The use of Frankel -3 in Class III Malocclusion: Short term and Long term effects

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Abstract

The aim of this article is to make a revision of literature to investigate the effectiveness of therapy with Frankel III in children affected by class III malocclusion, differentiating between short-term and long-term effects.

Introduction

Functional orthodontics exploits Moss’s theory, according to which the function influences the form. The goal is to eliminate soft tissue and muscle’s abnormal functions in order to replenish the balance of the whole stomatognathic system. On this principle, Frankel designed his functional regulator appliance in 1970.

In particular, one of these appliances, the FR-3 is used in the treatment of class III malocclusion during the deciduous, mixed and early permanent dentition stages to correct class III malocclusion characterized by maxillary skeletal retrusion (or underdeveloped maxilla) and not mandibular prognathism.

The FR-3 is composed of wire and acrylic. It’s made up of four acrylic parts: two vestibular shields and two upper labial pads. The vestibular shields extend from the depth of the mandibular vestibule to the height of the maxillary vestibule. According to Frankel, these shields act in order to remove the restrictive forces created by the buccinators and associated facial muscles against the lateral surfaces of the alveoli and the associated buccal dentition. The upper labial pads that lie in the labial vestibule above the upper incisors, function to eliminate the restrictive pressure of the upper lip on the underdeveloped maxilla. Moreover, these pads also provide a stretching of the adjacent periosteum, stimulating bone apposition on the labial alveolar surface. The force of the upper lip is transferred by the upper labial pads to the vestibular shields. These ones lie in close approximation to the mandibular alveolus: the force of the associated soft tissue may be transmitted through the appliance to the mandible.

There are five wire components in FR-3. The upper labial pads are connected to the vestibular shields by a support wire that may be a single continuous wire or a series of three adjacent wires. The lower parts of the vestibular shield are connected by a lower labial wire that rests against the labial surface of the lower incisors. On the lingual surface, an upper lingual wire originates in the vestibular shield, traverses the interocclusal space, and rests against the cingula of the upper incisors. The palatal wire originates in the vestibular shields and traverses the palate. There are two pairs of occlusal rests in the molar region.

It is imperative that a proper impression-taking technique be used and the impression has to be not overextended or underextended. The bite registration is taken with the patient’s mandible in the most comfortably retruded position.

It is a full-time appliance and that it will eventually worn at all times except during eating, dental hygiene, playing contact sports, language lessons, or playing musical instruments that are held in the mouth. Instead the term "functional" is related to continuously repetitive and frequent activity. It is usually recommended that the appliance be worn for a few hours a day for the first week, then gradually increasing wear time until the patients wear it full time.

Materials and Methods

Principal medical databases (Pubmed, Embase and Scopus) are used to find works and studies about treatment effectiveness of Frankel function regulator on the Class III malocclusion. Infact, many authors have got different opinions regarding this appliance. However, the majority studies found are cohort studies and used small sample. All considered studies used a treatment group of patient with class III malocclusion and a control group. All patients considered are growing.

Review

In children with an underdeveloped maxilla, Frankel expected that FR-3 redirect mandibular growth and stimulate forward growth of the maxilla through the muscle-blocking effects and stretching of the periosteum. There is no dispute about the vector of mandibular growth may be redirected vertically, but...
there is some controversy about the skeletal effects in the maxilla.
Frankel originally reported that bone apposition at point A increases with the use of the FR-3, whereas McNamara and Huge found that it caused forward and downward movement of the maxilla.
Kohmura et al reported a significant forward movement of point A and lateral expansion of both arches.
On the basis of Graber’s histologic studies some authors said that shields exert indirect tension on the periosteum enhancing osseous proliferation.
Soft tissue changes were also adopted in some studies: Kalavritinos et al pointed out that the thicknesses in the upper and lower lips increased and significant increases in facial convexity and nose prominence were observed upon assessment of the soft-tissue profile.
However Ulgen and Firatli reported that the forward displacement of the maxilla is insignificant and most of the improvement is due to the downward and backward rotation of the mandible, the decrease in SNB, and the retrusion of the mandibular incisors. Kerr stated that there is no significant increase in SNA.
Proffit agreed that little true forward movement of the upper jaw is obtained with FR-3 and most of the improvement is from dental change.
Although mandibular growth is not inhibited, the change in position and posture is advantageous in most children with mild skeletal class III malocclusion. Subsequent change in ANB and Wits obtained after treatment is significant.
There is no significant difference in the lengths of the maxilla and the mandible and in the vertical change.
Regarding dental effects, FR-3 can induce a linguoversion of the mandibular incisors and a labialversion of the upper incisors with a significant change in overjet.
The overbite change is insignificant.
The maxillary molars erupt downward and forward and this fact improve the class III molar relationship and contribute to create a normal overjet and overbite.
Few studies have investigated the effect of FR-3 therapy on the transverse dimension; the analysis of these ones reveals that this appliance can cause an increase in the intermolar and interpmolar distances both in the dental and the alveolar areas.
Infact, the teeth erupt clinically into a channel located between the tongue, lips and cheeks. These tissues play an important role in determining the labiolingual and buccolingual position of the teeth. With FR-3, by expansion of the soft tissue capsule, the dentition is no longer exposed to the restraining force of the perioral muscle band and the new form of the dentoalveolar process may be regarded as in balance with the functional forces. The buccal shields remove the pressure exerted by the perioral musculature and soft tissues on the dentition, resulting in the eruption of the permanent teeth in a more buccal direction and an expansion in the dentoalveolar arches.

Conclusions
FR-3 appliance can be the treatment of choice for children with mild or pseudo class III malocclusion caused by an underdeveloped maxilla or by a retrusion of maxilla.
In preadolescent with severe skeletal class III malocclusion due to an overdevelopment of the mandible, the recommended treatment is based on facemask and rapid palatal expansion appliance.
In the short term, the response of the craniofacial complex to treatment with the FR-3 appliance included significant favorable changes in the maxilla (size and position). However, SNA’s value didn’t differ in the long term between the FR-3 group and the untreated group in a significant way.
No significant long-term inhibition of mandibular growth is recorded. However, a significant mandibular shape change is observed in the form of closure at the gonial angle and associated closure of the mandibular plane angle.
It is advantageous for children with class III malocclusion that the mandible is redirect downward and backward.
Considered the many different views on the effectiveness of Frankel 3 specially in long term, future investigations related to observation with fulltime wear of the FR-3 are necessary to verify its effects, specially in the maxilla.

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