Future Dental Journal

Volume 8 | Issue 1 Article 3

2022

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Recommended Citation

El-Beialy AR, El Sharaby FA, ElSayed HS. Canine retraction rate and angulation with 0.017”X0.025” versus 0.016”X0.022” stainless steel arch wire with a power arm. *Future Dental Journal*. 2022; 8(1):17-20. doi: https://doi.org/10.54623/fdj.8013.

Future Dental Journal. Volume 8, Issue 1 (June 2022) 17—20

Contents lists available at Arab Journals Platform

Future Dental Journal

Journal homepage: https://digitalcommons.aaru.edu.jo/fdj/

Canine Retraction Rate and Angulation with 0.017"X0.025" Versus 0.016"X0.022" Stainless Steel Arch Wire with A Power Arm

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ARTICLE INFO

Discipline:
Orthodontics

Keywords:
Canine retraction, power arm, canine angulation, sliding mechanics

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ABSTRACT

Background: The dimensions of the arch wire affect its stiffness and the play between the wire and bracket. Canine retraction over stiffer arch wires limits the degree of canine tipping. However, the greater the wire dimensions, the greater the resistance to sliding. Frictional resistance is known to delay tooth movement. ***Aim:*** The aim of this controlled clinical trial was to compare canine retraction rate and angulation with 0.017"X0.025" versus 0.016"X0.022" stainless steel arch wire with a power arm. ***Materials and Methods:*** Twenty-four Class II malocclusion patients (age 13.8± 2.6 years) participated in this study. The teeth were leveled and aligned. Bilateral maxillary first premolars were extracted. In group A, the canines were retracted over 0.017"X0.025" wires. In group B, they were retracted using 0.016"X0.022" wires with a vertical power arm. The retraction force was 150g generated by elastomeric chains. The canine retraction rate and angulation were measured at the end of six months. The rates in the two groups were compared with the t-test and the angulation with the Mann Whitney test. ***Results:*** canine retraction rate was 4.64±1.5 in group A and 5.24±1.45 in group B. The canine angulation was 6.41±5.14 and 6.73±6.0 for group A and B, respectively. ***Conclusion:*** No difference was observed in the canine retraction rate or angulation with 0.017"X0.025" versus 0.016"X0.022" stainless steel arch wire with a power arm.

1. INTRODUCTION

Sliding mechanics is generally the more commonly used method of canine retraction.(1) Most clinicians prefer to retract the canines using stiff arch wires to better control distal tipping.(2) However, this is at the expense of generating more friction as the canine is retracted along the orthodontic arch wire to close the extraction space.(3)

The orthodontic force for canine retraction is applied at the bracket. Being away from the center of resistance a moment is created causing distal tipping of the canine.

AlKebsi et al(4) that the use of a power arm to approximate the point of force application to the center of resistance and reduce the rotational moment was effective.

The aim of this study was to compare the canine retraction rate and angulation using 0.017"X0.025" versus 0.016"X0.022" stainless steel arch wire with a power arm during canine retraction.

2. METHODOLOGY

This trial was conducted at the outpatient department of the FUE, between 2017 and 2018. The ethical committee approved the study protocol.

Twenty-four patients with an average age of 13.8± 2.6 were recruited. The patients were 17 females and 7 males. The patient inclusion criteria were class II malocclusion requiring the extraction of bilateral maxillary first premolars. The patients were excluded if they had received previous orthodontic treatment, were suffering from active periodontal disease or systemic disorders affecting bone metabolism.

The patients were treated with Roth prescription brackets with a 0.022" slot. Leveling and alignment were completed with a 0.016 X 0.022" stainless steel arch wire.

The patients were divided into two equal groups. In group A, the canines were retracted over 0.017"X0.025" stainless steel wires and the elastomeric chain was extended between the canine bracket hook and the first molar band hook. In group B, the canines were retracted using 0.016"X0.022" and a vertical power arm. Vertical power arms, 8 mm. in length, were fabricated from 0.017"X0.025" stainless steel straight wires. It was placed in the vertical slot of the canine bracket and extended cervically to 1/3 of the root length. The power chain extended between the power arm and the molar band hook. The retraction force was 150g generated in both groups.

Three dimensional images of the CBCTs were constructed by importing their digital imaging and communications in medicine (DICOM) images into the Invivo Dental 5 software (version 5.3.1, Company, Santa Clara, Calif.). The software tools were used to construct the planes and measure the distance moved by the canines and its angulation.

The canine retraction rate and angulation were measured on the pretreatment and post treatment CBCTs and the difference was calculated. The post treatment CBCT was taken six months after the start of retraction. The frontal plane was used for reference. This plane was constructed perpendicular to the transverse and sagittal planes passing through the incisive foramen. The rate of tooth movement was measured as the total movement in six month. (Fig. 1) The change in canine angulation was measured between the tooth axis and the frontal plane. (Fig. 1)

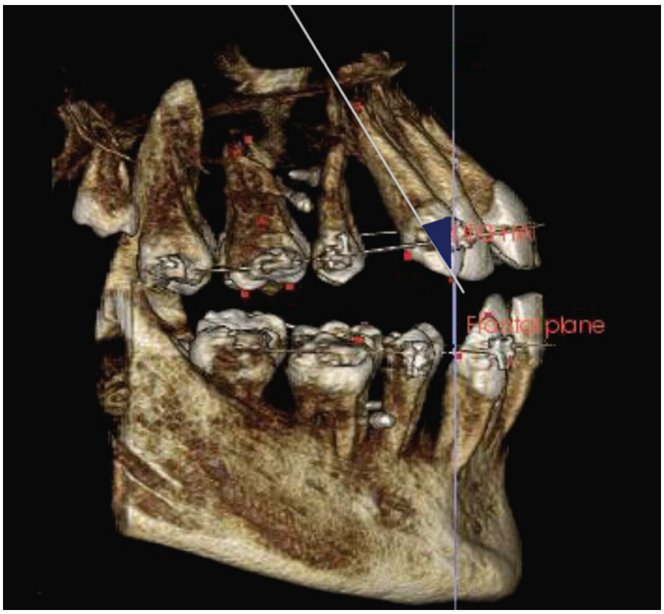

Figure (1) — Canine retraction and angulation measured to the Frontal Plane: passing through the incisive foramen, perpendicular to the transverse and sagittal planes

Statistical analysis

Canine retraction rate and angulation were tested for normality with the Shapiro-Wilk test. The baseline values were compared for the patient age and canine angulation. The canine retraction rate was compared in the two groups using the independent t-test. The mean difference in canine angulation was compared between the two groups with the Mann Whitney U test. All tests were two tailed and the confidence level was 95%. The SPSS (version 17) was used for the analyses.

3. RESULTS

Twenty-four quadrants in twelve patients were analyzed in each group. Only the mean difference of the canine angulation was non-parametrically distributed for both groups.

Groups A and B showed no statistical difference for patient age or canine angulation at the start of treatment. (Table 1)

There was no statistical difference between the two groups for canine retraction rate or change in angulation. (Table 2)

Table 1.

Baseline descriptive statistics of patients’ age and canine angulation for 0.017”X0.025” versus 0.016”X0.022” stainless steel arch wire with a power arm groups

	Canine retraction with 0.017”X0.025” stst. a/w n=24	Canine retraction with 0.016”X0.022” stst. a/w with power arm n=24		
	Mean ±SD	Mean ±SD	t	p-value
Patient age (yrs)	14.08±2.95	13.63±2.2	0.425	0.675
Angulation (º)	21.64±6.79	19.41±5.95	1.209	0.233

yrs: years, stst. : stainless steel, a/w: arch wire, SD: standard deviation, mm: millimeter, mo: month

Table 2.

Descriptive statistics and comparison of change in canine retraction rate and angulation for 0.017”X0.025” versus 0.016”X0.022” stainless steel arch wire with a power arm groups

	Canine retraction with 0.017”X0.025” stst. a/w n=24	Canine retraction with 0.016”X0.022” stst. a/w with power arm n=24		
	Mean difference ±SD	Mean difference ±SD	t	p-value
Retraction rate (mm/6mo)	4.64±1.5	5.24±1.45	-1.422	0.162
Angulation (º)	6.41±5.14	6.73±6.0	-0.351	0.726

yrs: years, stst. : stainless steel, a/w: arch wire, SD: standard deviation, mm: millimeter, mo: month

4. DISCUSSION

Space closure with friction mechanics provides controlled tooth movement.(5) and needs less frequent follow-up appointments.(6) Compared to friction less mechanics, the use of elastomeric chains is easier and less time consuming. However, sliding mechanics involves frictional resistance that is considered to hinder tooth movement and creates rotational moments around the tooth center of resistance producing distal canine tipping.(7)

The force magnitude applied to move the teeth must be sufficient to overcome the frictional force.(8) Several factors control the amount of resistance between the wire and bracket slot. These include bracket width,(9) the bracket-wire angle,(9) wire bending,(9) the number of ligatures,(10) ligature force, surface roughness as well as wire dimensions,(11) material and cross section. Also lubricants,(11) the wire wear and corrosion can affect friction.(12)

DOI: https://doi.org/10.54623/fdj.8013

Studies continue to show that different combinations of shape and slot size of the bracket, as well as the material of the bracket and arch wire produce different friction resistance.(13, 14)

Other studies report how the wire to bracket angle and the number of contacts between the wire and bracket wings can increase the friction resistance.(15)

It's generally believed that the reduction of friction and binding between the wire and the bracket slot will produce faster tooth movement. There is some evidence that bodily canine retraction compared to tipping, required less time.(16)

However this has not been reported in studies.(17) Makhlouf et al(18) show that coil springs produce more canine retraction than T-loops. A recent experimental study shows that self-ligating brackets do not accelerate tooth movement.(17)

The results of our study similarly show that using smaller wire size did not accelerate the canine retraction. This may have been due to the flexibility of the smaller wires, which increased their deflection and binding of the wires and brackets.

To overcome friction, the use of arch wires of smaller dimensions has been recommended.(19) This allows more freedom between the bracket and wire allowing the uncontrolled tipping. If the wire is stiff, the corners of the slots will bind with the wires restricting tooth movement. This increases the moment to force ratio till roots are uprighted. This process is repeated through out the canine sliding.(20)

The more flexible wires will deflect allowing more distal tipping compared to stiff wires. Several factors affect the wire flexibility, including arch wire size, material, and cross section. Barlow and Kula,(2) show that arch wires of larger dimension and higher stiffness provided better tipping control.

In our study, the tipping observed in six months, was similar to that reported by Akın and Camcı.(21) In their randomized clinical trial, a power arm was extended cervically to 1/3 of the root. The results showed no clinical difference during three months of canine retraction between the control group (3.62º±2.91) and the power arm group (4.82º±3.08). Similarly they show that the use of a bonded power arm provides tipping control even with 0.016" X 0.022" stainless steel arch wires.(21) The power arm provided excellent control in a case report of 2 patients.(22) The tipping, for both methods, in our study was less than that reported by Hayashi et al(23) in 2 months (7.94°).

Limitations of our study include a risk of selection bias since the patients were not randomized. Further studies can highlight how the use of a power arm with different combinations of bracket and arch wire can affect friction, rate of tooth movement and tipping during canine retraction. A larger sample size may provide more robust conclusions.

5. CONCLUSION

In light of the results of this study, canine retraction over 0.016"X0.022" stainless steel arch wire with a power arm did not increase the rate of canine retraction. However, it provided tipping control similar to that achieved with 0.017"X0.025" stainless steel.

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