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Comparison of maxillary canine retraction using power chain and active tie-back: An *In vivo* study

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Abstract

Aim: To compare the rate of canine retraction using power chains and active tieback.

Methodology: 20 patients of age between 18 – 25 years irrespective of sex were included in study. After alignment and extraction of maxillary first premolars, canine retraction was started with power chains on one side of the maxillary arch and with active Tie back on the other side. The difference between pre and post retraction measurements was recorded. The differences in the rate of canine retraction between both modalities were compared using independent sample t-test.

Results: The mean rate of tooth movement in group I and II was 1.29734 mm/month and 1.40054 mm/month respectively ($p \leq 0.05$) but there was no significant difference.

Conclusion: The rate of canine retraction is more rapid with active tie-back modality than with the Power chain.

Keywords: canine retraction, power chain, active tieback

Introduction

Space closure is one of the most challenging processes in Orthodontics. The ability to close spaces, especially those resulting from tooth extraction, is an essential skill required during orthodontic treatment. Space closure mechanics without knowledge can result in failure to achieve an ideal occlusion. Mechanics employed for orthodontic space closure by canine retraction in cases involving first premolar extraction cases include friction and frictionless mechanics [1].

In order to achieve good treatment outcomes, it is crucial to understand the principles behind space closure. Regulation of space closure is ultimately determined by the biomechanical forces applied to the teeth, variation in force and moment magnitude, moment-to-force ratio (M/F), force-to-deflection rate, and anchor unit [2].

Sliding mechanics is the most preferred method of closing extraction spaces. For this there are several method of applying force like elastic modules, elastic chains, NiTi coil spring, which provide a force of 100 to 200 gms. It has been suggested that forces of approximately 150 gms may be the ideal physiologic force for bodily movement of the canines [3].During the past few years, elastomeric power chains (EPCs) have been used in preference to other retraction orthodontic materials because of their elastic properties, ease of application and requiring no patient co-operation, low cost, being relatively hygienic, and their irritation-free nature due to their smooth surface [4]. On the other hand, canine retraction by Tie-back utilizes just an elastic module and a 0.010 or 0.009 inch stainless steel ligature which is much more cost-effective than NiTi closed coil spring; and has also proved to be effective in canine retraction [5]. So this is a comparative clinical study between Power chains and active Tie-back to compare the canine movement in maxillary arch using implant as a stable reference point.

Materials and Methods

Study Design

A Prospective randomized *in vivo* clinical study comprising 20 patients in each group (irrespective of sex) was conducted in the Department of Orthodontics and Dento-facial Orthopaedics, Buddha Institute of Dental Sciences and Hospital, Patna, Bihar, India.

The study protocol was reviewed by the Ethical Committee of the Hospital and granted ethical clearance. After explaining the purpose and details of the study, a written informed consent was obtained.

Inclusion criteria

- Patients 18-25 years of age
- Patient with class I and class II malocclusion
- Patients requiring bilateral extraction of first premolars with minimal crowding
- Patient completed his levelling and alignment phase
- Patient with no systemic illness

Exclusion criteria

- Missing tooth anterior to the first molar
- Severe crowding
- Patient with systemic illness
- Compromised periodontium
- Patient who are allergic to titanium
- Local bone pathology as detected in Orthopantamogram

Sample selection

The sample size was calculated using a prior type of power analysis by G* Power Software Version 3.0.1.0 (Franz Faul, Universitat Kiel, Germany).The minimum sample size of each group was calculated, following these input conditions: power of 0.80 and $P \leq 0.05$ and sample size arrived were 20 patients.

Grouping

Group I: retraction on right side of maxilla with Power chain

Group II: retraction on left side of maxilla with active tie-back

Methodology

All patients will be treated with fixed orthodontic therapy using MBT prescription of 0.022 slot (American Orthodontics). Canine retraction was started on 0.018 inch round AJ Willcock wire after initial levelling and aligning, engaged to the bracket hook and tied with stainless steel ligature. Canine retraction was accomplished with Power chain on one side and active tieback on contra-lateral side. 20 patients between 18-25 years of age included in each group.12 female and 8 male were in both the groups. Two micro-implants were placed in the maxilla. Upper first premolars were been extracted at the end of levelling and alignment stage. Mini-screws (8 mm length and 1.6 mm diameter titanium mini-screws from Forestadent®) were been applied in a week after premolars extraction. In the maxilla, micro-implants inserted between maxillary second premolar and first molar, inserted at an angle of 30°–40° and at 8 mm away from brackets slots, wire guides and periapical radiographs were been used to determine the 'miniscrews' suitable position.

Two sets of records were taken; the first was before the implant placement and other when canine retraction was completed in accordance with the patient's treatment plan. Records include (1) study models made from alginate impressions of the maxillary and mandibular dental arches and (2) cephalometric radiographs.

Canine retraction began after one week from micro-implants application (2 weeks from premolar extraction) using Power chain on one side and Active tieback on the other side. A 100 g force have been used to retract upper canines. The force line extended from the canine hook to micro-implants as a direct skeletal anchorage system. At every visit (at 4 weeks) force were measured and elastic chain replaced to maintain force at 100 g (measured with the Dontrix gauge; American Orthodontics).

The horizontal distance was measured from the reference line to the guide on the canine bracket on both sides at the beginning and end of canine retraction. The amount of canine retraction was calculated by the difference between the pre retraction and post retraction values. The rate of canine retraction was calculated by dividing the amount of canine retraction by time taken for the retraction [6].

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2010) and then exported to data editor page of SPSS version 20 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics included computation of means. Statistical test applied for the analysis was independent sample t-test [6]. The confidence interval and p-value were set at 95% and ≤ 0.05 respectively.

Results

20 patients between 18-25 years of age included in each group. Mean age of the study subjects is 20.89 years. 12 female and 8 male were in both the groups. Clinical measurements show that canines retracted 6.90 ± 1.10 mm in 179 days by Power chain and 7.08± 1.25 mm in 160 days by active tie-back. The speed of canine retraction was 1.29± 0.58 mm/mo by Power chain and 1.40± 0.43 mm/mo by active tieback without significant differences between the two methods. (Table 1)

Table 1: Comparison of mean overall rate of canine retraction

	Power chain		Tie-back		P	Sig
	Mean	SD	Mean	SD		
Time (days)	179.02735	15.40326	160.40436	16.90345	0.511	NS
Distance (mm)	6.90341	1.10921	7.08242	1.25468	0.986	NS
Speed (mm/mo)	1.29734	0.52844	1.40054	0.43691	0.631	NS

Test applied: independent sample t-test

Discussion

Canine retraction is probably the most common clinical situation where sliding mechanics are used to move a tooth over a relatively large distance. Therefore, clinicians are always keen to know and evaluate the superiority of one method over the other in retracting canines.

Some studies have been conducted in the past comparing space closure by canine retraction using different methods and showed conflicting results. Some showed NiTi coil springs to be superior to elastomeric modules/active tieback [7]. Others showed active tieback to be more effective as compared to active Lace-back [5].

In the present study, it was found that for Power chain mean rate of canine retraction was 1.29±0.52 mm per month and for active Tie-back it was 1.40±0.43 mm per month and there was statistically no significant difference between rates of retraction.

The present investigation revealed that monthly rate of canine retraction between Power chain and active tieback, there was statistically significant difference at first, second and third month, but at fourth month there was no statistically difference in rate of tooth movement.

Ziegler and Ingervall [8], concluded that the response to different methods of canine retraction is not dependent on the type of force; rather it depends on individual metabolic response. In a systematic review by Kulshrestha *et al* [9], on different methods of canine retraction, they found that optimum force for movement had no specific value.

However, Quinn and Yoshikawa [10], suggested a range of 100-200 grams to be sufficient and this was the force range observed in their review also. The duration of force rather than the magnitude is considered important for good biologic tooth response. Light continuous forces up to a threshold can provide an optimum force. High initial forces cause a greater rate of force decay than achieving greater rate of space closure.

As Kulshrestha *et al*,[9] also concluded, the scientific evidence is too weak to evaluate the efficiency of different canine retraction methods during space closure because a vast heterogeneity of the studies exists. Furthermore, they suggested that to achieve reliable scientific evidence, additional RCT's with sufficient sample size are required to determine the effectiveness of one technique of canine retraction over the other.

Conclusion

The present randomized clinical study concluded that both methods are effective to achieve space closure. The mean canine retraction rate was more rapid with active tieback than Power chain modality. Additional RCT's with

sufficient sample size are required to determine the effectiveness of one technique of canine retraction over the other. Furthermore study may be done using CBCT for accurate canine retraction measurement.

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