Introduction

It has long been the goal of orthodontics to correct anteroposterior tooth discrepancies. Many times the problem is only one of tooth relationships, but often the malocclusion is due to basal bone dysplasia. Certainly, treatment results are easier and more stable if the basic and deeper skeletal units can be altered. It must be decided whether the developing facial structures should be considered immutable and genetically controlled growth patterns or whether they can be permanently changed by the use of forces applied to the bone.¹

In dentofacial orthopedics, orthodontists attempt to influence growth by applying an external force (Figure 1), generally for 2 or 3 years. Almost all orthopedic appliances act intermittently. The growth of the jaws in the growing child might be influenced if the therapy starts at a very young age and if it continues until growth has stopped.

Duterloo defines orthopedic effect in orthodontics as a change in the position of bones in the skull in relation to each other induced by therapy.

According to Isaacson, orthopedic appliances provide a new muscular and functional environment for the facial bones that encourages growth changes of either the mandible or the maxilla.

Mandibular and Maxillary Changes with Functional Appliances – Conflicting Views

One of the most controversial topics in orthodontics relates to the effectiveness of functional appliances on mandibular growth. In skeletal Class II malocclusion, mandibular retraction
seems to be a major contributing factor; it occurs in about one third of the population.\(^2\)

Functional appliances encompass a range of removable and fixed devices that are designed to alter the position of the mandible, both sagittally and vertically, to induce supplementary lengthening of the mandible by stimulating increased growth at the condylar cartilage.\(^3\)

Experiments have demonstrated that appliances that position the mandible anteriorly stimulate significant mandibular growth by condyle remodelling in animal models, but the effects produced in humans are not the same.\(^4\) Evidence shows that favourable growth responses are not always achieved with functional therapy; some authors reported increases in overall mandibular length\(^5\)and changes in the amount of condylar growth,\(^6\)but others believe that mandibular length cannot be altered by such therapy.\(^7\) It has been claimed that most of the correction of the malocclusion is due to dentoalveolar changes with a small but statistically insignificant amount of skeletal effects.\(^4,8,9\) There are also controversies concerning the effects of functional appliances on the maxilla. Many studies indicate that forward growth of the maxilla might be inhibited\(^10\)but other authors stated that there is no appreciable effect on the position of the maxilla.\(^4,11\)

**Class II Correctors**

A literature survey was performed by applying the Medline database (Entrez PubMed). The survey covered the period from January 1966 to January 2005 and used the medical subject headings (MeSH). The following study types that reported data on treatment effects were included: randomized clinical trials (RCTs), and prospective and retrospective longitudinal controlled clinical trials (CCTs) with untreated Class II controls. The search strategy resulted in 704 articles. After selection according to the inclusion/exclusion criteria, 22 articles qualified for the final analysis. Four RCTs and 18 CCTs were retrieved. The quality standards of these investigations ranged from low (3 studies) to medium/high (6 studies). Two-thirds of the samples in the 22 studies reported a clinically significant supplementary elongation in total mandibular length (a change greater than 2.0 mm in the treated group compared with the untreated group) as a result of overall active treatment with functional appliances. The amount of supplementary mandibular growth appears to be significantly larger if the functional treatment is performed at the pubertal peak in skeletal maturation. None of the 4 RCTs reported a clinically significant change in mandibular length induced by functional appliances; 3 of the 4 RCTs treated subjects at a prepubertal stage of skeletal maturity. The Herbst appliance showed the highest coefficient of efficiency (0.28 mm per month) followed by the Twin-block (0.23 mm per month).\(^12\)

On the basis of available evidence, it cannot be concluded that functional appliances are effective in stimulating and increasing mandibular growth in the long term. Although favorable growth changes have been reported following phase 1 therapy, they are generally not substantial and long term stability appears to be poor.\(^13\)

The matter on correction of skeletal Class II discrepancies in growing children remains controversial despite extensive research. However most authors agree on the fact that major contributions derive from dento-alveolar changes rather than from skeletal ones.\(^14\)

A systematic review of mostly English-language orthodontic articles reporting treatment of Class II malocclusions with different orthopedic appliances was carried out. According to this review, only Herbst therapy was able to change mandibular growth to a clinically significant extent.\(^15\)

A statistical comparison of treatment changes in twenty patients treated with a Fränkel appliance and twenty treated with the Edgewise mechanism. Both groups showed similar improvements, with no significant differences in mandibular growth.\(^16\)

**Rapid Maxillary Expansion**

When a skeletal constricted maxillary arch is diagnosed, orthopaedic skeletal expansion involving separation of the mid-palatal suture is the treatment of choice. Three treatment alternatives are available for this purpose: rapid maxillary expansion (RME) (Figure 2), slow maxillary expansion (SME), and surgical-assisted RME (SARME). Both SME and RME are indicated for growing patients, whereas SARME is the alternative selected for non-growing adolescent and young adult patients. Even though RME treatments were reported to bring clinically stable results,\(^17\) others reported relapse after expansion was attained.\(^18\) Years later, other studies demonstrated that the attained changes were...
produced primarily in the underlying structures and, therefore, stable results were expected.  

**Figure 2:** Rapid Maxillary Expansion

Long-term transverse skeletal maxillary increase is approximately 25% of the total dental expansion for pre-pubertal adolescents. Better long-term outcomes are expected in transverse changes because of RME in less skeletally mature patients. RME appears not to produce clinically significant anteroposterior or vertical changes in the position of the maxilla and mandible.

**Class III Correctors**

Class III malocclusion is associated with a deviation in the sagittal relationship of the maxilla and the mandible, characterized by a deficiency and/or a backward position of the maxilla, or by prognathism and/or forward position of the mandible.

The etiology of Class III malocclusion is multifactorial because of an interaction of both hereditary and environmental factors. The contributions of the cranial base, maxilla, mandible, and temporomandibular articulation have been described in detail in the literature. Class III malocclusions associated with craniofacial disharmonies are much more difficult to treat and tend to relapse.

In a systematic review article the quality standard of the retrieved investigations ranged from low (four studies) to medium/high (five studies). Data derived from medium/high quality research described over 75% of success of orthopaedic treatment of Class III malocclusion (RME and facial mask therapy) at a follow-up observation 5 years after the end of orthopaedic treatment (Figure 3).

The orthopaedic effects of chin cap appliances (Figure 4), which were thought to improve facial growth in Class III patients with mandibular excess, became of great interest to clinical orthodontists in the 1960s. Since then, chin-cap therapy has been widely used as a method for treating developing Class III malocclusions in young patients. A number of clinical and experimental studies have reported that chin-cap force had several short-term orthopaedic effects:

1. Redirection of mandibular growth
2. Backward repositioning of the mandible
3. Retardation of mandibular growth
4. Remodeling of the mandible and the temporomandibular joint.

Sugawara et al. reported long-term growth changes of patients treated by chin-cap therapy at various age groups employing various treatment schedules. The possibility that these treatment effects may induce permanent skeletal changes and alter the prognathic skeletal profile, particularly when applied at an early age, has maintained an interest in chin-cap therapy among orthodontists. However, little is known about whether the improved skeletal profile could be maintained until craniofacial growth was complete. Most studies have been based on either relatively short-term results or long-term results that included too few subjects to be statistically valid.

As for treatment with chin-cap appliances, the study on short-term and long-term effects indicates that, on average, the skeletal profile is greatly improved during the initial stages of chin-cap therapy. However, such changes are rarely maintained during pubertal growth period. Treatment with chin-cap appliances seldom alters the inherited prognathic characteristics of skeletal Class III profiles after completion of growth.
Conclusion

This review might enhance the understanding of functional and orthopedic therapy by the general practitioner. Timing of treatment with functional and orthopedic appliances should be individualized by the occurrence of pubertal growth spurt and the overall clinical effect must be regarded as a combination of skeletal and dentoalveolar changes.

References


24. Laura De Toffol; Chiara Pavoni; TizianoBaccetti; Lorenzo Franchi; Paola Cozza Orthopedic Treatment Outcomes in Class III Malocclusion A Systematic ReviewAngle Orthodontist, Vol 78, No 3, 2008