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Expanding envelop of discrepancy

Introduction

Time is a crucial factor in Orthodontics which presents us with 2 pertinent questions, timing of treatment and time taken for treatment. While the duration of Orthodontic treatment is of concern to both the patient as well as the orthodontist, treatment timing is of paramount importance to the orthodontist as the success of orthodontic therapy, especially in individuals who present to us during the growth period, is dictated by appropriate treatment timing.

The one phase vs two phase debate is an evergreen one among orthodontists with several generations of orthodontists recommending early treatment ever since functional jaw orthopedics saw the light of day. However, the paradigm shifted in the late 90s after revered orthodontists such as Tulloch and Proffit et al[1], Keeling and Wheeler[2] et al, Gianelly[3] at al., with their prospective clinical trials presented robust data that the results of early orthodontic treatment although positive, do not stay on. They arrived at a conclusion that the inherent growth pattern and genetic potential of the patients causes the residual growth to nullify the treatment effects of phase 1 therapy, by the time comprehensive phase 2 orthodontic treatment is completed.

Proffit[4] cited 3 major reasons for this;

1. Facial growth in the three planes of space declines to adult levels at different timing of growth modification procedures for each problem is different.
2. Skeletal and dental development are not in synchrony and dental eruption may continue after skeletal growth is completed.
3. Permanent teeth do not erupt exactly in place of their predecessors and hence a 2nd stage treatment might often be necessary even if early treatment is done.

Hence, it can safely be said that the ideal orthodontic treatment timing is during the adolescent growth spurt starting in the late mixed dentition or early permanent dentition period. Gianelly et al[3] opined that when orthodontic treatment is

begun at the time of exfoliation of the second deciduous molar, the E space can be used for relief of crowding, if any, or correction of molar relationship which is also aided with the late mandibular growth with corresponds to the peak height velocity of the post pubertal growth occurring around this time.

Early treatment in Class II skeletal cases would however be preferred to avoid psychosocial and physical trauma such as injury to incisors.[5] All the above mentioned clinical trials have however indicated a clear statistically significant difference between the untreated controls and those who underwent growth modification as a part of Phase 1 therapy. Hence, it is prudent to consider all factors and make an informed decision in such cases.

Early treatment often followed by a second stage of Comprehensive therapy is usually needed in Class I problems requiring serial extractions and maxillary expansion to address crowding.[4] Class III problems presenting with a deficient maxilla might benefit with early growth modification procedures. [6] On the other hand, there are cases in which treatment should be deliberately delayed such as anterior open bite cases with a short ramus and unfavourable vertical growth pattern and Class III cases with a prognathic mandible which would definitely relapse with early treatment.[4]

Transverse skeletal problems require treatment quite early as growth is completed first in this direction. Early correction of the maxilla in the transverse direction also helps in solving Class II problems by means of the 'Foot and Shoe' principle and also aids in Class III correction of a retrognathic maxilla either spontaneously or with the help of orthopedic appliances. [7]

The focus of this paper by large, is treatment in preadolescent patients at the cusp of growth and how to address skeletal malocclusions at this crucial juncture of time.

The possibilities of treatment in Orthodontics is largely based on the envelope of discrepancy which has been revised to include treatment with skeletal anchorage apart from the traditional orthodontics, orthodontics with orthopedic treatment and orthognathic surgery. Treatment timing is important in determining the amount of change that can be produced. The amount of tooth movement with orthodontic therapy alone is about the same in children and adults. However, the success and extent of growth modification decreases after the adolescent growth spurt, and thereby would require orthognathic surgery beyond this point of time. There are

exceptions however such as controlling excessive vertical growth in children which is difficult, and TADs can be useful for this in older patients.[8]

With careful supervision, judgement & planning, and with the advent of newer techniques and appliances, this crucial window of time can be extended to produce skeletal changes beyond the said post pubertal growth spurt. The emphasis here is not usage of skeletal anchorage alone but to choose the correct modality of treatment at the right time, so as to make orthopedic treatment possible for a longer period than was thought of as possible thus far and to avoid surgery in the future.

The first step in this direction is to accurately identify the periods of growth. This has traditionally been done with the help of Skeletal Maturity indicators such as Hand and Wrist radiographs[a9], Cervical maturity indicators[b10], Frontal Sinus[c11], MP3 radiographs[d12]. Dental indicators such as Canine calcification[e13] stages are also being widely used to assess the skeletal maturity of individuals.

Once the skeletal maturity status is determined, the treatment plan can be tailored in different planes of space to utilise the maximum growth potential, depending on the nature of malocclusion. The following section focuses on how to increase the treatment timing window for malocclusions in various dimensions.

Discussion

Transverse Discrepancies

As mentioned earlier, transverse malocclusions should be addressed at the earliest, as the window of active growth period is limited in this direction and is completed first as the interdigitation of the mid-palatal suture begins between 10-13 years of age .

Previous studies showed that long term transverse craniofacial measurements were pronounced in individuals treated from CS1-CS3 (before or during the peak) and were skeletal in nature. Hence, the early mixed dentition was always thought to be the best time for correcting transverse discrepancies. Late treated groups between CS4-CS6(end or after peak velocity) showed less changes and they were dentoalveolar in nature.[14] It is often very difficult to treat transverse malocclusions because patients rarely visit the orthodontist in the early mixed dentition period which is the ideal time for treatment. One method of buying time in these malocclusions is by using procedures such as MARPE (Mini-implant Assisted Rapid Palatal expansion). This procedure not only addresses the transverse

discrepancy but a gain in arch length is also possible through it which will resolve any TSALD (Tooth Size Arch Length Discrepancy), if present. It is proven to work in adults too and can be used as an alternative to SARPE.

Class III malocclusions as a result of a narrow and retrognathic maxilla require expansion of the maxilla to correct the crossbite as well as to loosen up circummaxillary sutures. Bone anchored Maxillary Protraction which also employs MARPE is said to produce results superior to traditional orthopedic treatment with a facemask. Hence, Class III malocclusions also can be addressed later than what was deemed to be the crucial time for skeletal correction in such cases. This will be dealt with in detail under Class III malocclusions.

Sagittal Discrepancies

Class II Malocclusions

It is well documented that the ideal treatment timing for skeletal Class II Malocclusion especially for mandibular advancement with functional appliances, is during the pubertal growth spurt. To consider if an extension of this window of time is possible and whether treatment of a skeletal malocclusion by non surgical means is possible beyond this time frame, we need to establish that skeletal changes can be brought about in the mandible in young adults.

Pancherz and Ruf maintain that TMJ remodeling has been seen in young adult patients treated with Herbst.[15.] A possibility of improving facial profile in adults with Herbst has also been noted by the same authors.[16]To make the most of the available time, even when patients have reported after the peak in mandibular growth, the following treatment options may be considered.

Fixed Functional Appliances

Fixed functional appliances have always been the treatment of choice in patients on the cusp of pubertal growth. These appliances can also harness the growth potential in post pubertal patients and offer the advantage of being in the mouth throughout without having to rely on patient compliance. Thus, the constant and continuous positioning of the mandible in a forward position helps utilize the residual growth.

Molar to molar Rigid Appliances

This recently introduced category of rigid appliances are placed from the maxillary to mandibular molar with a thrust forward which helps in positioning the mandible ahead and thereby causing TMJ remodeling and permanent advancement of the mandible. The major advantage with these appliances is that they can be placed immediately without waiting for the fixed appliance therapy to reach a full sized archwire. Thereby, a lot of time is saved and correction of the skeletal malocclusion can be done non-surgically even when the patient approaches the orthodontist at or slightly beyond the pubertal growth spurt.

Fixed Functional Appliances with Skeletal Anchorage

Better skeletal effects and TMJ remodeling have been noted when fixed functional appliances are anchored to bone instead of the mandibular dentition as per few studies. Most studies show no lower incisor proclination which translates into more skeletal than dentoalveolar changes. In addition, they show a pronounced headgear effect on the maxilla.

Entire arch Distalization with Temporary Anchorage Devices

Skeletal Class II correction can be done by distalizing the entire arch with the help of Temporary anchorage devices. It is possible well into adulthood with good results and hence timing of treatment to treat a prognathic maxilla is no longer a crucial factor as earlier.

Class III Malocclusions

Traditionally, treatment of skeletal Class III is said to be best effective at CS1 (pre-pubertal) in both maxilla (supplementary growth of 2mm) and mandible (restriction of growth by 3.5mm over controls). Treatment at CS3 i.e during the pubertal growth spurt is effective only in growth restriction of the mandible (4.5mm over controls). [12]

The factors to be considered in treatment of skeletal Class III malocclusions are :

Maxillary growth is completed before mandibular growth, thereby persistent late mandibular growth may result in relapse even if maxillary growth was addressed at the ideal time i.e. in the early mixed dentition period.

With the advent of TADs, maxillary advancement is possible beyond the critical window of time from the deciduous and early mixed dentition to late mixed dentition and permanent dentition period.

This is possible through methods such as Bone Anchored Maxillary Protraction (BAMP) which has shown better results than with traditional orthopedic treatment by means of a Facemask in Class III patients.

Class III skeletal correction is also possible with TADs placed in the Maxillary posterior region and mandibular anterior/canine region followed by application of Class III elastic force of about 250 gms each side. This would result in orthopedic effects of both maxillary protraction as well and mandibular growth restriction or redirection.

With such methods, skeletal Class III malocclusions with dual components can be addressed at the same time around late mixed dentition so as to avoid 2 phases for the maxilla and mandible separately. Prolonged treatment procedures beginning in the early mixed dentition to treat the maxilla and proceeding into permanent dentition to keep the late mandibular growth at bay, can be prevented, thereby reducing burnout of the patients.

Transverse component of Class III should be resolved for stability of sagittal discrepancies too irrespective of the presence or absence of crossbites. Procedures such as MARPE help in extending the window of time as discussed under transverse discrepancies earlier.

Vertical Discrepancies

Skeletal Hypodivergence can only be attended to with the help of functional appliances, preferably early on or best at the pubertal growth spurt. Fixed functional appliances do give us a chance to regain lost ground if the patient reports slightly beyond the ideal time.

There are two schools of thought when it comes to the treatment of increased vertical dimension.

A 2mm increase in ramal height was seen when hyperdivergence is treated in CS3 i.e during peak velocity.[17]No such increase was seen in the pre-pubertal age group.

Profitt however claimed that hyperdivergence should always be treated only after the adolescent growth spurt.[18] This is because especially in unfavourable hyperdivergent patterns such as those with a very short ramal height, the growth of the ramus fails to keep up with the erupting posterior dentition which leads to an anterior open bite even if treated early. Hence, in such situations time is lost by the patient and the clinician.

Beyond the adolescent growth spurt, we now have multiple options in the form of TADs to gain true intrusion of posteriors and produce desirable skeletal effects comparable to orthognathic surgery. Closure of the anterior open bite with autorotation of the mandible gives us stable and reliable effects throughout in such cases.

Conclusion

As opposed to the general belief of some orthodontists that early treatment is the key to orthodontic success, it is pertinent to wait for the right time to begin growth modification. In case of maxilla, this may be early and slightly later for the mandible, with a good amount of variability between patients, in the sagittal direction.

Class II conditions are best treated during the pubertal peak of Growth when mandibular growth modification is needed.

Class III conditions require early redressal.

Transverse growth progress through growth modification is best achieved in early stages of growth between CS1 and CS3.

Adolescents approaching us for orthodontic treatment may not always end up with camouflage or Orthognathic Surgery. We can very well buy time with fixed functional appliances and recent advancements in Orthodontics such as the use of TADs.

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