Canine retraction using new Curved Sliding Technique and miniscrew anchorage

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Abstract

Background and Aim: Canine retraction is an important stage in many orthodontic cases involving extraction. The aim of this study was to develop a new technique for canine retraction and to evaluate it clinically with the use of miniscrew anchorage.

Materials and Methods: The sample comprised of fifteen patients (eight females and seven males)who had maxillary first premolars extracted and maximum anchorage was indicated in all subjects to solve crowding or protrusion. Canine retraction was done using new Curved Sliding Technique and miniscrew anchorage. Miniscrews were inserted between the maxillary second premolar and the first molar in the attached gingiva near the mucogingival junction**.** 150 g of force was applied with nickel-titanium coil springs. The evaluation was done on lateral cephalometric radiographs and dental casts. Paired-samples *t* test was used to evaluate the changes within group.

Results: The study showed excellent control of canine axis with intrusion (1.5 mm) and perfect rotational control during retraction. The rate of canine retraction was 1.32 mm/month.

Conclusion: The new technique demonstrated excellent efficiency in canine retraction and good rate of space closing due to the reduction of friction.

Keywords: Canine retraction, Curved sliding technique, Miniscrews.

Introduction

Many techniques are used for canine retraction which considered an important step in many orthodontic cases involving extraction. In 1974, Ricketts offered his hitherto well-known technique, bio progressive therapy. He developed a spring for canine retraction formed from 0.016 × 0.016-inch Blue Elgiloy wire; 2-3 mm activation results in 100-150 g.[1,2]

In 1976, Burstone used V bend for canine retraction, formed from 0.016-inch stainless steel wire inside 0.018-inch brackets or from 0.020-inch stainless steel wire inside 0.022-inch brackets. 150-200 g of force is applied from the molar band's hook to the hook or distal wings of canine bracket.[3]

In 1985, Poul Gjessing developed the (PG) retraction spring, which incorporates two oval loops called Danish loops. The spring is formed from 0.022 × 0.016-inch stainless steel wire.[4]

In 1997, Darendeliler MA et al developed a spring called drum spring (DS) retractor, which applies a constant and continuous force without the need for reactivation. Darendeliler said that continuous and constant force provides a more rapid canine movement than the continuous but diminishing force.[5]

Recently, Ferreira MDA et al developed a spr, 9m ing according to T loop. This spring is comprised of 0.016 × 0.022-inch or 0.017 × 0.025-inch titanium-molybdenum.[6]

It is known that springs, depending on loop mechanics, require considerable time for bending wires and there is a probability for activation space to finish after 2-3 subsequent activations.[7]

Sliding mechanics are better than loop mechanics in rotational control of the canine during retraction, but the force levels needed remain ambiguous. High and continuous forces with sliding mechanics during long space closing may cause distal tipping of the canine which results in bite deepening.[8,9]

Generally speaking, it is agreed that uncontrolled tipping produces a concentration of stresses within the periodontal ligament detrimental to periodontal health, particularly in the adult orthodontic patient. Therefore, force levels must be controlled to minimize tipping.[10-12]

These problems with the previous techniques encouraged us to develop a new technique for canine retraction, to enhance the desirable movements and to reduce the side effects.

Material and Methods

Sample estimation: It has been found that the sample followed the normal distribution; therefore, determining the minimum sample size to be statistically significant was according to the following formula:

$$n = \frac{Z^2 . \sigma^2}{(e)^2}$$

(N): is the sample size; (z): is the value corresponding to a confidence level, estimated at 99% (Z = 2.58) (i.e. significance level is 0.019); (σ): highest Standard Deviation value within the all linear and angular variables at the pilot study (σ = 4.19); (e): Margin of error (maximum acceptable error in mean estimate) (e=5).

$$n = \frac{(2.58)^2 \times (4.19)^2}{(5)^2} \approx 4.67$$

Thus: According to that previous study, the sample size (n) must be as minimum of 4.67 patients, whereas sample size of this study was n=15.

Fifteen patients (eight females and seven males) were included in this study. These patients had the following characteristics: 1- age between 18-25 years; 2- Ten patients had Angle class II Division 1 malocclusion and five had Angle class I malocclusion.3- The subjects had full permanent dentition (with or without the third molars). 4-Fixed orthodontic treatment was planned with the extraction of maxillary first premolars and maximum anchorage was indicated in all subjects to solve crowding or protrusion (with or without extractions in the mandibular arch). 5-Stainless steel direct-bonding MBT brackets (0.022-inch) (American Orthodontics®, Sheboygan, USA) were used in all patients.

All patients or guardians were advised of the purpose of the study and signed a consent form. No patient who was approached for the study refused to participate.

Curved Sliding Technique is a new technique we developed for canine retraction under consideration of the following conditions: 1- Achieving desirable movements with the least side effects. 2- Reducing treatment time. 3- Less wire bends. 4- Unlimited activation space. 5- Harmony with recent developments in orthodontics.

The new canine retractor is comprised of 0.019 × 0.025-inch stainless steel wire, and it consists of the following parts:1- Connection part: this part should adapted to insert in the canine bracket passively and tied with the bracket by a ligature wire. 2- The Bend: This part aims to reduce the beginning of the curved part slightly under tube level. This enables the wire to assume the necessary curve, the length of the bend is 3 mm. 3- Curved part: this part of the wire forms an arc of circle which radius is 4 cm. 4- The power arm: its length is 7 mm and it is connected with the connection part (Fig. 1).

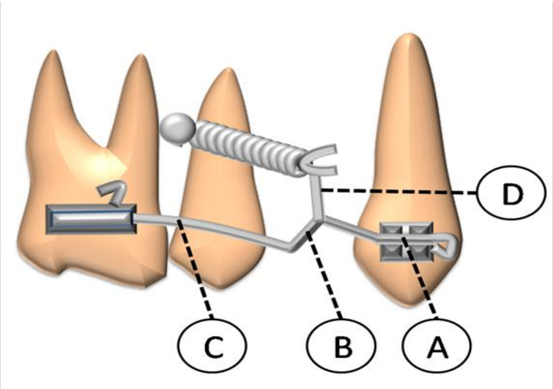

Fig. 1: Design of the new canine retractor. A: connection part, B: the bend, C: curved part, D: 7 mm power arm

The new technique can be used with miniscrew or traditional anchorage.

The Mechanics of the Curved Sliding Movement: With the retraction and entering movement of the curved wire inside the molar tube, the wire connected to the brackets will gradually win angle with the horizontal plane. This is accompanied with gradual increase of the altitude above the occlusal plane. This altitude increases wherever the point whose movement is studied, far away from the front of the molar tube (Fig. 2). As a result, the distal movement of the canineis accompanied with intrusion.

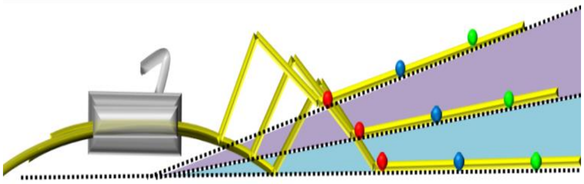

Fig. 2: The mechanics of the curved sliding movement

Upper Canine retraction was done in all patients using new Curved Sliding Technique and miniscrew anchorage. Miniscrews (1.5 mm in diameter, 8 mm in length, American Orthodontics®, Sheboygan, USA) were inserted between the maxillary second premolar and the first molar, preferably in the attached gingiva near the mucogingival junction. 150 g of force was applied with a nickel-titanium coil spring (closed) (Jiscop, Hansol Techno-town, Korea) extending from the miniscrew to the power arm. Palatal bar (1.1 mm) was used to maintain the position of the posterior teeth(Fig.3,4).

Fig. 3: The test showed excellent control of canine axis with intrusion after retraction with Curved Sliding Technique and miniscrew anchorage

Fig. 4: The test showed perfect rotational control of the canine during retraction with Curved Sliding Technique and miniscrew anchorage

To evaluate the dental and skeletal changes, lateral cephalometric radiographs were obtained at two times: T1, before retraction and T2, after retraction. To minimize measurement errors, reference bars (0.019 × 0.025-inch stainless steel wires) were inserted into the canine brackets. Longer reference bars on the right than on the left side were inserted to identify left and right teeth.

Cephalometricpoints: ANS, the anterior tip of the sharp bony process of the maxilla at the lower margin of the anterior nasal opening; PNS, the posterior spine of the palatine bone constituting the hard palate; Ptm, (pterygomaxillary point) apex of the teardrop-shaped pterygomaxillary fissure; U6M, the most anterior point on the mesial outline of the crown of the maxillary first molar; U6D, the most posterior point on the distal outline of the crown of the maxillary first molar; L, centroid of the maxillary first molar crown (midpoint between U6M and U6D).

Cephalometric reference planes: X-axis, the palatal cortex of the maxilla (ANS-PNS plane); Y-axis, perpendicular to X-axis through Ptm.

Cephalometric measurements: 1. X/U3, angle between the long axis of the upper canine and X-axis (°); 2.X-U3, distance between the upper canine and X-axis (mm); 3.Y-U3, distance between the upper canine and Y-axis (mm); 4.X/U6, angle between the long axis of the upper first molar (obtained by drawing a line through L perpendicular to the line connecting U6M and U6D)and X-axis (°); 5.X-U6M, distance between U6M and X-axis; 6.Y-U6M, distance between U6M and Y-axis; 7.X-U6D, distance between U6D and X-axis; 8. Y-U6D, distance between U6D and Y-axis (Fig.5).

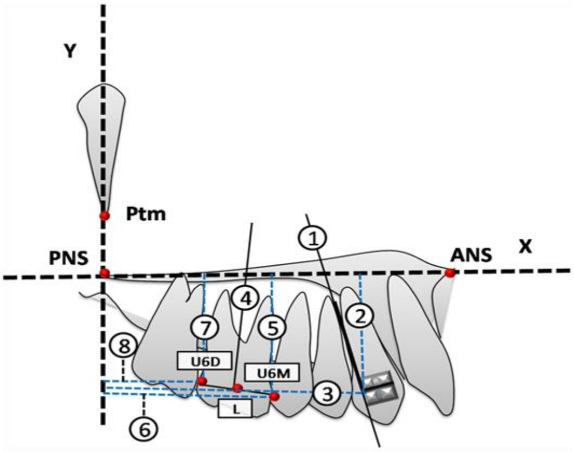

Fig. 5: Cephalometric points, reference planes and measurements used in the test

Rotational change in canine position was measured from the dental casts using Ziegler and Ingervall method (Fig. 6).[13]

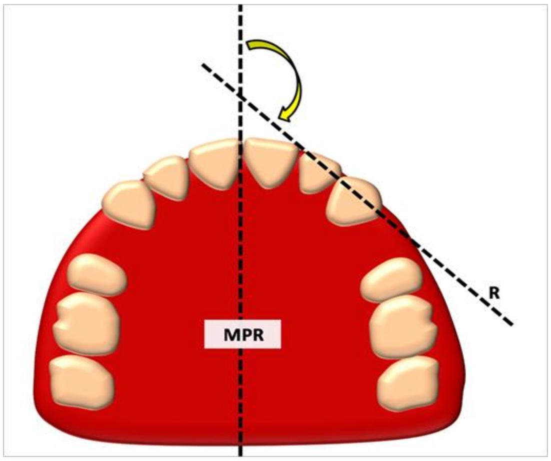

Fig. 6: To define canine rotation, the angle formed between a line (R) through the distal and mesial contact points of the canine and the mid-palatal raphe (MPR) was measured before and after retraction

Paired-samples *t* test was used to evaluate the changes within group.

The rate of canine retraction was calculated by dividing the amount of canine retraction by time taken for retraction.

Results

Descriptive values of pre-retraction and post-retraction measurements and the significance of the differences between pre-retraction and post-retraction are given in Table 1.

Results showed excellent control of the canine axis with intrusion (X/U3, 1.23°; X-U3, -1.52) these differences were significant ($P < .001$).

Distal tipping of the first molar (X/U6, 0.90°) was significant (P < .001). The test showed about 0.30 mm distal movement of the first molar (Y-U6M, -0.29 mm; Y-U6D, -0.30 mm), the differences were significant (P < .001). Vertical changes in molar position were (X-U6M, 0.22 mm; X-U6D, - 0.18 mm), the differences were significant (P < .01 and P < .05, respectively).

The test showed perfect rotational control of the canine (MPR/R, 0.70°) since the difference was not statistically significant (P > .05).The rate of canine retraction was 1.32 mm/month.

Table 1: Comparisons of measurements before retraction (T1) and after retraction (T2)

Parameters	T1		T2				
	Mean	SD	Mean	SD	D= T2-T1	SD	P
X/U3 (°)	82.16	2.55	83.4	2.52	1.23	0.58	.000***
X-U3 (mm)	25.60	1.95	24.08	2.00	-1.52	0.47	.000***
Y-U3 (mm)	45.86	1.82	40.73	1.97	-5.13	0.91	.000***
X/U6 (°)	90.60	1.95	91.50	2.07	0.90	0.43	.000***
X-U6M (mm)	22.46	1.59	22.68	1.61	0.22	0.24	.004**
Y-U6M (mm)	27.42	1.40	27.13	1.40	-0.29	0.29	.002**
X-U6D (mm)	21.8	1.68	21.7	1.55	-0.18	0.25	.014*
Y-U6D (mm)	14.70	1.62	14.40	1.84	-0.30	0.44	.018*
MPR/R (°)	136.20	4.19	136.90	4.14	0.70	1.33	.061^{NS}

^{NS} indicates non-significant; * P<.05; ** P<.01; *** P<.001

Discussion

The study of canine retraction using Curved Sliding Technique and direct miniscrew anchorage, showed excellent control of canine axis with 1.5 mm mean intrusion. These results can be clarified according to the mechanics of curved sliding movement. Subsequent, with the retraction and entering movement of the curved wire inside the molar tube, the segment connected with the canine bracket will gradually win angle with the horizontal plane. This is accompanied with gradual increase of the altitude above the occlusal plane. Therefore, retraction is accompanied with intrusion.

The change in first molar position was little (about 0.30 mm mean distal movement and 0.90° mean distal tipping), so posterior occlusion level was maintained effectively due to the use of the palatal bar.

The new retractor showed perfect rotational control due to its design (0.019 × 0.025-inch stainless steel wire tied with the canine bracket by a ligature wire). Curved Sliding Technique doesn't need much effort or time from the Orthodontist and activation distance is unlimited.

Studies have dealt with canine retraction with various techniques and appliances. Martins RP et al used beta-titanium alloy T-loop springs for canine retraction, the results were controlled tipping in the maxilla and uncontrolled tipping in the mandible, the rates of retraction were 1.6 mm/month in the maxillary and 1.9 mm/month in the mandible, these high rates may occurred due to the tipping.[14]

Herman RJ et al used sliding mechanics (0.017×0.025-inch stainless steel archwires in 0.022-inch slots and nickel-titanium springs) for canine retraction with direct micro implants anchorage. Results showed bodily movement in 57% of the cases, slightly tipping in 29%, and excessively tipping in 14%.[15]

Hayashi K et al compared canine retraction with sliding mechanics and Ricketts canine retraction spring using osseointegrated midpalatal implant. Results showed tipping of canines after retraction, 7.94˚ with sliding mechanics and 7.89 with Ricketts spring. Sliding Mechanics approach was superior to the retraction spring with regard to rotational control (rotational angle was 4.07˚ with sliding mechanics and 22.06˚ with Ricketts spring).[8]

In a randomized clinical trial by Dixon V et al, the rate of canine retraction with nickel titanium coil springs was 0.81 mm/month.[16]

In the clinical trial by Thiruvenkatachari B et al, the rates of canine retraction were 0.93 mm/month in the maxilla and 0.83 mm/month in the mandible with the use of direct miniscrew anchorage.[17]

In comparison with the previous studies, Curved Sliding Technique has excellent control of canine axis during retraction with intrusion which is considered a special result. Rotational control with Curved Sliding Technique is perfect which makes it superior to the previous techniques. Curved Sliding Technique also has a good rate of retraction (1.32 mm/month) due to reduction of friction when using Curved Sliding Technique because the second premolar bracket is not used in the retraction stage.

Conclusions

Canine retraction using Curved sliding Technique and direct miniscrew anchorage showed excellent control of canine axis with intrusion and perfect rotational control during retraction. It also showed a good rate of retraction due to the reduction of friction.

References

1. Ricketts RM. Bioprogressive therapy as an answer to orthodontic needs. Part I. Am J Orthod Sep 1976;70:241-68.
2. Ricketts RM. Bioprogressive therapy as an answer to orthodontic needs. Part II. Am J Orthod Oct 1976;70:359-97.
3. Siatkowski RE. Force system analysis of V-bend sliding mechanics. J Clin Orthod 1994;28:539-46.
4. Gjessing P. Biomechanical design and clinical evaluation of a new canine retraction spring.Am J Orthod 1985;87:353–362.
5. Darendeliler MA, Darendeliler H, Uner O. The Drum spring (DS) retractor: a constant and continuous force for canine retraction. Eur J Orthod 1997;19:115-130.
6. Ferreira MDA, Oliveira FTD, Ignácio SA et al. Experimental Force Definition System for a New Orthodontic Retraction Spring. Angle Orthod2005;75:368–377.
7. Bennett JC, McLaughlin RP. Orthodontic Treatment Mechanics and the Pre Adjusted Appliance. Barcelona ES: Mosby- Wolf Company, 1993;74.
8. Hayashi K, Uechi J, Murata M et al. Comparison of maxillary canine retraction with sliding mechanics and a retraction spring: a three dimensional analysis based on a mid-palatal orthodontic implant. Eur J Orthod 2004;26:585 -589.
9. McLaughlin RP, Bennett JC, Trevisi HJ. Systemized Orthodontic Treatment Mechanics. Barcelona ES: Mosby Company 2001; 139.
10. Kumar YM, Ravindran NS, Balasubramaniam MR. Holographic Analysis of the Initial Canine Displacement Produced by Four Different Retraction Springs. Angle Orthod 2008;79:368–372.
11. Roberts WE. Bone physiology and metabolism and biomechanics in orthodontics In: Graber TM, Vanarsdall RL, Vig KWL, eds. Orthodontics: Current Principles and Techniques. 4th edn. St. Louis: Mosby-Elsevier Inc 2005;263–275.
12. Thilander B, Rygh P, Reitan K. Tissue reactions in orthodontics In: Graber TM, Vanarsdall RL, Vig KWL, eds. Orthodontics: Current Principles and Techniques. 4thedn. St. Louis: Mosby-Elsevier Inc 2005;174–178.
13. Ziegler P, Ingervall B. A clinical study of maxillary canine retraction with a retraction spring and with sliding mechanics. Am J Orthod Dentofacial Orthop 1989;95:99–106.
14. Martins RP, Buschang PH, Gandini LG et al. Changes over time in canine retraction: An implant study. Am J Orthod Dentofacial Orthop 2009;136:87-93.
15. Herman RJ, Currier F, Miyake A. Mini-implant anchorage for maxillary canine retraction: A pilot study. Am J Orthod Dentofacial Orthop 2006;130:228-35.
16. Dixon V, Read MFJ, O'Brien KD et al. A randomized clinical trial to compare three methods of orthodontic space closure. J Orthod 2002;29:31-6.
17. Thiruvenkatachari B, Ammayappan P, Kandaswamy R. Comparison of rate of canine retraction with conventional molar anchorage and titanium implant anchorage. Am J Orthod Dentofacial Orthop 2008;134:30-5.