anterior position of the maxilla;
2. anterior position of the maxillary dentition;
3. mandibular skeletal retrusion in absolute size or relative position;
4. excessive or deficient vertical development.

McNamara, stated that most Class II patients present a deficiency in the anteroposterior position of the jaw. This type of malocclusion can be treated in growing patients with the use of functional appliances. Several functional devices have been designed to treat second class malocclusion by mandibular deficit. The goal of these functional appliances is to optimize mandibular growth in order to obtain a first-class skeletal relationship. The expected effects of these appliances include alteration of maxillary growth, a possible change in mandibular growth and position, and an improvement in dental and muscular relationships<sup>2,3</sup>.

### Frenkel 2

The function regulator, conceived by Rolf Frankel in 1956, influences the skeletal and dentoalveolar development by acting on the tone and posture of the perioral musculature, is a passive activator that has the task of re-training the perioral muscle and has specific characteristics other than other functional devices. The Frankel 2 regulator, Fr2, is the only tissue retention device and has the function of keeping the jaw in an active protruded position by a nociceptive stimulus on the mucosa, as opposed to the traditional activators in which the passive protrusion is bound by the presence of planes to slide in contact with the teeth. The Fr2 allows obtaining a 2-3 mm mandibular protrusion with successive slight reactivations, it aims to curb the sagittal growth of the upper jaw and promote mandibular growth; correct excessive vestibular inclination of the upper incisor and lingual inclination of the lower incisors. The device consists of two side shields, a lower vestibular shield and an upper arch; the vestibular shields move away the cheeks and eliminate the compression force by enhancing the expansion of the arch, guiding the mandibular closure, stimulating the development of the dentoalveolar structures, promote dental eruption by eliminating the interposition of the cheeks and the pressure on the alveolar processes. The vestibular shield extends the soft tissue to the base of the lower lip, trying to stimulate forward growth of the jaw by acting and stimulating the periosteum, and finally the vestibular arch is responsible for correcting the upper incisal torque. The Fr2 allows minor and projected 2mm mandibular movements, the bite of the construction should be taken in a protruded position of two mm unlike other functional appliances where the construction bite is head to head<sup>4,5,6,7,8</sup>.

### Å Bionator

The Bionator designed by Balters in 1950 is a passive actuator, scratchless, inclined and spring. Immersing in the dynamic space between the oral structures, recreates the seals varying the pressures and traction exerted by the musculature on the dentoalveolar structures. Is made up of a resin plaque, a palatal arch and a vestibular arch that extends with handles buccinatorias. On the resin body, milling can be performed to facilitate the correct eruption of the dental elements. The tongue is displaced from the top of the oral cavity and guided by the upper back shield

and the resin body towards the lower back area. In this way the contracted jaw is stimulated to increase transversely by the pressure of the tongue on the alveolar processes and on the cervical part of molar and premolar horns. The upper incisors are tongued by the pressure offered by the upper lip. three occlusal wounds are to be found for the construction of the functional apparatus: maximum intercuspitation, centric, functional bite in the case of a second class malocclusion in the head<sup>9,10,11</sup>.

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## Materials and Methods

The purpose of this review is to evaluate the skeletal effects of some of the most used functional devices. Several studies have been carried out to appeal skeletal effects and the stability of first division class II treatment with functional devices, although there are still doubts and inconsistencies in the scope of this topic. Many studies agree that the most significant treatment effects are restricted to dentoalveolar changes. The systematic review of literature has been performed on the principal medical databases: PubMed (Medline), Scopus. Â The keywords used were: *Bionator appliance*, *Frankel appliance*, *functional appliances effect*, *the treatment with functional correctors*. Following the search, 33 articles were selected.

## Discussion

### Changes in maxillary skeletal component.

According to literature, the Frenkel and the Bionator have little effect on the skeletal component of the maxilla<sup>12,13,14</sup>.

The results demonstrated no statistically significant influence on maxillary development because the changes in maxillary position and effective length were similar both in treated and untreated cases. Although redirection of maxillary growth is considered as one of the mechanisms to correct antero-posterior Class II discrepancies by functional orthopedic appliances effect is not expected with the FR<sup>15,16</sup>. Â

In contrast, other investigators<sup>17,18</sup> noted some restrictive effect, particularly when the SNA angle was used. However, as Mills<sup>19</sup> pointed out, this effect could be related to the lingual inclination of the upper incisors and the accompanying posterior remodeling of Point A.

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### Changes in the mandibular skeletal component.

A statistically significant increase in mandibular protrusion and length was observed during treatment with Frankel e Bionator, particularly patients treated with the bionator. This finding, of increased mandibular growth after functional appliance treatment, agrees with the results of a number of investigations involving the bionator or Frankel appliance<sup>20,21</sup>.

The results also showed a statistically significant change in mandibular length in the FR-2 group that was 3 mm greater than in the Class II untreated group. These findings confirmed the previous FR-2 data of Perillo et al.<sup>23</sup>, Â Faltin et al.<sup>24</sup> found a 5.1-mm increase in mandibular length in patients treated at puberty with the bionator. Although others<sup>25,26</sup> did not support such an increase, McNamara et al.<sup>27</sup>, who found no evidence of a statistically significant increase in mandibular body length in patients treated with the FR-2.

A study by Marcio Rodrigues de Almeida<sup>28</sup> evaluated the effects of frenkel and bionator in patients with second class malocclusion. The results of the study show that the mandibular size was significantly influenced in both the FR-2 and the bionator groups, particularly in patients treated with the latter. The effective mandibular length increased 3.0 mm in the control group, 3.9 mm in the FR-2 group, and 4.9 mm in the bionator group. Overall, bionator therapy produced a larger and more significant effect on growth and position of the mandible than did FR-2 treatment. Considering the maxillomandibular measures (ANB, NAP), both therapies produced similar reductions in the sagittal Class II discrepancy, while the control group remained basically unchanged. Mandibular plane orientation was unaffected by treatment, while the palatal plane rotated significantly more clockwise in the treated groups, finally the control group actually rotated counterclockwise.

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### Dentoalveolar effects.

As for dentoalveolar effects, both devices result in lingual tipping of the upper incisors due to the presence of the labial wire, and a vestibular tipping of the lower incisors. Therefore, before the treatment is important evaluate the initial inclination of the lower incisors to prevent the inclination from becoming excessive. Despite the fact that the two devices do not have dental support, the dentoalveolar effects are evident<sup>29,30</sup>.

Frankel and Frankel<sup>6</sup> recommended that the labial arch should not contact these teeth and should not be activated and also stressed that antero-posterior activations greater than recommended cause a

greater uprighting of the maxillary incisors. McNamara,<sup>31</sup> stated that the labial arch should barely touch the labial surfaces of the maxillary incisors and recommended the use of the FR-2 in Class II division 1 because the upper lingual wire would help in controlling the tipping and vertical position of the maxillary incisors.

While lingual tipping of upper incisors is desirable in the treatment of a second class first division malocclusion, the vestibular tipping of the lower incisors appears to be due to the mesial force resulting from the mandibular protrusion. However, Wieslander and Lagerstrom,<sup>32</sup> and Bolmgren and Moshiri,<sup>33</sup> reported that treatment with the activator appliance does not alter the position of the lower incisors.

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## Conclusion

- Both the Frenkel and the Bionator did not have an inhibitory action on the growth of the maxilla.

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- Both devices resulted in a statistically significant increase in mandibular growth and protrusion, with higher increases in bionic treated patients.

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- The presence of the vestibular arc determines the palatal inclination of the upper incisors contributing to the treatment of the second class I divisions.

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