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The segmental mechanics - An efficient method to reduce treatment duration in severely crowded cases

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Abstract:

Segmental mechanics consists of multiple wire cross-sections in different segments of the arch. The advantages of segmental mechanics in comparison with continuous mechanics are a statically determinate force system, relatively constant force, minimal side-effects on the anchorage unit, minimal arch wire fabrication, decreased treatment duration and enhanced esthetics. Individual retraction of the canine using segmental mechanics prior to unraveling of anterior teeth crowding helps in preventing round tripping of the anterior teeth and thereby facilitating a reduction in treatment time. The following article presents several case reports that highlight the efficiency of segmental mechanics in the reduction of treatment duration in severely crowded case

Introduction

Proper diagnosis and treatment planning is a key to effective patient management. One of the prime concerns of the patient seeking orthodontic treatment is esthetics. Optimum treatment in the shortest duration of time is a pre-requisite to successful orthodontic management.

Continuous mechanics in severely crowded cases results in round tripping with proclination of the anterior teeth during leveling and aligning. This is followed by en-masse retraction of the entire anterior segment thereby increasing treatment time.

Segmental mechanics1 on the other hand involves placing brackets only in the posterior segment and the canine initially and individually retracting the canine into the premolar extraction space. This provides space for unraveling the crowding in the upper and lower arch without proclining the upper and lower anterior teeth. Anchorage considerations should be planned at the beginning of treatment to meet the requirement of each particular case. Table 1 highlights the advantages of segmental mechanics over continuous mechanics.

Individual canine retraction by segmental mechanics takes place in approximately 4-5 months. Space develops in between the upper and lower anterior teeth due to periosteal pull resulting from retraction of the canine. This is followed by leveling and aligning of the arch, finishing and detailing, settling and debonding with reduction in treatment time.

Case 1

A male patient aged 17years came to the hospital with a complaint of irregular upper and lower front teeth. The patient had a skeletal class I malocclusion with bimaxillary retrusion with Angle's class I malocclusion with severe crowding in the upper and lower anteriors, moderate proclination of the upper anterior teeth and mild proclination of the lower anterior teeth, average growth pattern, competent lips and balanced soft tissue profile. The etiology of malocclusion was an arch length tooth size discrepancy with the space required in the upper arch being 16mm and that in the lower arch being 17mm.

Fig 1 – Intraoral photographs showing the segmental loop placed between the permanent canine and the auxiliary tube of the first permanent molar.

Fig 1a

Fig 1b

Extraction of 14, 24, 34, 44 was done. Maximum anchorage was achieved by means of a transpalatal arch and also by banding the second molars in all four quadrants. Segmental retraction of 13,23,33,43 was accomplished with segmental T loop (fig 1). The canines was retracted into the first premolar extraction space allowing for unraveling of crowding of the upper anterior teeth thereby avoiding round tripping of the anterior teeth (fig 2). This in turn reduces the treatment time considerably.

Fig 1c

Fig 1d

Fig 1e

Fig 1f

Figg.2 a,b,c,d,e,f Intraoral photographs showing the end of canine retraction

Case 2

A case of skeletal class III with mildly retrognathic normally inclined maxilla, mildly prognathic anteriorly positioned mandible with severe proclination of the upper anterior teeth, mild proclination of the lower anterior teeth, high FMA, vertical growth pattern, recessive chin and balanced soft tissue profile. Etiology of malocclusion was an arch length tooth size discrepancy requiring 15mm of space in the upper arch and 4mm in the lower arch. A striking finding in this case was that the left upper canine was palisading the root of the maxillary left lateral incisor. The canine was labially placed with the root in approximation with the labial cortex making retraction with friction mechanics difficult (fig 3). Treatment plan was to camouflage skeletal class III malocclusion. The second molars were banded at the start of treatment and a transpalatal arch was used to enhance anchorage. Extraction of 14, 24, 35 was done. Segmental retraction of left upper canine was performed with T loop. Fig 4 showing the canine well retracted into the premolar extraction space with sufficient space for the alignment of the lateral incisor.




Figg.3 a,b,c,d,e,f - Intraoral photographs showing left upper canine palisading the root of the maxillary left lateral incisor. The root of canine is placed in the buccal cortex.




Fig 4 - Intraoral photographs showing canine retraction achieved with a segmental T loop. Note the space obtained for alignment of the lateral incisor

Case 3

A female patient aged 12 year came to the hospital with irregular arrangement of teeth. The case was diagnosed as skeletal class I malocclusion with orthognathic normally inclined maxilla and orthognathic normally positioned mandible with crowding of the upper and lower incisors with average growth pattern with competent lips and balanced soft tissue profile. A significant finding in this case was that the canine was buccally and highly placed with the deciduous second molar present in the upper arch.

Treatment plan involved extraction of all the first premolars. Maximum anchorage was achieved by transpalatal arch and involvement of second molars. The patient was treated by the segmental approach to retract the canine in all four quadrants and gain space for de-crowding the incisors thereby avoiding round tripping of the anterior teeth and increase in treatment time (fig 5). Figure 6 shows the upper and lower arches at the end of retraction. Note that the deciduous molars had exfoliated and the second premolars are in the process of eruption.

Fig 5 a,b,c,d,e,f -Intraoral photographs showing retraction of the canine by means of segmental T loop. Note the severe crowding and deep bite.

Fig 6 -Intraoral photographs showing the end of canine retraction with the canine retracted into the extraction space of the first premolars

Discussion

Duration of orthodontic treatment plays a vital role in the success of any clinical practice. Timely completion of treatment allows more accurate prediction of the number of treatment visits and therefore a more accurate prediction of overhead costs. This provides valuable information for determining fees. Factors that affect treatment duration can be classified into patient factors, patient diagnostic characteristics, treatment modality and patient compliance. Patient factors include sex of the patient and adult versus child status. Patient diagnostic characteristics consist of extraction status, interincisal distance, sadde angle, articular angle, gonial angle and sum of angle. Treatment modalities can be single vs multiple phase, metal vs ceramic bracket, nickel titanium wire used, elastic wear and headgear wear. Patient compliance comprises of missed appointments, number of brackets debonded, number of bands recemented, sum of replaced brackets and bands. A langer ANB angle correlated with increased treatment time.

Of the above factors mentioned adult vs child, articulate angle, single vs multiple phases time elastic wear prescribed, headgear wear prescribed, missed appointment, months of missed appointment, number of bracket debonded, number of bands recemented, sum of replaced brackets and bands, negative oral hygiene was found to have a statistically significant effect on treatment duration2. A large ANB angle correlated with increased treatment time. On the contrary larger mandibular plane angle tended to have a shorter treatment time3.

Although the effect of treatment mechanics on treatment duration has not been much investigated the above method of segmental retraction of permanent canine to create space for the anterior teeth thereby avoiding round tripping and proclination of the anterior teeth especially in cases with severe arch length tooth size discrepancy can go long way in reducing treatment time.

Segmental mechanics		Continuous mechanics
Segmented arch consists of multiple wire cross-sections, varying wire sizes in different segments of the arch.		Continuous arch is a straight wire of a particular cross-sectional dimension and material contoured to the arch from and is attached to each adjacent brackets and tubes.
Segmented wire does not connect all the adjacent brackets. The arch is consolidated into active and reactive units. Active units are springs generating relatively constant force within an optimum range producing desirable tooth movement whereas the reactive unit is used for stabilization.		A single continuous wire passes through all the brackets
Force is calibrated producing a statically determinate force system which can be checked by spring tester and moment transducer.		Force cannot be calibrated. Statically indeterminate force.
Relatively constant force produced		Inconsistent force
The interbracket distance is increased thereby decreasing the load deflection rate which in turn produces optimum force		Short interbracket distance is found between the brackets. Load deflection rate is high.
Sufficient amount of horizontal activation can be done		Lack of space between the brackets limits horizontal activation
In segmental technique the reactive forces are transferred to the entire anchorage unit minimizing side-effects.		A continuous arch takes the adjacent teeth as anchor tooth causing side effects on the adjacent teeth.
Minimal arch wire fabrication		Arch wire has to be sequentially stepped up.
Esthetics is also enhanced because brackets are initially not placed in the upper and lower anterior teeth during initial strap up.		Brackets are placed on all the anterior teeth. Esthetics is compromised
Treatment duration in decreased in severely crowded cases		Increased treatment time due to round tripping of anterior teeth in severely crowded cases.

Table 1 –showing the advantages of segmental mechanics over continuous mechanics

Also patient compliance and co-operation is increased as brackets are not placed on the anterior teeth at the start of treatment.
Thus segmental retraction of the canine is highly efficacious in patients with arch length tooth size discrepancy.
This article hopes to rekindle the modern day orthodontist interest in segmental mechanics. Treatment mechanics should be determined depending on the need of the specific case instead of resorting to a stereotypic treatment plan.

Conclusion

The above paper enumerates the advantages of segmental mechanics over continuous mechanics in selected cases. Proper diagnosis, treatment planning and appropriate treatment mechanics result in successful completion and good prognosis of any particular case much to the satisfaction of the patient.

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