Original Article

Comparison of Rate of Space Closure using Active Tie Back and NiTi Coil Spring in Angle's Class I Bi-Max Malocclusion Subjects following Piezocorticision

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ABSTRACT

Introduction: With an increase in the patient's demand for a faster orthodontic treatment, different ways to accelerate orthodontic treatment have been commonly used by clinicians all over. One such treatment modality is the use of Piezocorticision to fasten the treatment. In our study, this modality was effectively used to accelerate the treatment and a comparison of the two commonly used methods of en-masse anterior retraction namely the active tie back and the NiTi closed coil spring are compared as to which gives a faster space closure.

Methodology: The present study was conducted using a split mouth technique, designed in a total of 20 Angle class I bimaxillary protrusion subjects in the Department of Orthodontics. Upon reaching 19x25 SS, upper 4s were extracted and Piezocorticotomy was done. An active tie back was given on the right side and a NiTi closed coil spring in the upper left quadrant. Patient was recalled every 3 weeks and space closure was evaluated.

Results: There was no statistically significant difference in the rate of space closure by both the methods, with greater rate of tooth movement seen with NiTi closed coil in 1st and 3rd appointments and lesser in 4th and 5th appointments.

Conclusion: Piezocision technique is one of the newest techniques in accelerating tooth movement, it has good clinical outcome, and is considered less invasive in the surgical approach.

Keywords: Accelerated orthodontics, Active tie back, NiTi closed coil spring, Piezocorticision.

INTRODUCTION

A conventional fixed orthodontic treatment requires long duration[1] which poses high risk of dental caries, gingival inflammation, external root resorption and therefore, decreased patient compliance.[2] Evolution of new bracket prescriptions and techniques move towards one final goal to create a force system that can work efficiently and shorten the orthodontic treatment period. In the recent years, treatment mechanics for retraction of anterior segment has mostly changed from closing loop mechanics to sliding mechanics, which reduces the chair time for orthodontists, improves patient comfort, and prevent excessive force application.[3]

Friction or sliding mechanics is used extensively due to its simplicity[4] and en-masse retraction is a preferable alternative to two-step retraction during space closure, especially because it is aesthetically much more acceptable.[5] Numerous retraction techniques are used in sliding mechanics such as active tie back, elastomeric chain[6], laceback[7,8], intermaxillary elastics[6], coil springs[6], or headgear with j-hook.[6,9]

Tieback is a single elastic module and a ligature wire attached between the first molars to the hooks on the archwire. Elastic tie backs produce lower forces during space closure (150g range) which create less tipping force against the arch wires and, in turn, less arch wire deflection. This reduces friction in the system and allows for more efficient space closure.[10]

Nickel titanium closed coil springs serve as one of many

techniques for space closure, individual tooth retraction or protraction, distal movement of teeth, and traction on impacted teeth. NiTi coil springs do not exhibit rapid force decay such as that seen with e-chain or elastic modules, nor do they display the extremes in space closing forces of S S coil springs or closing loops. Their use does not require dependence on patient co-operation.[11]

Out of the many methods available for en-masse retraction of anterior segment, the two commonly used methods namely, active tie back and NiTi closed coil spring are compared in the present study. The spirit of inter-disciplinary collaboration in dentistry has taken over traditional orthodontic tooth movement protocols and synthesized periodontal tissue engineering and regenerative surgery, not only towards methods of rapid orthodontic tooth movement but also provided every young clinician with a protocol that also reduces side effects like relapses, root resorption, inadequate basal bone, dental caries, and infection.[12]

Periodontally accelerated osteogenic orthodontics (PAOO) has been popularized as an adjunctive clinical procedure to meet the constant demand of reducing the treatment time and maintaining the integrity of periodontal structure.[13] The surgical component of PAOO technique is an in-office procedure. Piezosurgery is used in periodontology to supplement the existing surgical procedures. The mild vibratory movements of the Piezosurgery knife enables it to be used with greater precision of the cut and causing less discomfort to the patient when compared to traditional surgical instruments.[14]

Previous studies have been done to compare the effects of PAOO in accelerating tooth movement. However, this study is a first of its kind which compares the different methods of retraction following Piezocorticision. The aim of this split mouth clinical study is to compare the rate of space closure using active tie back and NiTi coil spring in Angle's class I bi-max subjects following Piezosurgery induced corticotomy.

METHODS

The present study was conducted using a split mouth technique, designed in a total of 20 subjects, irrespective of their gender, aged 15 years and above, undergoing orthodontic treatment involving extraction of upper first premolars, in the Department of Orthodontics. The surgical intervention (Piezocorticision) for the study to accelerate the tooth movement was performed on the selected subjects in the Department of Periodontics and Implantology.

The subjects fulfilled the following selection criteria i.e age 15 years and above, complete permanent dentition, patients desiring orthodontic treatment in a shorter duration, orthodontic treatment requiring extraction of upper first premolars in Angle's class I bimaxillary dentoalveolar protrusion cases, patient's requiring retraction of proclined/ protruded teeth, gingiva showing no signs of inflammation, periodontally healthy patients with generalized probing depths less than 3 mm.

Medically compromised, alcoholics or drug abusers, pregnant ladies, coagulation disorders or patients on anticoagulant therapy, patients taking long term medications that slow down bone metabolism, such as bisphosphonates, patients with severe crowding in upper and lower anteriors were excluded.

An ethical clearance was obtained from the college ethics committee and an informed written consent was obtained from the patients. All the patients were bonded with Unitek Gemini MBT Metal Brackets (0.022), 3M Unitek. After the completion of initial alignment and levelling, 19x25 SS arch wire was placed for 1 month in all the subjects. The anterior segment (cuspid to cuspid) was consolidated with 0.09" S S ligature to allow en-masse retraction[15], following which the maxillary first premolars were extracted. The selected subjects were kept on 19x25 SS wire for a month, they were then referred to the Department of Periodontics and Implantology for Piezocorticision procedure.

Figure 1: Osteotomy cuts made using Piezosurgical unit.

The surgical procedure was performed on all the selected subjects using Piezosurgical unit (W and H, Piezomed SA-320 along with instrument kit "Bone") as shown in figure 1. Bone graft using alloplast bone graft material was placed and primary closure of the gingival flaps was done using Mersilk 3-0 Black braided suture (Mersilk, 3-0, Ethicon, NW 5028) as shown in figure 2.

Figure 2: Grafting of the corticotomy site.

All the post-surgical instructions and medications were given to the patients, who were recalled after 10 days for suture removal. They were referred back to the Department of Orthodontics after suture removal for placement of the arch wire. Crimpable hooks (4 mm length) were placed between maxillary lateral incisors and maxillary cuspids in both quadrants as it represents the center of resistance for anterior maxilla.[18] Retraction assembly comprising of elastic tie back (Ormco) on the maxillary right quadrant (Figure 3) and NiTi closed coil spring (G and H orthodontics, 9 mm, light [150 g]) on the maxillary left quadrant (Figure 4) was placed on the same day.

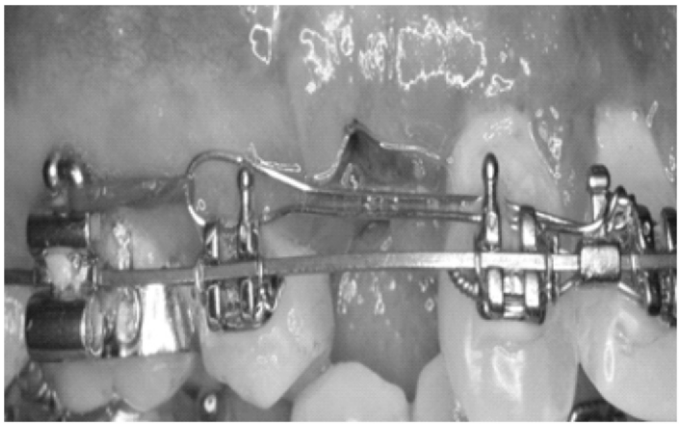

Figure 3: Retraction using Elastic tie back in maxillary right quadrant.

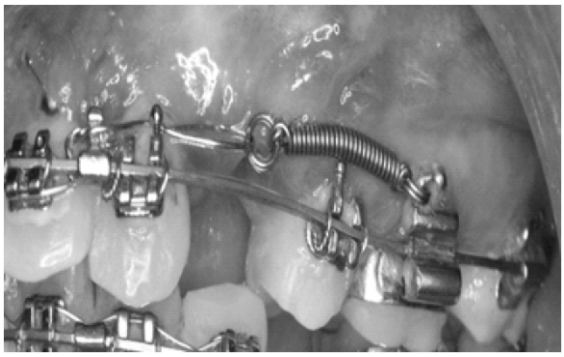

Figure 4: Retraction using NiTi closed coil spring in maxillary left quadrant.

The subjects were recalled and the retraction assembly was activated every 3 weeks. In the lower arch, retraction was done with active tie back in both the quadrants, which were activated every 3 weeks. The distance between the cusp tip of the maxillary cuspids and the buccal cusp tip of maxillary second bi-cuspids was measured using a Boley gauge (GDC, 4982) in all the subjects on every appointment (Figure 5).

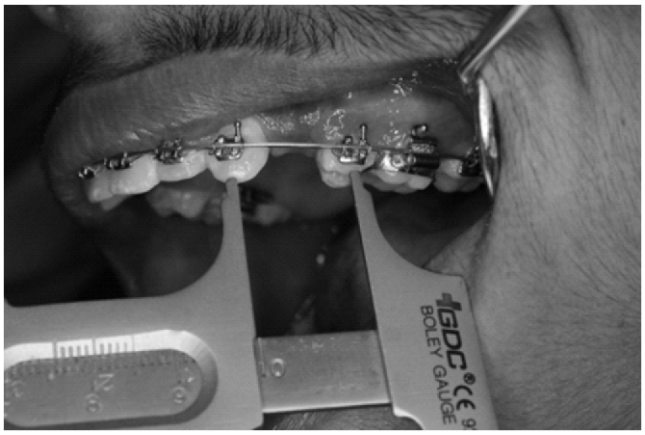

Figure 5: Measurement of space closure using Boley gauge with cusp tip of canine and buccal cusp tip of second premolar as reference.

A force of 150 gm was delivered using both the methods of retraction and was measured with the help of a Dontrix force gauge (Dynamometer, 42-FGD-352, Nexadental). Retraction assemblies were re-activated on every visit to keep the force values constant. This was done until the extraction space was considered closed when the tooth surfaces of maxillary cuspid and maxillary second bi-cuspid came into contact (irrespective of anterior segment retraction or molar protraction).

The data collected was entered in Microsoft Excel and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS, IBM version 20.0). The level of

Table 1: Evaluation and comparison of rate of space closure using an active tie back and a NiTi closed coil spring in Angle's class I bimaxillary dentoalveolar protrusion

	Active tie back	NiTi coil spring	p value
Mean± S.D.	1.64 ± 0.21 mm	1.78 ± 0.19 mm	0.085

significance was fixed at 5% and $p \leq 0.05$ was considered statistically significant. Kolmogorov- Smirnov test and Shapiro-Wilks test were employed to test the normality of data. Mann Whitney U test was performed for quantitative variables.

RESULTS

Table 1 shows the evaluation and comparison of rate of space closure using an active tie back and a NiTi closed coil spring in Angle's class I bimaxillary dentoalveolar protrusion. A comparative evaluation revealed no significant difference (p value=0 .085) in the rate of tooth movement with greater rate of space closure seen with NiTi closed coil spring in Angle's class I bimaxillary dentoalveolar protrusion.

Table 2 shows the evaluation and comparison of rate of space closure at different time intervals using an active tie back and a NiTi closed coil spring in Angle's class I bimaxillary dentoalveolar protrusion. A comparative evaluation revealed significant difference between the two groups at T1, T3, T4, and T5 time interval with greater rate of space closure with NiTi closed coil spring when compared to active tie back for T1 and T3 and lesser rate for T4 and T5.

DISCUSSION

The duration of orthodontic treatment is the main concern of most patients. Unfortunately, long orthodontic treatment time has several disadvantages like higher chances of dental caries, gingival recession, and root resorption. Therefore, the quest to find the best method to increase rate of tooth movement with the least possible disadvantages remains.[19]

Conventionally, this process is slow and orthodontic treatment time ranges anywhere between 12-48 months. By enhancing body's response to these forces, tooth movement can be accelerated. Many methods are available to accelerate tooth movement, such as surgical methods (corticotomy, Piezosurgery etc), mechanical/physical stimulation methods (vibration, lasers), drugs, magnets etc. These methods have successfully been proven to reduce treatment times by as much as 70%.[20] PAOO is an established and efficient technique that has gradually gained popularity as an adjunct treatment option for accelerating orthodontic treatment in adults.[1] Corticotomy has roots in Orthopaedics going way back to the early 1900s. Conventional tools such as chisel and mallet, surgical burs or trephine burs require greater exposure of the surgical site and are difficult to control in areas that require precise cut and are densely mineralized. In addition, the frictional heat generated by motor-driven instruments may interfere with the healing process.

In the following study, Piezosurgery was used for corticotomy. Numerous advantages of Piezosurgery over conventional corticotomy devices were evident like

Table 2: Evaluation and comparison of rate of space closure at different time intervals using an active tie back and a NiTi closed coil spring in Angle's class I bimaxillarydentoalveolar protrusion

Time interval	Active tie back Mean ± SD	NiTi coil spring Mean ± SD	p value
T2	1.92 ± 0.27	2.07±0.27	0.166
T3	1.50 ± 0.20	1.69±0.25	0.047
T4	1.23 ± 0.25	0.80±0.32	0.003
T5	0.38 ± 0.41	0.11±0.29	0.05
T6	0.07 ± 0.27	0.03±0.13	0.956
T7	03 ± 0.13	0.00	0.317
T8	0.00	0.00	–
T8	0.00	0.00	

p value < 0.05 significant

precise cutting and safety as it is an ultrasonic device that enables micrometric cutting depending on micro-oscillation of the hand piece which resulted in width of the cuts smaller than the width achievable with rotary instruments.[21] Other advantages like blood less field, reduced postoperative pain due to minimally invasive nature and reduced traumatic stress to the patient due to the noise-free nature of the micro-vibration are well appreciated by the patient and the operator.[22,23]

Space closure in orthodontics can be achieved using one of the two methods, either sliding mechanics (frictional mechanics) or closing loops (frictionless mechanics).[24] Space closure using sliding mechanics is comparatively simpler[4] and is the preferred method in pre-adjusted edgewise. The force of 150 gm was employed in the present study which followed the recommendations of many authors who applied forces between 100 gm and 200 gm for en-masse retraction.[25] Boester and Johnston[26] found that 150 gm of retraction force gave the highest anterior retraction rate. Excessively rapid space closure might produce adverse effects[10] and therefore in this study, it was decided to keep the force levels constant. A force value of 150 gm was maintained on every appointment and was measured by a Dontrix gauge in both the retraction methods.

The present study was conducted on 20 Angle's class I bi-max malocclusion subjects. Piezosurgery assisted corti-cotomy was performed in all the selected subjects, with corticotomy being performed in both maxillary and mandibular arches simultaneously.

The study was conducted with an aim to evaluate and compare the rate of space closure using the two methods of retraction: 1) Active tie back and 2) NiTi closed coil spring. These two methods of retraction are commonly used in sliding mechanics and they also have many advantages over the other methods. Elastic module with ligature tieback is relatively a better alternative to E-chain for space closure.[27] The tie-back method of space closure has a more appropriate initial force and slower force decay than the e-chain, may have a clinical value, approaching a more light and continued force.[28] In a comparative study conducted between e-chain and NiTi closed coil spring, coil spring produced faster retraction.[29]

The force decay in cases of retraction by active tie back is approximately 30-40% in first 48 hrs[28] which is more than in cases where retraction is done by a closed coil spring. In our study the difference in the rate of anterior retraction, with NiTi closed coil spring being faster than ATB, is likely because of the same reason. Padmaraj V Angolkar et al[30] in an in-vitro study concluded that most of the springs showed a major force reduction in the first 24 hrs to 3 days. After that the force decay was gradual but small until 21 days. Between 21-28 days, a sharp increase in force loss was noted in most of the springs. Considering this a recall period was fixed to 3 weeks even when the effects of corticotomy finished after around 4 months.

In this study, a comparative evaluation of rate of tooth movement using an active tie back and a NiTi closed coil spring in Angle's class 1 bimaxillary dentoalveolar protrusion subject revealed no significant difference, with greater rate of tooth movement seen with NiTi closed coil spring (Table 1).

A similar study conducted by RHA Samuels et al, and LH Mair[31] showed significantly greater and a more consistent rate of space closure with NiTi closed coil springs than elastic module. A significant difference was observed in Angle's class I bi-max subjects at T1, T3, T4, and T5 time interval with greater rate of movement with NiTi closed coil spring when compared to active tie back for T1 and T3 and lesser rate for T4 and T5 (Table 2).

A study conducted in non corticotomy patients by Shankar S et al[32] concluded similar results indica-ting faster rate of canine retraction by NiTi closed coil spring compared to active tie back in the first and second month and faster rate of canine retraction by active tie back compared to NiTi closed coil spring in the third month. They however, suggested that this difference could be due to the fact that they changed the tie back module every month, while the NiTi coil spring was not changed. Whereas, in the present study both the tie back module and the NiTi coil spring were activated up to the same force level on every appointment.

In a survey conducted by Khalid H Zawawi[33] on 150 subjects, only 7.8% selected corticotomy along with extractions. Fear from the surgery (53.2%) was the most frequent reason for not selecting corticotomy followed by fear from pain (36.9%). Certain side effects and post-

operative complications have also been reported in the literature including slight interdental bone loss, loss of attached gingiva, periodontal defects[34] to a severe form like subcutaneous hematomas extending to face and neck. No such complications and side effects were seen in any of the subjects in our study.

The surgical approach is the most clinically used and tested with known predictions and stable results. However, it is invasive and aggressive, and patients are not open to the idea of involving surgery unless it is the only option that is needed to have a good occlusion. Piezocision technique is one of the newest techniques in accelerating tooth movement, it has good clinical outcome and is considered less invasive in the surgical approach.

CONCLUSION

The surgical approach is the most clinically used and tested with known predictions and stable results. However, it is invasive and aggressive, and patients are not open to the idea of involving surgery unless it is the only option that is needed to have a good occlusion. Piezocision technique is one of the newest techniques in accelerating tooth movement, it has good clinical outcome and is considered less invasive in the surgical approach.

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