TIMING OF ORTHODONTIC TREATMENT OF MALOCCLUSIONS IN THE MIXED DENTITION PERIOD

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Abstract

The ideal time to initiate orthodontic treatment in children is a controversial subject in the scientific literature. Beginning treatment in the, even though tempting, has a disadvantage in the fact that recommended wrongfully can prolong treatment, sometimes spanning to up to 10 years and leading to patient burnout and dissatisfaction. However, waiting until the late mixed dentition also has its disadvantages. Commencing treatment in the permanent dentition implies compliance issues with teenage patients, female patients with little growth remaining.

Early mixed dentition treatment often focuses on skeletal rather than dental correction. In order to design a comprehensive treatment plan, the clinician must have a complete grasp of the growth and development patterns, but also of the outcome of the chosen treatment option.

Is there a conclusive benefit of early treatment for certain orthodontic issues? This question has yet to be fully answered by researchers. The clinician can diagnose and intercept certain developing problems with early treatment. Many other cases on the other hand should be supervised, but not treated until the permanent teeth are erupted.

Keywords: *primary dentition, mixed dentition, orthodontic treatment.*

Introduction

The appropriate timing of orthodontic intervention has been an intriguing debate among specialists due to lack of solid scientific evidence. The effectiveness of the intervention depends largely on the type of malocclusion. Most often, the main issue is the benefit obtained by treating developing malocclusions in the early mixed dentition stage when compared with treatment started in the late mixed dentition or in the permanent dentition, when said malocclusion has already been established. One reason for the controversy is that the implied toll of an early treatment time is a two-phase protocol. Phase 1 usually takes 6 up to 12 months of active treatment with the intent to augment dento-skeletal relationships. Phase 2 is the "finishing" step after the eruption of the permanent teeth [1]. In this situation we must carefully analize the risk/benefit of an early intervention so as to justify the potential added cost of two-phase treatment?

Preventive orthodontics are procedures aimed at promoting the development of a normal occlusion and support the prevention of malocclusion from developing whereas interceptive orthodontics encourages the restoration of a normal occlusion once a malocclusion has started to develop. Genetic and environmental factors can contribute to the development of such a pathology and can span several years, thus making it difficult to determine specific causative factors. Malocclusions are not life threatening, but

are important public health issues as most can be prevented or intercepted [2].

The prevalence of Class II malocclusions can affect almost 25% of adolescents in the developed countries making it one of the more frequently treated malocclusions in the industrialized world [3]. Addressing such issues in the mixed dentition provides several benefits. First, if explained properly, children at this age are more conscientious and cooperative than adolescents. Second, early treatment of detrimental habits, such as digit sucking and tongue thrusting, is advocated after 8 years of age as it can improve speech difficulties due to open bite, which often occurs as a result of oral habits. Also, at 8 years, the first permanent molars are fully erupted, facilitating removable appliance therapy, which is also better tolerated at this age [4].

Treatment usually involves an **initial intervention** during the mixed dentition (phase I), frequently followed by a **second phase** during early adolescence (phase II).

The supporters of this type of treatment suggest that there are significant benefits to early intervention including:

- A dental health benefit due to addressing crowding early and improving access for dental hygiene thus providing a suitable environment for the righteous development of the periodontum [5].
- Psychosocial benefit - there is a proven association between the number and severity of dental anomalies including increased overjet and overbite, anterior spacing and open bites with teasing and bullying. Persistent teasing is known to negatively impact self-esteem and so a malocclusion may have a negative socio-psychological impact. Early treatment to resolve occlusal issues in those affected has been recommended [6].
- Optimization of growth and development of the skeletal pattern. The malleability of the skeletal system is still debated in the literature, however, contemporary research with prolonged follow-up periods of up to 10 years, have confirmed that overjet reduction, for example, obtained through functional appliance therapy is identifiable both to skeletal and dento-alveolar changes in the short-term [2].
- Subsequent orthodontic treatment (if needed) is more straightforward and expeditive
- The need for extractions of permanent teeth and surgical orthodontics is reduced
- Reduced risk of dental trauma [7]

All articles thoroughly reviewed by the authors to come to a consensus regarding the role of paedodontist, oral surgeon, and orthodontist in an interdisciplinary approach.

The aim of this article is to analyze the existing literature and offer an overview and consensus of the literature to the clinician regarding the various studies with regards to the debate weather one phase treatment is better that two phase in mixed dentition.

Correct timing of intervention

The issue of timing is a most pressing one in orthodontics, as its determination for interceptive and functional treatments has been reported to be a critical issue in dictating the success or failure in the treatment of several types of malocclusions [8]. Optimal timing, especially for dentofacial orthopedic type treatment, relies

on the correct detection of specific growth phases by way of the appraisal of skeletal maturity. The significant growth stages in orthodontically treated subjects are circumpubertal, prepubertal, pubertal, and postpubertal growth phases, each of which has its own characteristics regarding the differential growth of the maxilla and mandible [9].

In order to correctly establish the treatment plan and favorably intervene practitioners must make good use of several growth indicators such as:

1. **Hand and wrist maturation method**

This method was proposed by Fishman, also referred to as skeletal maturation assessment (SMA), comprises of 11 stages, in which stages 1 to 4 correspond to prepubescence, those from 5 to 7 - pubertal, and the following as postpubertal.

2. **Third finger middle phalanx maturation method**

More recently, the use of the sole third finger middle phalanx has been suggested as it would have the convenience of an easy interpretation of the phases, that can be performed in any private practice with minimal irradiation [10].

3. **Cervical vertebral maturation method**

Analisis of the cervical vertebrae modifications in developing individuals has seen increasing interest during the last few decades as an index of individual skeletal maturity. The variant proposed by Baccetti et al., encompases six stages, in which stages 1 and 2 have been described as prepubertal, stages 3 and 4 as pubertal, and the rest as postpubertal [11]. As a main advantage of this method is that it does not require supplementary radiographic exposure, as for the previous methods, because lateral head film is usually available as a pretreatment record. Nonetheless, evidence is inconsistent regarding the capability of this method in identifying the pubertal growth phase or the peak of mandibular growth.

4. **Dental maturation**

Another proposed method for skeletal maturation evaluation is that based on dental maturation, which can be easily measured through the estimation of tooth formation, and which can be performed out on panoramic or even intraoral radiographs. This method takes into account the shape, length and proportion of the root, relative to the crown height [12].

5**. Chronological age**

Regarding the average age of onset of peak pubertal growth in stature is 12-14 years in boys and 10-12 in girls, however, considering the high individual variability there is little diagnostic accuracy for this particular method. However, high variability was seen among individual subjects and there is little diagnostic accuracy of the method. It is worth mentioning that the onset of the pubertal growth spurt is influenced by several factors, including genetics, ethnicity, nutrition, and socioeconomic status. All in all, it has been generally implied that boys up to 9 years old and girls up to 8 are in the prepubertal growth phase. Consequently, clinical applicability of this indicator in day to day practice is precarious [13].

6. **Standing height**

This method has been used as an indicator of the pubertal growth phase as it relies on serial recordings at regular intervals to build an individual curve of growth. Perinetti et al., noted a fair degree of correlation between the standing height peak and mandibular growth peak. According to this article, this method may be convenient in clinical practice to determine the onset of the pubertal growth phase, although true feasibility of the method limits its application in clinical practice [14].

7. **Biochemical markers**

The previous, more accurate methods, all used radiation, as such, more recently, several biomarkers have been proposed in aiding the assessment of skeletal maturity. There is scarce data regarding this particular subject, however, biomarkers evaluated in serum, urine and gingival crevicular fluid such as alkaline phosphatase, insulin-like growth factor, parathyroid hormone-related protein have been reported as useful indicators of growth [15,16]. These studies reported increased levels of the investigated biomarkers during the pubertal growth phase. Of particular interest are the biomarkers which can be quantified in the gingival crevicular fluid, as its sampling requires a very simple, rapid, and noninvasive procedure that can be performed and repeated whenever necessary, of particular interest being the markers routinely used in the assesement of periodontal status [17,18]. Despite all this, further research in this area is still needed so as to precisely define the most suitable biomarkers and their corresponding reference values.

Timing according to type of malocclusion

As stated previously, correctly assessing the type of malocclusion is of the essence when deciding the timing of orthodontic treatment. Among the anomalies that benefit from this type of treatment are: skeletal class II, transverse maxillary deficiency, skeletal class III and palatally displaced canines.

Skeletal class II malocclusion is one of the most frequent dental and skeletal abnormalities, mandibular retrusion being the most constant cause, as such, functional treatment is a legitimate option to augment mandibular length, but only when implemented during the pubertal growth phase [19]. The oppinions in the literature regarding this subject are devided, Ishaq in 2016 stating that the high-quality evidence regarding the influence of fixed functional appliances on skeletal and dentoalveolar changes is scarce. However, based on the limited evidence, it appears that they have some effect on the skeletal mandibular parameters [20].

Skeletal Class III malocclusion has a much lower prevalence in the general population compared to class II, and ranges between 1 and approximately 25% depending on the evaluated population, but varying greatly within different races and geographic regions [21].

This type of malocclusion is constituted early and it is not a self-correcting one, hence intervention in an early stage, such as in temporary dentition or in the prepubertal growth stage, has been recommended to an extent [22]. Prepubertal treatment by RPE and pratraction using a face-mask produces favorable growth both in the maxillary and the mandibular bone, however, proper timing of intervention may therefore rely on chronological age and phase of dentition for very young patients, and on other radiographic indicators for older patients [23]. There is a fair amount of evidence to ilustrate that early treatment with a facemask results in positive improvement for both skeletal and dental effects in the short term. Regarding the long-tern benefits, the results were inconclusive due to lack of evidence. There is some evidence with regard to the chincup, tandem traction bow appliance, and removable mandibular retractor, but the studies had a high risk of bias. Further high-quality, long-term studies are required to evaluate the early treatment effects for Class III malocclusion patients [24]. Even though present evidence favors early intervention, there is a scarcity of high-quality studies with long follow-up periods assessing the proficiency of orthopedic correction of skeletal class III malocclusion.

Transverse maxillary deficiency is a common type of malocclusion that can be adorned clinically by a unilateral or bilateral posterior crossbite. Until now, very few long-term studies evaluated the skeletal effects of maxillary expansion treatment, however, a long-term study included both prepubertal and postpubertal patients treated by rapid maxillary expansion. In this study, patients treated before the pubertal growth spurt exhibited stability of the maxillary skeletal width, maxillary intermolar width, and lateronasal width up to approximately 8 years post-intervention. Conversely, patients treated after the pubertal growth spurt showed only dento-alveolar effects at the follow-up period of 8 years [25]. Recently, skeletal long-term modifications after rapid maxillary expansion (RPE) have been described, albeit this effect is still supported by low evidence [26]. Considering all this, an early intervention at the prepubertal growth stage is recommended to treat this type of malocclusion, but taking into consideration chronological age and stage of dentition so as to maximize the desired results.

Palatally displaced canines is a disorder of a genetic component that can foreshadow the impactation of teeth, contributing to the developement of a problematic anomaly, often in need of complex surgical-orthodontic treatment [27]. A recent study has reported that RPE aided by extraction of the temporary canines is an effective interceptive treatment that increases the chance of eruption up to 80% [28]. Timing for this type of treatment has been proposed as prepubertal growth phase and up to the late mixed dentition.

Conclusion

Certain malocclusions can be timely corrected with a two phase protocol and thus significantly reduce the demand for comprehensive orthodontic treatment in the permanent dentition. Appropriate management of the child during the supervision stage is paramount to maintaining the result and minimizing phase II treatment. However, one must discern the cases that could benefit from this type of treatment so as to avoid unnecessary or overtreatment. The benefits of early two phase orthodontic treatment are difficult to conclusively establish due to the predicament in realizing a direct comparison with later one phase treatment by means of prospective evidence. This comparison is further convoluted by inevitable discrepancies related to differences in dental, skeletal and overall maturation and development in different age stages.

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