

Space Closure Rate in Mandibular Canine Retraction by Ni-Ti Closed Coil Spring: A Clinical Trial

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Abstract

Introduction: In Majority of patients seeking orthodontic treatment, teeth must be extracted in order to obtain proper esthetics, occlusion, and stability as well as extraction of teeth is often a need to close residual space, after the initial decrowding and aligning. Pre adjusted fixed orthodontic appliances commonly utilize sliding mechanics for space closure with different types of force delivery systems. A variety of materials have been used as force delivery systems to close spaces between teeth as in the case of canine retraction after the extraction of premolars. Among all sliding or frictionless methods of canine retraction, super-elastic nickel titanium coil spring has a particular property in producing light continuous force at a long range of action, compared with previously available materials. Nickel-titanium closed coil spring, with a continuous action, might have some advantages in fixed appliance space closure mechanics. **Materials and Methods:** Over the period of one year from May 2015 to April 2016, this clinical trial was carried out and A total number of 20 patients (40 quadrants), who required canine retraction into first premolar extraction sites as part of their orthodontic treatment in the Department of Orthodontics of BSMMU selected as study population. The quadrants were affixed by nickel titanium closed coil springs (medium force, Ni-Ti extension spring, Ormco) with 200gm force measured by Correx Tension Gauge. Space closure was measured by means of direct measurement from the mesial surface of mesial wing of the 2nd premolar bracket and the distal surface of distal wing of the canine bracket with digital Vernier Calipers. **Results:** Mean space closer rate in mandibular canine retraction was 1.07 ± 0.12 mm/month by nickel-titanium (Ni-Ti) closed coil spring method with p value < 0.001 .

Conclusion: This study revealed that space closer rate in mandibular canine retraction by nickel-titanium (Ni-Ti) closed coil spring is 1.07 ± 0.12 mm/month.

Key words: Ni- Ti closed coil spring, Canine retraction.

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Introduction:

Tweed's work revolutionized the field in the 1940's and 1950's as it now became acceptable to extract teeth for orthodontic correction. In 1989, a survey of 238 orthodontists in Michigan was conducted to evaluate the prevalence of orthodontic extractions and found the mean rate of extraction treatment to be 39%. The rate of extraction varied greatly between orthodontists¹. On a daily basis, orthodontic patients present with malocclusions and or facial imbalance. Often times, teeth must be extracted in order to obtain proper esthetics, occlusion, and stability. Extraction of teeth can improve the facial esthetics of a patient with procumbent or protrusive lips. This can be accomplished by retracting the anterior teeth into the extraction spaces, thus retracting the lips to a more balanced position^{2,3,4}. In severe crowding and extraction cases, the canines have been distalized to relieve the crowding as space to correctly align the incisors will not be available. Canine retraction is a very important step in treatment of patients with crowding needed first premolar extraction. Orthodontic treatment involving extraction of teeth is often a need to close residual space, after the initial decrowding and aligning^{5,6,7}. The closure of space can be achieved by two techniques, friction (sliding) mechanics or frictionless (loop) mechanics. Sliding (Frictional) mechanics involves either moving the brackets along the arch wire or sliding the arch wire through bracket & tube. Loop (Frictionless) mechanics involves movement of teeth without the brackets sliding along the arch wire but with the help of loops^{8,9,10}.

Pre adjusted fixed orthodontic appliances commonly utilize sliding mechanics for space closure with different types of force delivery systems^{11,12}. A variety of materials have been used as force delivery systems to close spaces between teeth as in the case of canine retraction after the extraction of premolars. These include latex elastics, coil spring, elastic module, elastomeric power chain, headgear and magnet^{13,14}. Nickel-titanium (Ni-Ti) closed coil spring delivered constant force till the terminal end of deactivation stage is reached. The advantages of these springs are that they can be easily placed and removed without arch wire removal and do not need reactivation at each appointment; therefore, patient cooperation is not needed. The most time consuming stage of premolar extraction based orthodontic treatment is canine retraction. Any procedure which reduces the time required to retract canine will also serve to shorten overall treatment time. Reducing the duration of orthodontic treatment is of great interest to orthodontists^{15,16,17}. In context of Bangladesh, there is no study regarding space closure rate in canine retraction by any force system.

Materials and Methods:

Over the period of one year from May 2015 to April 2016, this clinical trial was carried out in the Department of Orthodontics at Bangabandhu Sheikh Mujib Medical University (BSMMU). A total number of 20 patients (40 quadrants), who required canine retraction into first premolar extraction sites as part of their orthodontic treatment selected as study population. Patients were selected on these criteria, Age between 15 to 30 years who needs to 1st premolar extraction for treatment, who gave consent for inclusion in the study and free from any systemic disease^{18,19}. All the patients were treated with pre adjusted edge-wise fixed appliance using stainless steel 0.018x0.025-inch slot Roth brackets. After all, first premolars were extracted, initial leveling and alignment was carried out. All teeth were ligated with 0.010" stainless steel ligation wire. Standardized anchorage control using tip back and toe in bend was used in all patients and 2nd premolars were included in anchorage unite. Then canine retraction carried out by individual sliding of canine using round 0.016-inch stainless steel arch wire with elastomeric Power Chain. The quadrants were affixed by nickel titanium closed coil springs (medium force, Ni-Ti extension spring, Ormco) with 200gm force measured by Correx Tension Gauge. In clinical practice, a four to six-week appointment interval is common²⁰.

Space closure was measured by means of direct measurement from the mesial surface of mesial wing of the 2nd premolar bracket and the distal surface of distal wing of the canine bracket with digital Vernier Calipers every four weeks' interval.



Figure-1: Ni-Ti Closed Coil Spring.



Figure-2: Digital Vernier Calipers.

Results:

During this study period distribution of patients according to gender, Female were predominant. Male female ratio was 1:4. Amongst the patients, Maximum 11 (55.0%) were in age group 16-20 years followed by 7 (35.0%) and 2 (10.0%) were in age group 21-25 years and >25 years age group respectively. Mean of age was 20.60 ± 3.54 years within the range of 16-27 years.

Figure 3 shows distribution of patients according to gender. Female were predominant. Male female ratio was 1:4.

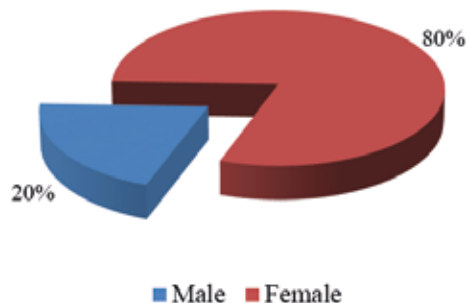


Figure-3: Pie chart of patients according to gender.

Table I shows distribution of patients according to age. Maximum 11 (55.0%) were in age group 16-20 years followed by 7 (35.0%) and 2 (10.0%) were in age group 21-25 years and >25 years age group respectively. Mean of age was 20.60 ± 3.54 years within the range of 16-27 years.

Table-I: Distribution of patients according to age.

Age	Frequency	Percentage
16 – 20	11	55.0
21 – 25	7	35.0
>25	2	10.0
Total	20	100.0
Mean \pm SD	20.60 \pm 3.54	
Range (Min – Max)	16 – 27	

Figure 4 shows distribution of patients according to type of occlusion. Maximum 16 (80.0%) cases were Bi-maxillary proclination and 4 (20.0%) cases were Class 2 div 1.

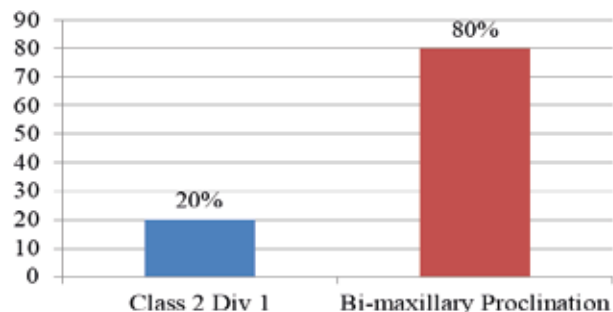


Figure-4: Bar diagram Distribution of patients according to type of occlusion.

Discussion:

A total of twenty patients were selected for canine retraction in the Department of Orthodontics at BSMMU. Among all patients female were predominant with male and female ratio 1:4. According to age distribution, mean age was measured 20.60 ± 3.54 years within the range of 16-27 years. Maximum patients were in age group 16-20 years which accounted 55.0% that followed by 35.0% and 10.0% were in age group 21-25 years and >25 years' age group respectively. Young populations especially female are more inclined to get a better aesthetic configuration of own self. This may be one of the causes of such type of age and sex distribution in our study. Among 17 patients in a study done by Samuels, Rudge, and Mair, there were 12 girls and 5 boys with a mean age of 14.7 years (range = 11.1 to 17.1 years)¹⁴.

In this study, a majority of 80.0% cases were Bi-maxillary proclination and the rest of 20.0% cases were Class 2 div 1. Mean space closer rate was 1.06 ± 0.19 mm/month in male and 1.07 ± 0.10 mm/month in female in Ni-Ti closed coil spring method in mandible. There was no statistical significant difference between these two groups. Unpaired t test was done to measure the level of significance.

In consideration of total time required for closing the space in canine retraction (months) was 6.25 ± 0.91 months in Ni-Ti closed coil spring method in mandible.

A clinical trial done in England on twenty seven patients and found 0.51 mm/week mean rate of tooth movement in nickel titanium closed coil springs group^{13,15}.

In our study mean space closer rate in mandibular canine retraction is 1.07 ± 0.12 mm/month in Ni-Ti closed coil spring method with p value < 0.001.

Conclusion:

This study revealed that space closer rate by Ni -Ti closed coil spring in mandibular canine retraction is 1.07 ± 0.12 mm/month.

Conflict of Interest: None.

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