An Evaluation & Comparison of Anterior En Masse Retraction UsingT-loop with TMA & CNA Wires & Mushroom Loop with CNA & TMA Wires After Single Activation

Dr.Vishal Kumar
Sr. Lecturer
Dept. of Orthodontics
Dr. B.R.A.I.D.S. & Hospital,
Patna.

Dr. Nidhi
P.G. Student
KLE institute of
Dental sciences,
Belgaum.

Dr. K Vignesh
Professor,
Dept. of Orthodontics
Sri Ramachandra Dental
College & Hospital, Chennai.

Dr. Arun B Chitranjan
Professor & H.O.D.
Dept. of Orthodontics
Sri Ramachandra Dental
College & hospital, Chennai

Abstract

Orthodontic space closure is one of the most important phases of active orthodontic treatment. It requires not only a through and proper diagnosis and treatment planning but also requires a proper bio-mechanics. Development of new materials and design of closing loops might modify the treatment plan.

Keywords: Retraction, TMA, CNA, T-loop, Mushroom loop.

Introduction

Orthodontic tooth movement is the result of the controlled application of mechanical forces to the teeth and the periodontium. Precise control of tooth movement like control of the anchorage units, vertical forces, root positions and rotations during closure of extraction spaces is of paramount importance in meeting treatment goals.

In the pre-adjusted edgewise technique, retraction is achieved either with friction or frictionless mechanics.

Frictionless mechanics have evolved from earlier simple vertical loops to the present day complex loop designs. Materials use for frictionless retraction have also ranged from stiff stainless steel wires to the more flexible beta titanium wires, and to the newer materials like CNA wires.

Aims & Objectives

The following observation done in this study. (1) Amount of anterior en masse retraction using T loop and mushroom loop made up of TMA and CNA arch wire, (2) Vertical and angular changes in canine during retraction, after single activation, over a period of six weeks.

Material and Methods

28 patients undergoing fixed orthodontic treatment in the department of orthodontics, Sri Ramachandra Dental College and Hospital, were chosen for this study. The mean age of the subjects at the start of observation was 16 years with a range of 12 to 24 years. All patient were bonded with 0.022” X 0.028” Pre-adjusted Edgewise Appliance (Roth prescription). A passive palatal bar was fitted. Initial levelling and aligning was routinely done until the patients have a 0.017” X 0.025” stainless steel arch wire could be inserted passively. The anterior segment was consolidated by 0.009” round ligature wire.

Subjects were divided at random into 4 groups of 7 each. In Group I, en mass retraction was done with 0.017” X 0.025” Beta-titanium wire incorporating the continuous T-loop design, as described by Nanda. In Group II, en mass retraction was carried out with 0.017” X 0.025” Beta-titanium wire incorporating the continuous Mushroom loop design. In Group III, en mass retraction was carried out with 0.017” X 0.025” CNA wire. Preformed mushroom loop arch wires were used. In Group IV, en mass retraction was carried out with 0.017” X 0.025” CNA incorporating the continuous T-loop design.

All 4 types of loop were given at 40^0 beta and 20^0 alpha activation to develop the differential moment for Group A anchorage. The torque in the posterior legs, if any, was eliminated to make the wire passive in the third order in the buccal segments. On insertion, each closing loop was activated 6mm. activation levels of the spring were confirmed with calipers. An observation period of 6 weeks was planned to allow full expression of the force system delivered by the spring under a single activation.

Recording Technique

All radiographs were taken from “Radiograph Plus” at the speed of 85 KV and 10 MAS. To reduce error associated with landmark detection, a Tooth Position Locating Device (TPLD) was fabricated from sections of 0.021” X 0.025” stainless steel wires, which were attached to the maxillary first molars, canines, and a single central incisor before film exposure. These devices aided in precisely locating the before and after treatment positions of the teeth cephalometrically. Lateral cephalograms were taken just before spring insertion and activation (T1), as well as at the end of the six weeks study period (T2).

Superimposition Method & measurement technique:

Once the before (T1) and after (T2) radiograph records were collected at the end of the study period, the maxillary and cranial base structure were traced on acetate paper using 0.5mm drafting pencils for all the 28 patients for this study. Functional occlusal planes as described by Johnston were traced for each film. The structures of the maxillae were then superimposed ignoring dental changes.

Variable measurement

The various measurements, which were made the Anterior Movement

The distance between canine to vertical reference line was measured at (T1). Same was done after the study period (T2). The difference between T1 and T2 gave the distance of the canine moved.

The Vertical Response

The distance between canine and molar to horizontal reference line was measured at T1, same was done after the study period (T2). The difference between T1 and T2 gave the amount of vertical displacement taken place. Negative values were assigned for intrusion and positive values for extrusion.

The Angular Response

The change in the angulation of TLPD with reference to horizontal reference plane was measured for molar and canine between T1 and T2. negative values were assigned for crown tipping, positive value for root movement.

Data & Error Analysis

Data for bilateral molar and canine movements were combined so that a total of 56 observations of each variable were assessed among the sample of 28 subjects. Descriptive statistics of means, standard deviations, and ranges were computed for horizontal, vertical, and angular dental changes. Mean differences were considered significant at $P<0.05$. The error standard deviation was determined using Dahl berg's formula. Comparison between T-loop retraction and mushroom loop retraction were done for all variables considered and evaluated statically. Mean difference were considered significant at $P<0.05$.

Results

Data for bilateral molar and canine movements were combined so that a total of 56 observations of each variable were assessed among the sample of 28 subjects. Descriptive statistics of means, standard deviations, and range were computed for horizontal, vertical, and angular dental changes with statically software Statistical Package for Social Science (SPSS Version 15) Alpha levels were set at *0.05*; mean differences were considered significant at $P<0.05$.

Discussion

Orthodontic space closure should be specially tailored based on the individually of each case. At least six goals should be considered for any universal method of space closure.

(1) Differential space closure: the capability of anterior retraction, posterior protraction, or a combination of both should be possible.

(2) Minimum patient co-operation. This is achieved by eliminating the usage of headgears and elastics.

(3) Axial inclination control

(4) Control of rotations and arch width.

(5) Optimum biologic response. This includes rapid tooth movement with a minimum lowering of the pain threshold. Tissue damage, particularly root resorption, should also be at a minimum.

With sliding mechanics, space closure is slowed as the bracket undergoes “stick-slip” action along the arch wire, which may promote rapid changes in the magnitude, location and direction of periodontal strains. It can also be associated with the side effects like uncontrolled tipping, deepening of bite and loss of anchorage.

Well-designed closing loops promote a more continuous type of tooth movement by eliminating the intermittent force delivery as seen in sliding mechanics. CJ Burstone in his “Segmented Arch technique” had segmented the dental arch into an “active unit/segment” and a “reactive unit/ segment”. The active and reactive segments are joined by specialized spring. The advantage of this technique is that it delivers known force systems, which are statically determinate, and the type of movement of teeth can be controlled by the clinician.

The rationale for using a continuous-wire spring is more typical of conventional clinical practice than the segment and secondly, the Mushroom loop is designed only as a continuous pre-fabricated arch. The force system in continuous arch is not as well defined as in segmental arch. Thus this investigation was aimed to quantify and compare the actual tooth movement that resulted from a single activation to the 4 different continuous arch closing loops. By limiting the study to a single activation, the clinical effects of the prescribed force system can be more carefully evaluated and compared.

Space closure requiring precise anchorage, needs appropriate bio-mechanical strategies to be incorporated into the appliance design. The key feature is differential M/F ratios, which can be achieved either by differential forces or differential moments. Firstly, differential forces cannot be simply produced by a spring, elastic or chain elastic in an intra arch appliance, because the retraction force applied to the anterior teeth is reciprocally applied to the posterior teeth. To deliver unequal forces, external or extra-arch mechanisms must be included. Headgear and intermaxillary elastics are probably the two most common means of generating there additional forces. Unfortunately, this approach depends on patient compliance for success.

The important criteria to be considered for the use of closing loops are 1. Loop position, 2. Loop pre-activation or gabling and 3. Loop design. Length of the loop, the height of the loop, the diameter of bend, or, by adding helices.

The results of this study showed mean anterior retraction with the T loop made of TMA was 1.52mm while the mushroom loop design of the TMA wire was 1.86 mm. The T loop and mushroom loop designs of the CNA wire showed an equal mean retraction of 2.2mm. Thus, there was more mean retraction of anterior segment with CNA wires as compared to TMA wires with the design of the loop not making any difference with CNA wires. There was also a statistically significant difference between the T loop made of TMA wire and the two loop designs using CNA wires. The CNA beta titanium used in the mushroom loop is presumed to have a much lower stiffness and promotes a more constant force delivery. Contemporary studies have shown that continuous forces promote greater tooth movement, as the periodontium experiences more continuous stress, as shown by our results, which can also be attributed to lower force level an high moment to force ratio produced by it**.**

Biologic variation should also be considered. Studies of tooth displacement and space closure using human and animal models report substantial variability that could not be explained by force system and thus implicate individual biologic factors, for example-cellular turn over rate, vascularity or bone density. Keeling et al have documented tandem pattern of bone remodeling over time, represented by activation, resorption, reversal, and formation. These cyclic waves of remodeling events may be occurring at different time points during clinical observation and thus may reflect the variability documented in the present and other studies.

Mean angular changes in the canine for the four groups ranged between +1.1 to 1.79 degrees, whereas a previous study showed the mean of 0.4º.

Summary and Conclusion

28 subjects were selected and divided into 4 groups of 7 each to compare the anterior en masse retraction, vertical and angular changes in the canine and molar using two different loop designs that is T loop and Mushroom loop using TMA and CNA wire materials after a single activation. Differential moment force systems for Group A anchorage were applied by placing activation bends of 20º and 40º as alpha and beta moments respectively on a continuous arch. The changes were evaluated cephalometrically. The findings of the study suggest that

1. Anterior retraction was faster with CNA wires as compared to TMA wires. The design of the loop made no difference to the rate of retraction.

2. The vertical change in canine position was lesser with CNA wires as compared with TMA wires. The angular change in canine position was similar in all the four groups studied.

The mushroom loop design using CNA wire performed better than the T loop design using TMA wires for the various parameters tested

References

1. Nanda R, Kuhlberg AJ. Biomechanics of extraction space closure, Biomechanics in clinical orthodontic. Philadelphia. PA, Saunders, 1997.
2. Nanda R. Biomechanics basis of extraction space closure, in Biomechanics and Esthetic in clinical orthodontic. (2005)194-211..
3. Nanda R, Uribe. Treatment of class II division 2 malocclusion in adult: Biomechanical considerations J Clin Orthod 2003
4. Proffit WR. Contemporary Orthodontics. 2nd ed. St. Louis, mo: Mosby-year book inc: 1993.
5. Burstone C.J. The mechanics of the segmented arch techniques. Angle Orthodontics. 1966; 36:99-120.
6. Burstone CJ. The segmented arch approach. Am J Orthod Dentofacial Orthodop. 1982; 82(5): 361-378.
7. Smith R, Burstone CJ. Mechanics of tooth movement. Am J Orthod Dentofacial Orthodop. 1984;85:294-307