"GROWTH MODULATION WITH FIXED MECHANOTHERAPY: USE OF EXTRA-ORAL FORCES"

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Controversies about early orthodontic treatment, particularly Class II, Division 1 malocclusion, revolve about modalities and timing of treatment. The most critical issue regarding methods of treatment has been the capability to affect facial growth. The claim that functional appliances may stimulate mandibular growth has shaped the nature of the debate on the interaction between treatment and growth. The argument on timing of early treatment involves intervention not only in various stages of dentitions but also in the modality of treatment. The present case takes into consideration the age of the patient, the innate growth potential and the best of the effects from the straight-wire appliance (SWA) as well as the extra-oral forces. The positive motivation of the patient, undoubtedly plays a crucial role. The conventional therapy by using extra-oral forces are beneficial provided the forces are controlled lest they may lead to root resorption and further complications.

Key Words: growth potential, non-extraction, headgear, incisor retraction.

Efforts have been made during the last few decades to explain the potential benefits of several techniques of orthodontic treatment and remodel them into a philosophy called 'the combination technique' (Thompson, 1981; Hocevar, 1985[1]; Kesling, 1989). The combination of the Begg and the straight wire (SW) technique was improved by a second generation of combination brackets developed by Thompson (1988). In accordance with the above, a combination of straight-wire technique in a non-extraction case with growth potential remaining in the patient was combined with the concept of anchorage from an extra-oral source i.e. headgear[2]. The high-pull headgear was used for intrusion and retraction of upper incisors by utilization of pre-existing spaces to correct the increased overjet.

The varied uses of headgear in restraining maxillary growth, for example in combination with an activator during the periods of active growth have been dealt in detail in the literature[3]. Besides, extra-oral forces via headgear have been advocated by Charles Tweed to prepare anchorage especially in the maxillary arch. Dr. Tweed had also used such type of stationary anchorage for retraction of incisors with the famous edgewise appliance[4].

The incorporation of extra-oral forces can be used along with a SWA (Straight-wire Appliance) thus taking advantage of stationary anchorage as well as built-in tip and torque from the Pre-adjusted appliance.

Case selection for treatment with a myo-functional or fixed functional appliance calls not only for a particular skeletal pattern and absence of severe crowding but also the time of the orthodontic treatment. In patients who do not require a major correction in profiles, the utilization of the growth potential patient helps in improvement the dental relationships which calls for a more conservative type of orthodontic treatment also known as non-extraction fixed mechanotherapy[5,6].

The stages of maturation of cervical vertebrae, described by the changes in shape of C2, C3 and C4 and/ or other maturiy indicators on cephalometric X-rays and Orthopantomogram have been related to the skeletal development in the patient

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Diagnosis and Treatment plan

An 11 years old boy reported with the complaint of forwardly placed upper front teeth and gaps between them. There was a positive familial malocclusion history.

The incisor display during speech was 5mm and during smile was 9mm. There was incompetency of the lips (**Figure 1**).

The overbite was 3.5 mm (60%) with a midline diastema along with spacing in upper anterior region. The molar and canine relations were end-on bilaterally (**Figure 2**).

The *problem list* for the patient consisted of the following:

Convex profile, malaligned teeth & asymmetrical arches, incompetent lips, midline diastema, increased curve of spee (4mm), increased overjet, overbite (9mm) and rotated teeth.

Treatment plan consisted of a non-extraction approach utilizing the innate growth potential of the boy. The treatment mechanics included anchorage control using an intra-oral trans-palatal arch (TPA) which had been activated thus serving the dual purpose of anchorage and molar rotation correction.

The brackets used were of the SWA with Roth prescription and 0.022-inch slot was used for an improved control over the teeth.

The treatment steps included leveling and alignment of the upper and the lower arches which was started with 0.016" Ni-Ti wire (upper arch) and 0.014" Ni-Ti (lower arch). The molar alignment for 36 and 46 was done by giving first order bends (as in conventional Tweed's) with molar offset bends.

Retraction and intrusion of upper incisors using high pull headgear with I-hooks on 16 X 22 S-S wire (Upper arch) upon which hooks were soldered distal to the maxillary central incisors for engaging the J hooks of headgear. Hooks were also soldered distal to the lateral incisors for engaging Class II elastics to achieve the correct molar relationship bilaterally. The high-pull headgear was used for a 3 month period with 14 hours/day wear till the desired results were achieved (**Figure 3**).

The upper space closure was continued with Type I module tie after approximately 2 months of headgear use for 14 hours per day with a force of 180-200 gms/side. The second molars were banded for their alignment later in the treatment.

Results

The relevant changes from various skeletal, dental and soft tissue analyses are shown in a tabulated manner.

Table I shows that the patient had Class I skeletal relationship (ANB of 3°). Since the upper incisor inclination showed a value of 14mm (Upper incisor to nasion-pt A) and the patient had a horizontal growth pattern, the retraction of upper incisors and a slight proclination of lower incisors was the treatment of choice in order to correct the pre-treatment overjet of 9mm. The overall active treatment time was 2 years and 7 months.

Table I Comparison of pre-treatment and stage findings

Parameter	Pretreatment	Stage
SNA	78 degrees	75 degrees
SNB	75 degrees	77 degrees
ANB	3 degrees	2 degrees
N PER to Pt. A	-9 mm	-10 mm
Go Gn to SN	23 degrees	26 degrees
U 1 to NA(angle)	45 degrees	26 degrees
U 1 to NA(linear)	14 mm	10 mm
L1 to NB	32 degrees	31 degrees
L1 to NB	7 mm	8 mm
L 1 to Md PLANE	109 degrees	111 degrees
S line to upper lip	5 mm	3 mm
S line to lower lip	8 mm	9 mm

The incisor display at rest showed a marked improvement with competency of lips established (**Figure 4**). The chief complaint of the patient i.e. gaps between the upper front teeth was corrected. The canine relation was established so that a canine guidance could be achieved (**Figure 5**).

The slight opening of the bite as seen in **Figure 5** was induced due to the leveling of the II molars which would correct by natural settling after the fixed appliance is removed.

The soft tissue relationships improved as evident from the Steiner's S-line to upper and lower lips (**Table I**).

There was no root resorption despite forces from extra-oral device as evident from the orthopantomogram (**Figure 7**). This was most probably contributed due to any absence of "jiggling" forces which is one of the causes of external apical root resorption (EARR).

DISCUSSION

By interpolating the results from two previous studies of the Herbst appliance (Hägg *et al.*, 2002 [7], 2003), it was demonstrated that 6 months of treatment with a conventional Herbst did not significantly affect forward growth of the maxilla, but after an additional six months of treatment there was a statistically significant effect. The combination of headgear and a fixed functional appliance, headgear-Herbst appliance, further enhanced the restraint of maxillary growth, and the effects were already evident after six months of treatment (Hägg *et al*, 2003). These findings seem to indicate that the length of treatment is an essential factor in the modification of maxillary growth with headgear and functional appliances.

It was reported from a randomized control trial (Tulloch *et al* [8]) that there was no difference in the final outcome between the one- and two-phase treatment groups. The excessive treatment time of a minimum of 8 months to correct the existing overjet in the present case was, therefore, deemed unnecessary.

In the present case the timing of treatment interventions was influenced by the severity of the malocclusion and the age and maturation of the patient at the time the patient presented for treatment.

The four superimpositions show the combined effect of growth and treatment changes (**Figure 8**). The mandibular growth in a downward and forward direction along with change of the hard tissue landmark (pt. A) with retraction of upper incisors (due to combined effect of extra-oral forces and Class II elastics) had added effect on correction of the increased overjet.

CONCLUSION

In the present era of dominance of mini-implants as temporary devices for anchorage, the role of extra-oral anchorage system i.e. headgear should not be a story of the past. The much debated one-phase Vs two-phase treatment protocol should be dealt with the presenting clinical features and the "achievable" goals for the specific case. The correct timing of treatment at an early age prevents the later developing complications thus saving the patient from the surgical trauma (both psychological as well as physical) which might then become the only possible treatment option.

The present case deals with the combined effect of restriction of the maxillary growth and retraction of the upper incisors utilizing the spaces as well as dental changes in the lower arch to correct the existing overjet.

Intrusion of incisors with an archwire requires complex wire bending adjustments to prevent undesirable side effects such as extrusion and flaring of the posterior teeth. With a good patient motivation and co-operation, retraction and intrusion using the headgear helps in achieving the desired goals with minimal chances of root resorption provided the mechanics obey the biological principles.

References

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Figure 1. The pre-treatment profile was rather straight. Dental changes were, therefore, to be achieved.



Figure 2. Intra-oral photographs showing end-on molar and canine relations with increased overjet.



Figure 3. High-pull headgear with Class II elastics and various hooks soldered to the upper arch wire.



Figure 4. Extra-oral photographs comparing pretreatment to stage

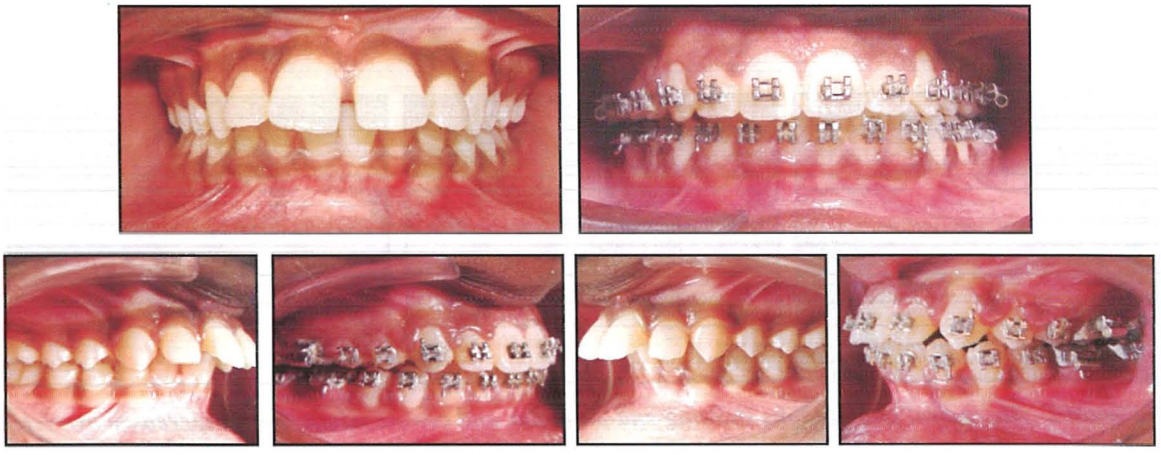


Figure 5. Intra-oral photographs showing changes after reduction of overjet

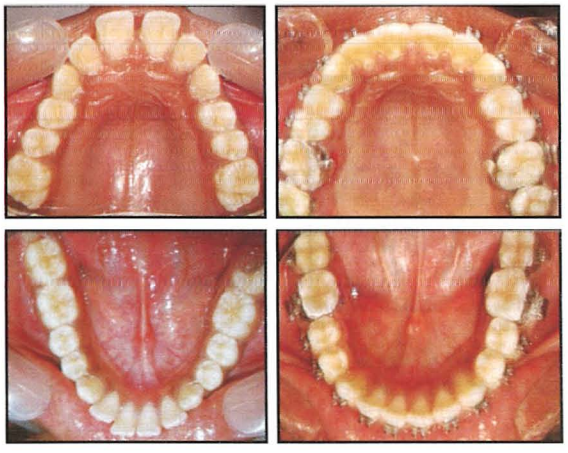


Figure 6. Intra-oral pre-treatment and stage occlusal photographs

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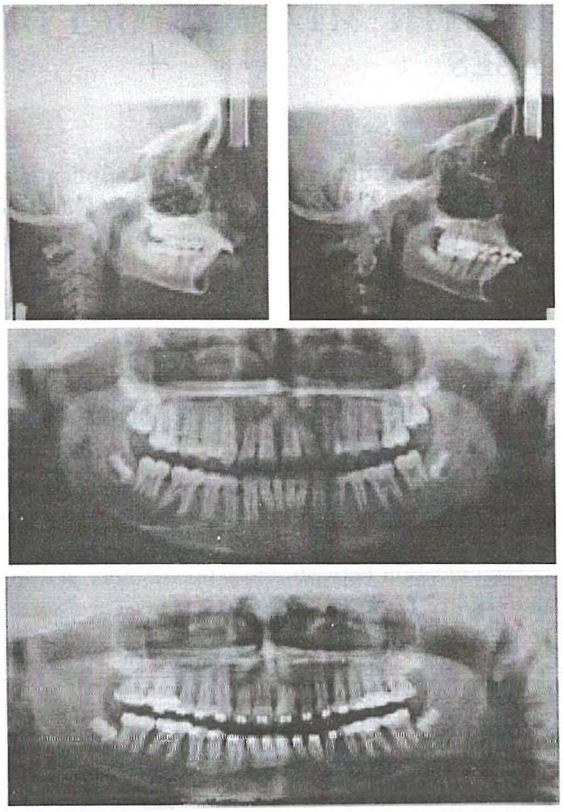


Figure 7. Pre-treatment and stage radiographs

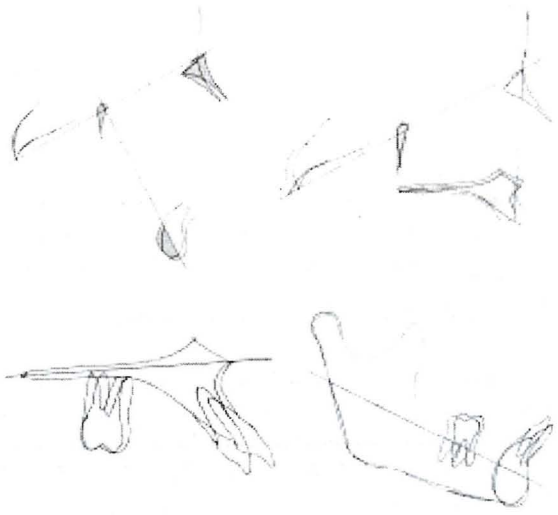


Figure 8. Ricketts superimposition showing skeletal and dental changes

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Dr. B.P. Rajan, BSc, BDS, MDS, FDSRCPS, DSc., an International Honorary PFA Fellow, passed away at Chennai on Tuesday November 22, 2011 at 79 years of age.

During his brilliant academic carrier, he served the Dental Profession as: Professor & Head of Operative Dentistry at Government Dental College, Chennai; First Principal of Tamilnadu Government Dental College, Chennai; President of Indian Dental Association; President of Dental Council of India; Vice – Chancellor of Tamilnadu Dr. MGR Medical University; Founder of Ragas Dental College, Chennai; Founder of Rajan Dental Institute; Special Representative of Government of Tamilnadu at New Delhi.

May God bless the departed soul rest in eternal peace.