A Study of the Movement of Maxillary Canine after Retraction with Light Force in Initial Leveling Phase

Surajit Somngam

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ชื่อวิทยานิพนธ์	การศึกษาการเคลื่อนฟันเขี้ยวในขากรรไกรบนด้วยแรงขนาดเบาในระยะปรับระดับฟัน
ผู้เขียน	นายสุรจิต สมงาม
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ปีการศึกษา	2554

บทคัดย่อ

ในการรักษาผู้ป่วยฟันซ้อนเกและฟันยื่น ที่จำเป็นต้องถอนฟันกรามน้อยซี่ที่หนึ่ง ต้องใช้เวลา 4-6 เดือนในระยะการปรับระดับฟันก่อนที่จะเริ่มเคลื่อนฟันเขี้ยว ในระหว่างนี้บริเวณกระดูกที่ถอนฟันจะเกิดการฝ่อลีบ ซึ่งเป็นลักษณะที่จะขัดขวางการเคลื่อนของฟันเขี้ยวหรือก่อให้เกิดอันตรายต่อเนื้อเยื่อปริทันต์ต่างๆ เช่น รากละลาย หรือไม่มีกระดูกหุ้มรากฟันได้ ดังนั้นการเคลื่อนฟันเขี้ยว ภายหลังการถอนฟันในระยะปรับระดับฟันจะช่วยแก้ปัญหาการฝ่อลีบ ซึ่งลวดที่ใช้จะมีขนาดเล็กและความแข็งต่ำ อาจทำให้เกิดการล้มและหมุนของฟันเขี้ยวได้ แต่อาจป้องกันได้หากใช้แรงขนาดต่ำ ดังนั้นการศึกษานี้จะทำการเคลื่อนฟันเขี้ยวในระยะปรับระดับฟันโดยใช้แรงขนาดเบา วัตถุประสงค์ เพื่อศึกษาการเปลี่ยนแปลงของฟันเขี้ยวในขากรรไกรบนด้วยแรงดึงขนาดเบาในระยะปรับระดับฟัน วิธีการวิจัย ผู้เข้าร่วมการศึกษาจำนวน 13 คน อายุ 19.77 ± 1.74 ปี มีแผนการรักษาทางทันตกรรมจัดฟันที่ต้องถอนฟันกรามน้อยซี่ที่หนึ่งและดึงฟันเขี้ยวในขากรรไกรบน โดยได้รับการติดเครื่องมือทางทันตกรรมจัดฟันชนิดติดแน่น และปรับระดับฟันโดยใช้ลวดนิเกิลไททาเนียมขนาด 0.012 นิ้ว ดึงฟันเขี้ยวด้านทดลองหลังจากถอนฟันภาย ใน 7 วัน ด้วยยางดึงฟันที่หาระยะการดึงให้ได้แรงขนาด 18 กรัมในห้องปฏิบัติการ ทำการเปลี่ยนยางดึงฟันทุกเดือนจำนวน 3 ครั้ง รวมระยะเวลาทั้งหมด 4 เดือน เก็บข้อมูลระยะการเคลื่อนที่ การหมุน ของฟันเขี้ยวและระยะการเคลื่อนที่ ฟันกรามจากแบบศึกษา ซึ่งได้จากรอยพิมพ์ฟันทุกเดือนจนสิ้นสุดการศึกษาและวัดปริมาณ การล้มของฟันเขี้ยว จากภาพรังสีกระโหลกศีรษะด้านข้างก่อนและหลังการศึกษา ผลการศึกษา ฟันเขี้ยวด้านทดลอง มีอัตราการเคลื่อนที่ 0.84 ± 0.34 มิลลิเมตรต่อเดือน มีการล้มไปด้านไกลกลางเฉลี่ย 9.15 ± 5.52 องศา มีการหมุนแบบด้านไกลกลางเข้าด้านเพดานเฉลี่ย 9.25 ± 8.16 องศา ฟันเขี้ยวด้านควบคุมมีอัตราการเคลื่อนที่ 0.28 ± 0.15 มิลลิเมตรต่อเดือน มีการล้มไปด้านไกลกลางเฉลี่ย 3.31 ± 3.76 องศา มีการหมุนแบบด้านไกลกลางเข้าด้านเพดาน เฉลี่ย 0.69 ± 9.53 องศา ฟันกรามด้านทดลอง มีอัตราการเคลื่อนที่ 0.22 ± 0.13 มิลลิเมตรต่อเดือน 2 ฟันกรามด้านควบคุม มีอัตราการเคลื่อนที่ 0.15 ± 0.13 มิลลิเมตรต่อเดือน โดยอัตราการเคลื่อนที่ การล้ม และการหมุนของ

ฟันเขี้ยวด้านทดลองมีค่ามากกว่าด้านควบคุม (*p-value* < .05) และอัตราการเคลื่อนที่ของฟันกรามทั้งด้านทดลอง และด้านควบคุมไม่แตกต่างกัน (*p-value* >.05) สรุปผลการศึกษา วิธีรักษาโดยใช้แรงขนาดเบาเคลื่อนฟันเขี้ยวได้ตั้งแต่ระยะแรกของการปรับระดับฟัน สามารถทำได้ โดยทำให้ฟันเขี้ยวมีอัตราการเคลื่อนที่ 0.84 มิลลิเมตรต่อเดือน มีการล้ม การหมุนของฟันเขี้ยวยังอยู่ในค่าปกติของ แอนดรูว์ และมีการสูญเสียหลักยึดเพียงเล็กน้อย

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ABSTRACT

The orthodontic treatment plan of moderate crowding and protrusion requires the first premolars extraction and takes 4-6 months to level and align before canine retraction. In this period, the extracted alveolar bone will be collapse. The alveolar bone collapse may effect on orthodontic tooth movement such as increase risks of bone dehiscence, fenestration, and root resorption. Moreover, these will delay tooth movement and increase overall treatment time. Therefore, canine should be retracted as soon as possible after the first premolar extraction in leveling phase, but the small round wire used in initial leveling phase usually causes canine tipping and rotation. Nevertheless, the light force may reduce the undesirable movement such as tipping and rotation. **Objective:** To compare the dental changes of the maxillary canine be retracted with the light force and the leveling effects. **Research methodology:** Thirteen subjects (2 males and 11 females, mean age 19 years 9 months) which required the maxillary first premolars extraction and canine retraction were participated. The canines were separated in to control and experimental side. The experimental canine side was retracted with the prestretched elastomeric chains (18 g) on 0.012” NiTi wire. The experimental canine was reactived with the new prestretched elastomeric chains every month for 3 months; overall time for the study is 4 months. The distance of canine and molar movement, canine and molar rotation was measured form the series of models at initial and 4 months after canine retraction from each subject (T0 to T4). The canine and molar tipping was measured form lateral cephalometric radiographs with reference jigs. **Results:** The rate of experimental canine retraction was 0.84 ± 0.34 mm/month. The experimental canines were distal tipping 9.15 ± 5.52 degree and disto-palatal rotation 9.25 ± 8.16 degree. The rate of control canine movement was 0.28 ± 0.15 mm/month. The control canines were distal tipping 3.31 ± 3.76 degree and disto-palatal rotation 0.69 ± 9.53 degree. The experimental canine had the rate of canine movement, tipping and rotation significantly more than the control (*p-value* < .05). The rate of experimental molar movement was 0.22 ± 0.13 mm/month. The rate of control molar movement was 0.15 ± 0.13 mm/month. The rate of molar movement was not significantly difference (*p-value* > .05). **Conclusion:** The maxillary canine retraction with light force in initial leveling phase can be introduced in straight wire technique. The rate of CRLL was 0.84 mm/month, the range of tipping and rotation is within the limit of Andrews' six keys to normal occlusion and the anchorage loss was minimal.

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Surajit Somngam

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LISTS OF ABBREVIATIONS AND SYMBOLS

CRLL	=	canine retraction with light force in initial leveling phase
NSAIDs	=	non steroid anti-inflammatory drugs
mm	=	millimeter
et al.	=	and others
g	=	gram
NiTi	=	nickel titanium
Fig.	=	figure
ANS	=	anterior nasal spine
PNS	=	posterior nasal spine
PP	=	palatal plane
T0	=	time at the start of incisor retraction
T4	=	time after canine retraction for 4 months
%	=	percent
”	=	inch (es)
/	=	per

CHAPTER 1

INTRODUCTION

Background and Rationale

Moderate crowding requiring first premolars extraction for the canines aligned in the ridge use needs 4-6 months for leveling and aligning before the canine retraction. In this period, the extracted alveolar bone may collapse.

Alveolar bone resorption after extraction is greatest during the first year and occurs at a particularly fast rate during the first 3 months[1]. The reduction in width of the alveolar ridges was 3.87 mm and the mean clinical mid-buccal height loss was 1.67 mm[2]. The alveolar bone collapse may have an effect on orthodontic tooth movement such as increased risks of bone dehiscence, fenestration, and root resorption. Moreover, post extraction site will increase the gingival band thickness over time[3]; these will delay tooth movement and increase overall treatment time.

To decrease the chance of bone collapse and gingival band, the canines should be retracted immediately after first premolars extraction, which is in the initial of leveling phase. The wires used in initial leveling phase usually are small round wires. The cautions of canine retraction with small wire are tipping and rotation. However, the amount of force is a factor involved in the moment of center of resistance, tipping or rotation[4]. Therefore, the light force may reduce the undesirable movement such as tipping and rotation.

As 18 g force is the lowest canine retraction force that has been reported by Iwasaki[5]. The study showed that 18 g force can retract the canine with the rate of tooth movement approximate 0.9 mm per month, tipping 3 degree, and rotation 0.3 degree. Therefore, it is interesting to study the canine retraction in initial leveling phase, after extraction and in small arch wire, with light force to decrease tipping and rotation. In this study, **"C**anine **R**etraction with **L**ight force in **L**eveling phase" will be named "CRLL".

Review of literature

Leveling phase

The major stages of orthodontic treatment are: (1) aligning and leveling, (2) correction of molar relationship and space closure, and (3) finishing. The goals of the first phase of treatment are to bring the teeth into alignment of dental arch and correct vertical discrepancies[6]. When all teeth in dental arch are engaged into a straight wire, it is important to recognize whether the teeth are aligned in the shapes of arch wire and along the occlusal plane. The dental changes are occurring in three dimensions[7].

First, the change in the sagittal plane is the tendency for anterior teeth to incline forward. These results from the tip built into the brackets and it is more pronounced in the upper teeth. Second, vertical plane, tends to produce a transitional deepening of the anterior teeth overbite, due to the tip in the canine brackets. If the canines are tipped distally, the mesial aspect of the canine bracket slot is directed occlusally. The wire engaged in the incisor brackets, causes extrusion. Lastly, lateral plane is tending to tipping or extrusion of posterior teeth during expansion.

Additionally, Burstone and Koenig[8, 9] analyzed the force systems between 2 brackets, step, asymmetric V, and symmetric V geometry. Step geometry involves the two same directions of moments and the two opposite vertical forces. For example, if the central incisors have labio-lingual discrepancy, it will create step geometry. Asymmetric V geometry involves the two opposite directions of vertical force but a single moment concentrated on one tooth such as a palatally positioned lateral incisor rotated distally inward. Finally, the central incisors are mesial rotation, which is created by a symmetric V geometry, the two equal and opposite moments. The fundamental principles of biomechanics explained are useful for analyzing the force system resulting from the placement of straight wire in to adjacent teeth.

Nickel-titanium arch wire

Nickel-titanium orthodontic alloys are based on the intermetallic compound NiTi, which has weight percentage 55% nickel and 45% titanium[10]. There are two features of considerable importance for clinical orthodontics: (1) low elastic modulus and (2) wide elastic working range. These properties are suitable for using in initial aligning and leveling phase, and the remarkably flat load curve for superelastic NiTi makes it the preferred material[6].

Orthodontic force

Optimal orthodontic treatment requires a mechanical input that leads to a maximum rate of tooth movement with minimal irreversible damage to the root and periodontium[11]. Many studies were conducted to seek the optimum force for tooth movement.

Differential force concept

Storey and Smith[12] found that there is the optimum range of force that should be used to produce a maximum rate of movement of canine, 150-200 g force. This force did not produce any movement of molar anchorage unit. By increasing the force above the range, the rate of canine movement decreases and finally approaches zero. The maximum rate of mesial movement of the molar anchorage unit occurred in the high range of force, 300-500 g force, with little or no movement of the canine. Referring to this experiment, Begg[13] put forth a clinical concept call "differential forces in orthodontic treatment". This concept has been repeatedly applied as a clinical entity when used the Begg technique. However, subsequent research[14, 15] found that heavy force produced about the same canine retraction as did light and the rate of canine retraction was highly variable between individual patients. This indicates that the optimal force will be different for each patient. Furthermore, the magnitude of forces is just one of the many variables affecting the rate of tooth movement.

Optimum force

The classic definition of optimal force by Schwarz in 1932[16] was "the force leading to a change in tissue pressure that approximated the capillary vessels' blood pressure (20-25 g/cm^2 of root surface), thus preventing their occlusion in the compressed periodontal ligament". Storey and Smit[12] studied distal movement of canines in orthodontic patients and suggested that there is an optimum range of pressure (150-200 g force) on the tooth-bone interface that produces a maximum rate of tooth movement. And then Quinn and Yoshigawa[17] suggested that 100-200 g force is optimal for canine retraction.

A recent systematic review[18] of tooth movement in humans suggests that no evidence is about the optimal force level in orthodontics.

Light force in orthodontics

Oppenheim[19] advocated the use of the lightest force that is capable to bring tooth movement. Reitan[20] observed that during the initial stage of tipping movement, cell free zone or hyalinized area was frequently created with continuous force of 30 g force. The undermining resorption was removed varied form 2-4 weeks. However he also advocates the use of very light force.

Due to intra- and inter-individual variations in the anatomy of the alveolar support structures, orthodontic forces with the same magnitude will generate widely different stress and strain distributions in these tissues in different individuals. Both the nonlinear mechanical properties of the tissues as well as the varied mechanical support of the teeth in different individuals, the load transfer through the alveolar tissues is complex and for these reasons only very small orthodontic forces should be applied to the teeth to avoid ischemia and local necrosis of the tissues.

Objectives and specific aims

Research questions

1. Can the maxillary canine be retracted with the light force during initial leveling phase?
2. How does the tooth move with CRLL?
   - Canines: amount and rate of tooth movement, tipping and rotation
   - Molars: amount and rate of tooth movement

Research objectives

1. To compare the tooth movement between the light force canine retraction together with leveling phase and leveling phase alone.

- Canines: amount and rate of tooth movement, tipping and rotation
- Molars: amount and rate of tooth movement

2. To evaluate the side effects with CRLL: canine tipping, canine rotation and anchorage loss.

Hypothesis

1. The maxillary canine can be moved with light force during leveling phase more than leveling phase.

2. CRLL does not initiate undesirable tooth movement such as canine tipping, canine rotation and anchorage loss.

Significance of research

If the study found that the maxillary canine can be moved with light force during leveling phase without undesirable tooth movement, it could be new the new technique for maxillary canine retraction in initial leveling phase.

CHAPTER 2

RESEARCH METHODOLOGY

Population and sample

The population for this study was defined as adult patients who intended to receive orthodontic treatment at Dental Hospital, Faculty of Dentistry, Prince of Songkla University during the sampling time frame. Thirteen accidental cases were selected from the population by consecutive sampling.

Inclusion Criteria

- Male or female patients age between 18-30 years
- Anterior teeth protrusion or moderate crowding cases (Anterior teeth crowding 4-6 mm)
- Patients required extraction maxillary first premolars and canine retraction
- Symmetric canine on both sides
- Maximum or moderate anchorage
- No significant medical history
- No periodontal diseases: pocket depth < 4 mm, no bone loss

Exclusion Criteria

- No ectopic or rotation of the canines of both sides
- Failure of bonding on the maxillary canines, first molars
- NSAIDs usage during study
- Loss of anchorage

The patients were instructed to avoid NSAIDs in the month before appliance placement and during the study. In case of toothache, the patients were instructed to take acetaminophen. Each patient was informed on the objectives of the study, the experimental procedure and the consent form would be signed for participating in this study.

Laboratory measurement of pre-stretched C-chain

The 18 g force of prestretched elastomeric chain (Alastik, Unitec/3M) was measured by Universal testing machine. First, the length of elastomeric chains 3, 4, 5 and 6 units were measured. Then, the elastomeric chains were pre-stretched in air to 100% for 10 second and their length was measured. The pre-stretched elastomeric chains were measured the length that generated the 18 g force. The average length of pre-stretched elastomeric chains that generated 18 g force was about 0.5 millimeters. Therefore, the midpoint of distal wing of the canine bracket in the clinical study was used as at reference to retract the canine with the 18 g force (Fig. 1).

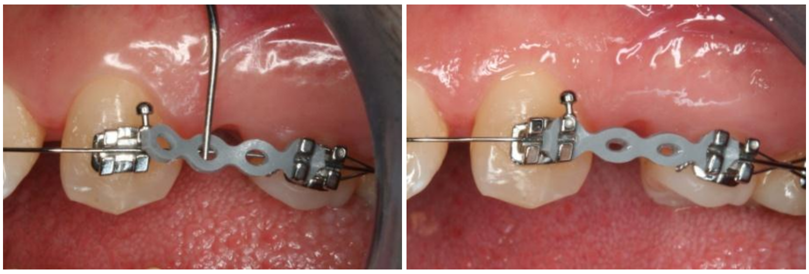


Fig. 1 The method to activate the pre-stretched elastomeric chains that generated the 18 g force in the clinic

Clinical management

1. The teeth were bonded with Roth's prescription pre-adjusted edgewise appliances (Ormco®) 0.018'' slot for the incisors and 0.022" slot with vertical slot for the canines and posterior teeth.

2. The impressions and the lateral cephalometric radiographs were taken for initial record. And then, the maxillary first premolars were extracted before CRLL within 1 week.

3. The posterior teeth were coligated as a unit with ligature wire. The 0.012" NiTi arch wire (Highland metal®) with cinch back was inserted in the slot of brackets. During the experimental period, same arch wire was used, no changed, because of decease leveling affected on canines.

4. The canines were separated in to control and experimental side by simple random sampling. The experimental canine side was retracted with the pre-stretched elastomeric chains (18 g force) (Fig.1).

5. The 4-6 units pre-stretched elastomeric chains were selected to retracted the canine according to the distance between the ends of pre-stretched elastomeric chain to the midpoint of distal wing of canine bracket. The one end of the pre-stretched elastomeric chain were engaged to bracket mesial or distal wing of second premolar or molar, the other side was far from the midpoint of distal wing of canine bracket that was approximated 0.5 mm**.** When the appropriate pre-stretched elastomeric chain was chosen, it was engaged to distal wing of canine‘s bracket.

6. The experimental canine was reactivated with the new pre-stretched elastomeric chains every month for 3 months; overall time for the study is 4 months. Before reactivation, the impressions were taken for data record. The control canine was leveled with leveling arch wire without any retraction force or coligate to other teeth during the study period. For the post-experimental data, the impressions and the lateral cephalometric radiographs were taken after 4 months.

Fig. 2 The experimental canine was retracted in the clinical study

The measurement of the changes of canines and molars

The series of models after the bracket placement and 4 months after canine retraction from each subject were used to measure changes in the position of canines and molars relative to the stable landmarks throughout the observation period.

Model analysis

The impressions were taken before bracket placement (T0) and every month for 4 months for the reference models. The reference points were marked on dental cast using a 0.5 mm graphite pencil.

The distance of molars and canines movement

The distances of canine retraction and mesial movement first molars were measured directly on working casts with metal-tipped digital calipers that used palatal plug as a reference for the measurement[21, 22] (Fig. 3). The palatal plug was fabricated from acrylic with reference wires (0.018- inch stainless steel) embedded in the acrylic that extended to the cusp tips of the canines and to the central fossa of the first molars. The palatal plugs were done by using the initial model (T0) as a reference and the same palatal plugs were transferred to each model of the same subject from T1 to T4. This superimposition allowed for the direct observation of the amount of canine retraction and mesial movement of molars (anchorage loss).

The canine distal movement was measured from the point of cusp tip to reference point on the wire. And molar mesial movements were measured from central pit to tip of reference wire. If there were movement of canines and molars, it will be seen the reference point on canine cusp tip and central fossa of molar separated away from reference points on wires. The distances were measure with digital venire caliper (to the nearest 0.01 mm) along the mid palatal raphae.

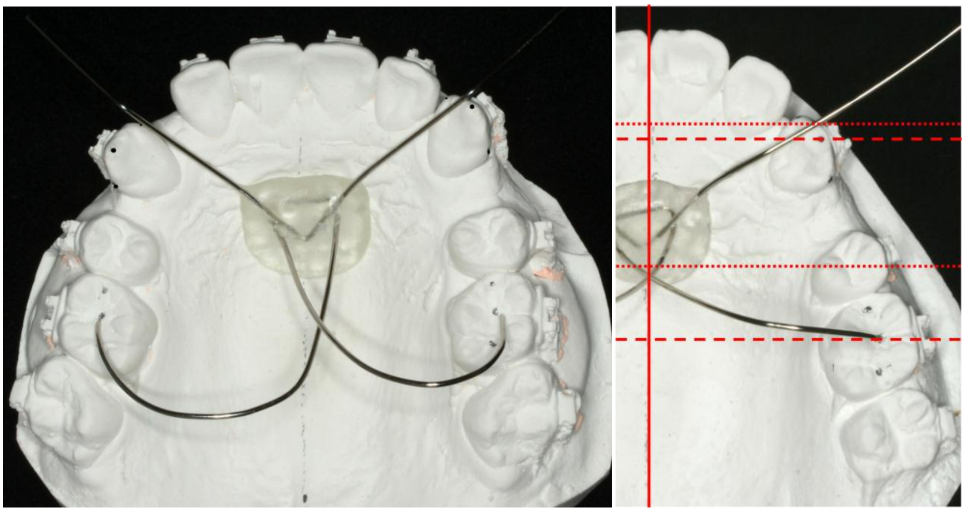


Fig. 3 The measurement of the distances of canines and molars movement with the palatal plug[22]

Canine rotation

The models were scanned into a computer. The images were transferred to Microsoft PowerPoint and printed with laser printer.

Rotation of canines was measured using the angle between midline of the palate and line from mesial to distal contacts point of canines (Fig. 4).

The rotation of canines was the difference between the angular parameters measured on the final and initial models (T4- T0). The Negative signs of the difference of the canine rotation mean that the canines are disto-palatal rotation.

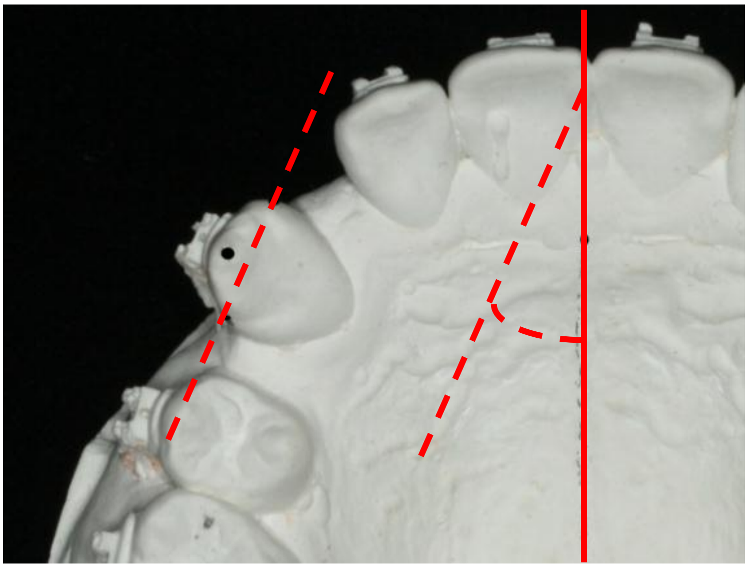


Fig. 4 The measurement of canine rotation to the median palatine raphae[23]

Lateral cephalometric analysis

Lateral cephalometric radiographs were obtained immediately after bracket placement. All radiographs were taken with the same cephalostat (Orthophos® CD, Siemens, Germany). A tooth positional locating device was fabricated from sections of 0.022” x 0.025” stainless steel wire that were attached to the canines before film exposure. These devices aid in precisely locate the before and after canine retraction (Fig. 5).

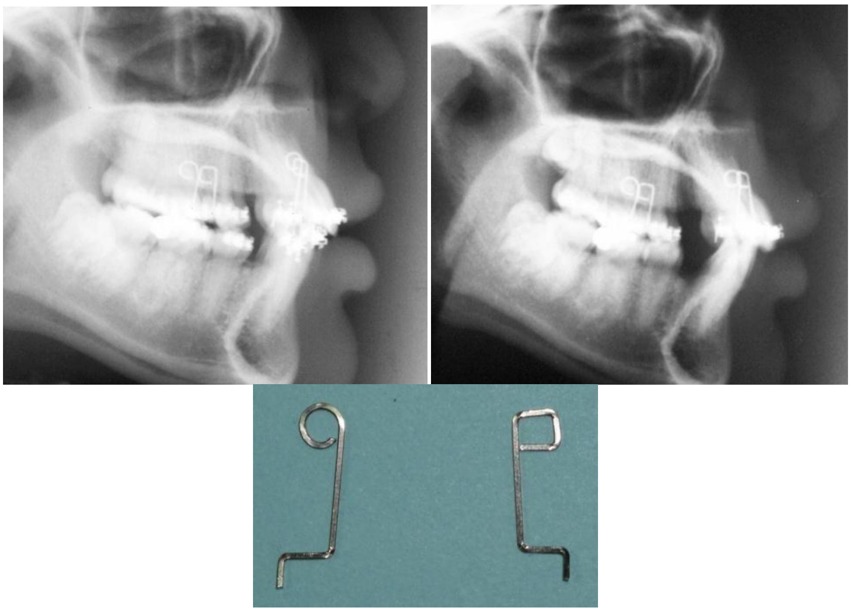


Fig. 5 The reference jigs of canines (lower) and the lateral cephalometric radiographs with the reference jigs at T0 (left upper) and T4 (right upper)

Canine tipping

The amount of tipping was carried out with reference to the palatal plane of the maxilla (ANS-PNS). A coordinate system will be set up on the pre-retraction lateral cephalometric films. The angular parameters were measured on the pre-retraction and post-retraction lateral cephalometric films[24] (Fig. 6). The canine angulation is the angle between the long axis of the upper canine reference jig and the palatal plane. The tipping of canines was the difference between the angular parameters measured on the final and initial lateral cephalometric radiographs (T4- T0). Negative signs of the difference of the canine rotation mean that the canines were distal tipping.

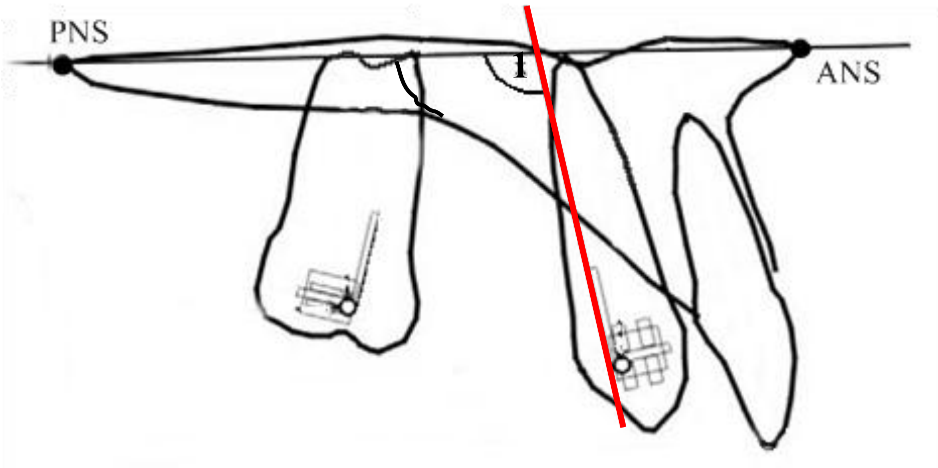


Fig. 6 Cephalometric analysis of angular measurements; Canine angulation: Angle between the long axis of the upper canine reference jig and the palatal plane (degree)

Measurement errors

The same investigator made the measurement of the dental models and the radiographies. The study models were randomly measured. And the dental models and the lateral cephalometric radiographs were measured twice 2 weeks apart. In accordance with Dahlberg, the accidental errors in duplicate measurements were calculated from the equation;

$$S_x = \sqrt{\frac{\sum D^2}{2N}}$$

Where S_x is the error of the measurement, D is the difference between duplicated measurements and N is the number of double measurements. The error in this study was found to be lower or equal 0.5 millimeters and degree[25].

For intra-observation reliability, the re-measurements were compared to the initial measurements using a paired t-test. There was no statistically significant difference between these two results with *P value* > 0.05.

The reliability evaluated by calculating the intraclass correlation coefficient (ICC) was more than 0.9. Based on the clinical importance of measurement errors, this reliability of this study was an acceptable level (0.80 >ICC <0.95)[26].

Table 1 The measurement errors of the study calculated with Dahlberg formula

	Canines			**Molars**
	Movement (mm)	**Tipping (degree)**	**Rotation (degree)**	**Movement (mm)**
Experiment	0.12	0.39	0.39	0.05
Control	0.26	0.22	0.50	0.12

Statistical analysis

The models and lateral cephalometric radiographs were measured and compared between the initial and final data of each side and each patient. The data were tested for it normality with the Shapiro-Wilk test found that all available were normally distributed (*p-value* > 0.05). The dental changes of control and experimental side were compared with Paired *t*-test with significant level at 0.05.

CHAPTER 3

RESULTS

This study was designed to develop the new protocol to retract the canine in the initial of the treatment phase. Therefore, the comparison of the control side had to distinguish the effect in the leveling phase.

The thirteen healthy young adults (2 men and 11 women) with 19.77 ± 1.74 years of average age needed to have orthodontic treatment with maxillary first premolar extraction. All of 13 participants had good oral hygiene throughout the study. Table 2 shows the distribution of the samples in gender and age in years. Ten of 13 cases were acceptable in posterior occlusion (class I molar relationship or slightly class II molar relationship with good intercuspation). Two of 13 cases were posterior cross bite of maxillary second premolar. And 1 case presented posterior open bite.

Table 2 Patient demographic data

Gender	Number	Range of age (years)	Age (years) Mean ± SD
Male	2	18	18.00 ± 0.00
Female	11	18 - 23	20.09 ± 1.70
Total	13	18 - 23	19.77 ± 1.74

Clinical observations

After the maxillary canines were retracted along the 0.012” nickel titanium continuous arch wire with the use of pre-stretched elastomeric chain, none of subjects were complaint about pain from the retraction force. In some cases the subjects complained about pain in a few days from the extraction first premolars, which pain management was only acetaminophen taken; no use of NSAIDs. During the study, 0.012” nickel titanium wires were deformed at incisor area especially in crowding cases. In this situation, the same arch wire was continue used because to deceased effect of nickel titanium arch wire on canines.

Fig. 7 The clinical changes at the initial of the study (T0; Left side) and at the end of the study (T4; right side). The experimental canine was moved more than the control side with little distal tipping, disto-palatal rotation into the alignment and the same anchorage loss.

The canine changes

In all cases, clinically significant canine movement was observed more in the experimental side than in the control side during 4 months of the study period. Five of 13 cases were shown more distal tipping in the experimental side than the control side. And there were no severe rotation of the entire experimental canine (Fig. 7).

The molar changes

All of the experimental molars did not show clinically significant mesial movement of posterior teeth. The anchorage loss was not found in all cases both in experimental and control sides. There were no the clinical significant tipping and rotation of the experimental molar when compared with the control side.

The measurement and statistical analysis of tooth movement

The canines tipping and rotation in the experimental and control groups before the study (T0) were showed no differences in tipping and rotation of canines and molars between groups (*p-value* > .05) before the canine retraction.

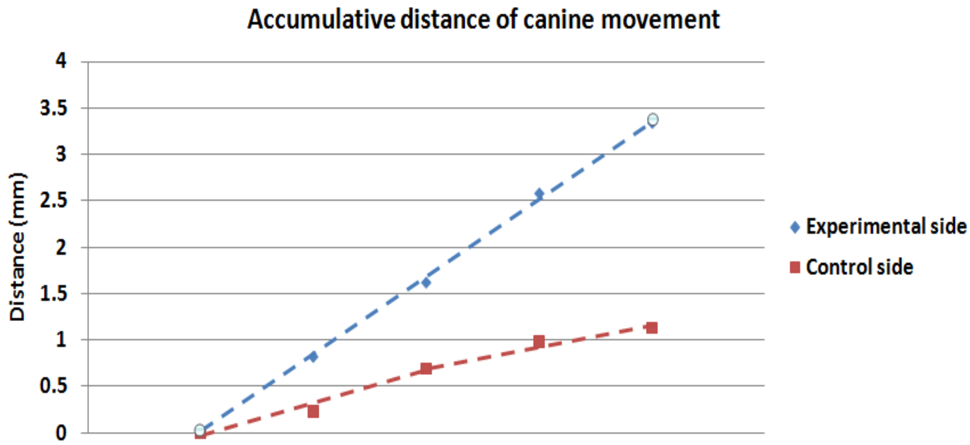
Table 3 The difference of canine tipping and rotation before the study

Compare the parameters at T0	***P-value***
Canine tipping	.595
Canine rotation	.328

The canine movement

After the study, the experimental canines were retracted in 4 months; the accumulative distance of experimental canine movement was more than the control canine in every month (Fig. 8). The average of experimental canine retraction was 3.34 ± 1.34 millimeters or 0.84 ± 0.34 millimeters/month. The distances of experimental canine movement were in the range between 1.61 to 5.20 millimeters. The control side was moved in average 1.13 ± 0.58 millimeters or 0.28 ± 0.15-millimeters/ month. The distances of canine movement were in the range between 0 to 1.88 millimeters. All experimental canines were moved more than the control canines (Fig. 9). The difference of the rates of canine movement between groups was statistically significant at *p-value* < .05 (Table 4).

The total amount of canine distal movement of the experimental and control sides in each subject was shown in figure 9 in the order of more canine movement form the most to the least.



(n=13)	T0	T1*	T2*	T3*	T4*
Experiment	0	0.82±0.46	1.62±0.74	2.58±1.04	3.34±1.34
Control	0	0.23±0.41	0.69±0.52	0.98±0.55	1.13±0.57

Fig. 8 The accumulative distance of canine movement (mm) on the experimental side compared with the control side (* *P-value* < .05)

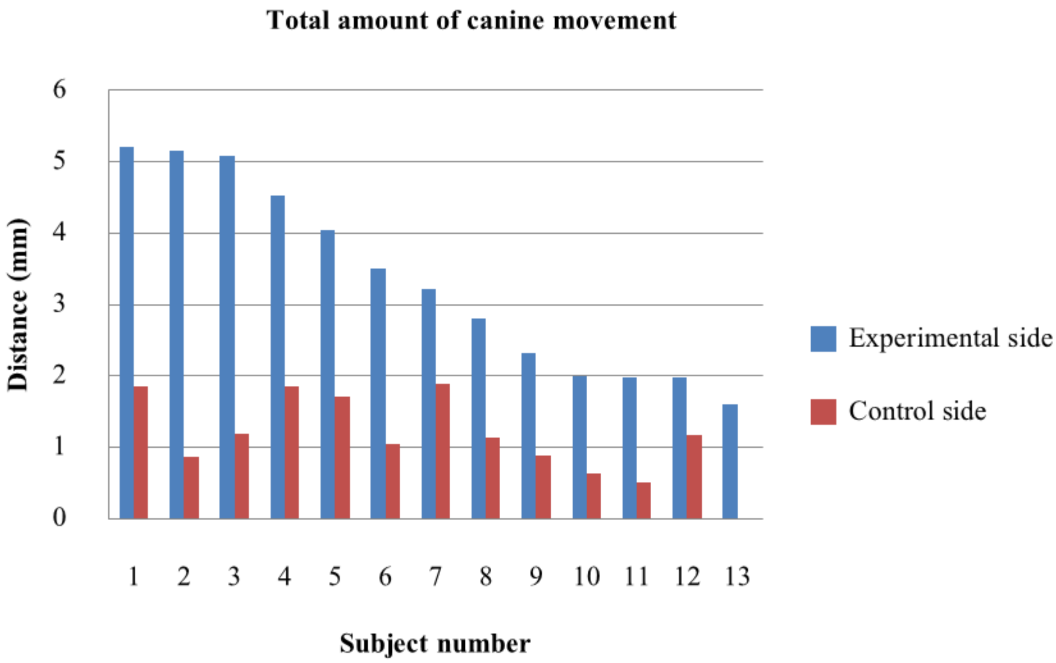


Fig. 9 The total amount of canine distal movement of the experimental and control sides in each subject

The canine tipping

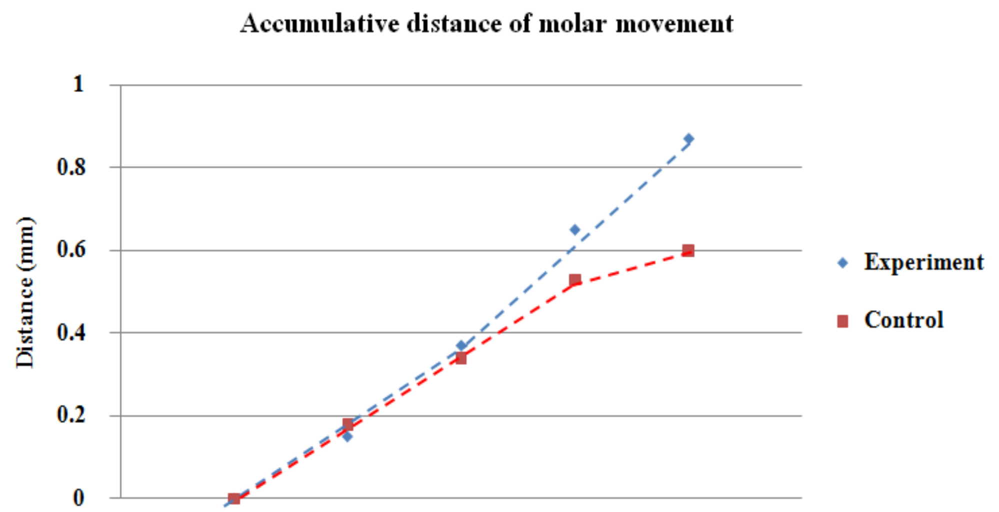
The 11 experimental canines were distal tipping when compared to initial position and only one had no change of inclination. The average of distal tipping was 9.15 ± 5.52 degree. The control sides were different in tipping, 10 subjects were distal tipping and the others were mesial tipping. The average of distal tipping was 3.31 ± 3.76 degree in control groups. The difference of the canine tipping between groups was statistically significant (*p-value* < .05) (Table 4).

The canine rotation

The 11 experimental canines were disto-palatal rotation when compared to initial and only 2 subjects were disto-buccal rotation. The average was disto-palatal rotation 9.25 ± 8.16 degree. In The control groups, 7 subjects were disto-palatal rotation and the others were disto-buccal rotation. The average of rotation was disto-palatal rotation 0.69 ± 9.53 degree in control groups. The difference of the canine rotation between groups was statistically significant (*p-value* < .05) (Table 4).

The molar movement

The accumulative movements of molars were shown in figure 10. The average of the experimental molar movement was mesial moved 0.87 ± 0.53 millimeters or 0.22 ± 0.13 millimeters/ month. The average of the control molars were mesial moved 0.60 ± 0.51 millimeters or 0.15 ± 0.13 millimeters/month. There were 6 experimental molars mesial moved more than control molars, 4 experimental molars mesial moved less than control molars, and 3 experimental molars mesial moved equal to control molars. The difference of rates of molars movement between groups was not statistically different (*p-value* > .05) (Table 4). And the total amount of molar movement of the experimental and control sides in each subject was shown in figure 11 in order to the more canine movement to the lesser canine movement (Fig. 11).



(n=13)	T0	T1	T2	T3	T4
Experiment	0	0.15±0.26	0.37±0.33	0.65±0.46	0.87±0.53
Control	0	0.18±0.24	0.34±0.34	0.53±0.47	0.60±0.51

Fig. 10 The accumulative distance of the molar movement (mm) on the experimental side compared with the control side.

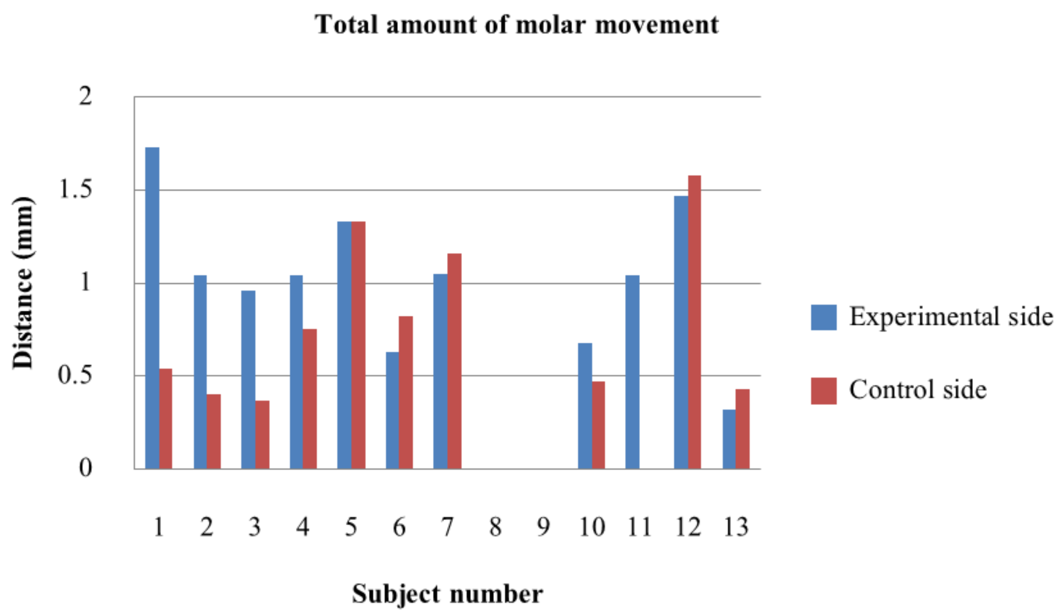


Fig. 11 The total amount of molar mesial movement of the experimental and control sides in each subject.

Table 4 The changes of canines and molars of experimental and control groups

		Distance of tooth movement (mm)	Rate of tooth movement (mm/month)	Tipping (degree)	Rotation (degree)
Canines	**Experiment**	3.34 ± 1.34	0.84 ± 0.34	-9.15 ± 5.52	-9.25 ± 8.16
	Control	1.13 ± 0.58	0.28 ± 0.15	-3.31 ± 3.76	-0.69 ± 9.53
P-value		<.001**		<.001**	.021*
Molars	**Experiment**	0.87 ± 0.53	0.22 ± 0.13	-	-
	Control	0.60 ± 0.51	0.15 ± 0.13	-	-
P-value		.061		-	-

* *p-value < 0.05, ** P < 0.001*

CHAPTER 4

DISCUSSIONS

The aim of this study was to determine the changes of canines and molars form the light force canine retraction in initial leveling phase. To distinguish the effect of nickel titanium wire in the leveling phase, the experimental sides were compared with the un-retracted sides.

The dental changes of the leveling phase and light force retraction in leveling phase.

Canine changes

In the conventional leveling phase, all teeth will be aligned which are mesio-distal direction, bucco-lingual direction and occluso-gingival direction, therefore the control canines were changed due to the effect of nickel titanium arch wire. Most of control canines were tipped distally and rotated to alignment in the disto-palatal direction. In this study, the control canines were moved in short distances as shown in figure 8 that is the effect of leveling phase. In the experimental canines were retracted with 18 grams and shown the continually increment of the distance of movement in each month with statistical significant. However, the tipping and rotation of experimental canines is more than the control canines but it was normally in conventional canine retraction[4, 6] because the retraction force that does not pass through the center of resistance of the canines. Therefore, the canine retraction in this study was from the light force and the effect of nickel titanium wire in the leveling phase.

Anchorage loss

In this study the maxillary canines were retracted to the second premolars ligated with first and second molars and there were no spaces between the second premolars and the molars. Therefore, this study would use the molar movement to present the changes of anchorage.

Although, the result showed there were mesial movement of the molars to the extraction site during the study in both sides but these were not statistically significant when compared to the control molars. And also, there was no effect of the light force to the anchorage loss when compare with the changes of the anchorage in the leveling phase. This study, showed that in cases of severe crowding or protrusion with the absolutely maximum anchorages practitioner should be aware the loss of anchorage in the leveling phase.

CRLL technique

The rate of canine retraction

From the previous studies of the rate of canine retraction with various methods[5, 22-24, 26-35], the rates of canine movement are in the range of 0.35 to 1.97 millimeters per month (or approximately 1 millimeters/month). When compare with the rate of canine retraction with light force from this technique, the rate of tooth movement is nearly equal to that of the other studies with sliding mechanics (Table 5). Moreover, when compared to some studies using the optimum force (100-200 grams of force); the rate of canine retraction in this study was higher[23, 28, 30-31]. Compared to the studies using the elastomeric chain for canine retraction, our study showed the rate of canine retraction was the same as that in Nightingale and Jones'study[29] but more than that in Dixon's study[31].

Table 5 The rate of canine retraction with various forces from previous studies in sliding mechanic

Study	Source of force	Force magnitude (grams)	Rate of canine retraction (mm/month)
This study, 2012	Elastomeric chain	18	0.84
Yee *et al*, 2009[27]	Nickel titanium spring	50	0.60
Thiruvenkatachari *et al*, 2008[28]	Nickel titanium spring	100	0.81
Rajcich and Sadowsky, 1997[23]	Nickel titanium spring	100-150	0.80
Nightingale and Jones, 2003[29]	Elastomeric chain	100-200	0.84
Samuels *et al*, 1998[30]	Nickel titanium spring Nickel titanium spring Nickel titanium spring	100 150 200	0.64 1.04 0.96
Dixon *et al*, 2001[31]	Active ligature Elastomeric chain Nickel titanium spring	200 200 200	0.35 0.58 0.81
Lotzof *et al*, 1996[22]	Elastomeric chain	200	1.50

When we compared our study to the frictionless mechanic studies (Table 6), the rate of canine retraction from this study was slower than others e.g. Darendeliler's study[32] and Daskalogiannakis and McLachlan's study[33]. Both studies were using low continuous force magnitude. But the rate of canine retraction form this study was equal to that in Iwasaki's study[5] that used the same force magnitude.

Table 6 The rate of canine retraction with various forces from previous studies in frictionless mechanic

Study	Source of force	Force magnitude (grams)	Rate of canine retraction (mm/month)
This study, 2012	Elastomeric chain	18	0.84
Iwasaki *et al*, 2000[5]	Retraction loop and Nickel titanium spring	18 60	0.80 1.14
Darendeliler *et al*, 1997[32]	Drum spring Nickel titanium spring	50 50	1.60 1.22
Daskalogiannakis and McLachlan, 1996[33]	Retraction loop Magnet	70 70	0.67 1.22
Hayashi *et al*, 2004[34]	Retraction spring	100	1.97

The rates of canine retraction were different among previous studies. Because there are many factors affecting to the rate of tooth movement including bracket slot's size, type of bracket, type of wire, wire diameters, force magnitude, type of orthodontic force and moreover biological factors, for example; saliva, plague accumulation etc.

A recent systematic review of tooth movement in humans[18] suggests that no evidence is about the optimal force level in orthodontics. There are many reasons for such conclusion; First explanation is inability to precisely calculate the distribution of stresses and strains at the periodontal ligament level. Second reason is the controlled type of tooth movement. Third reason is the tooth movement evaluated over a relatively short period of time. And the last is individual variation of the subject responses. So the usage of the lightest force to move the teeth for the safe and less damage of periodontal structure is appropriate to the patient.

The canine tipping

When compared with the canine tipping from previous studies (Table 7), this study had distal canine tipping more than various studies except Hasler's study[35] that retracted canine into the recent extraction site. Hasler proposed that the canine retraction into the recent extraction site to produce distal tipping because of less bone resistance at cervical region. When compared with Sueri and Turk study[24], this study had lower canine tipping because of lower force magnitude in canine retraction. When compared with Iwasaki's study[5], which used the stainless steel wire with anti-rotation and anti-tipped wire bending co-operated into the mechanic, the tipping and the rotation of the canine will be less than this study. Moreover, the stainless steel wire with larger diameters can be better controlled the tooth movement.

Table 7 The canine tipping from previous studies

Study	Mechanic	Source of force	Force magnitude (grams)	Tipping (Degree)
This study, 2012	Sliding	Elastomeric chain	18	9.15
Sueri and Turk, 2006[24]	Sliding	Nickel titanium spring	150	11.63
Iwasaki *et al*, 2000[5]	Frictionless Frictionless	Retraction loop and Nickel titanium spring	18 60	3.20 3.20
Darendeliler *et al*, 1997[32]	Frictionless Frictionless	Drum spring Nickel titanium spring	50 50	7.89 7.94
Hasler *et al*, 1997[35]	Frictionless	Gjessing spring	100	15.80

The canine tipping of the previous studies was found from 3.20 to 15.80 degree. However, there were differences in the method of the measurements. Moreover, these methods were not shown the clinical representation after canine retraction (but compare to the initial of treatment). So the canine angulation at T4 was compare to the occlusal plane. The average of canine angulation at T4 was 7.76 ± 3.36 degree. When compare to the normal canine angulation of Andrews[36], 11 degree, found that the difference was approximately 3 degree (Fig 12).

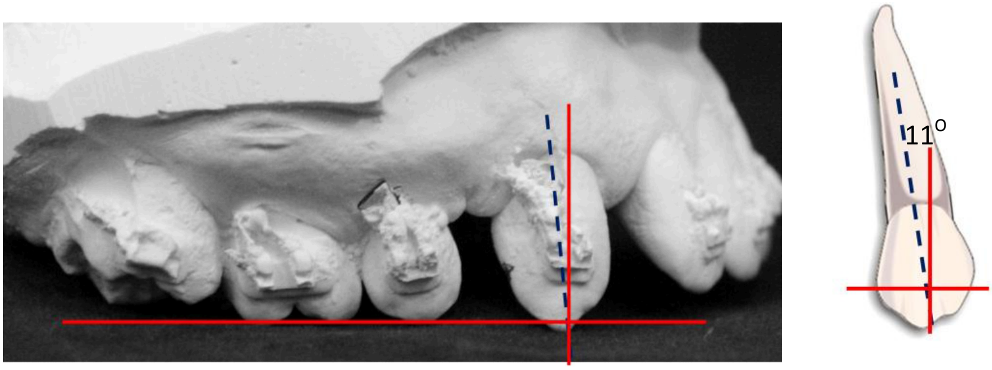


Fig. 12 The canine angulation of this study (Left) compared to the normal canine angulation of Andrews (Right)

Canine rotation

The canine rotation from previous studies was shown in table 8. The canine rotation form this study was lower than that in Rajcich and Sadowsky's study[23] and Darendeliler' study[32], but higher than that in Sueri and Turk's study[24] and Iwasaki's study[5] that used the large arch wire size in canine retraction.

Table 8 The canine tipping and rotation from previous studies

Study	Mechanic	Source of force	Force magnitude (grams)	Rotation (Degree)
This study, 2012	Sliding	Elastomeric chain	18	9.25
Sueri and Turk, 2006[24]	Sliding	Nickel titanium spring	150	7.75
Iwasaki *et al*, 2000[5]	Frictionless Frictionless	Retraction loop and Nickel titanium spring	18 60	0.60 5.90
Darendeliler *et al*, 1997[32]	Frictionless Frictionless	Drum spring Nickel titanium spring	50 50	22.06 4.07

However, in conventional orthodontic treatment during canine retraction, the disto-palatal rotation was occurred because the canine was moved into the new position along the arch form (Fig 13).

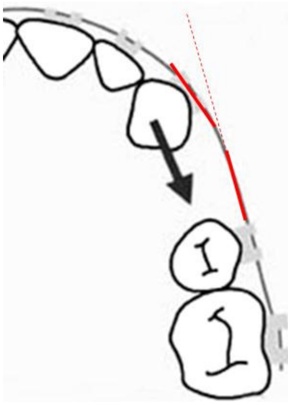


Fig 13 Shown the disto-palatal rotation of the canine after canine retraction into the new position

Additionally, in clinical observation, there were no clinical significance of canine tipping and rotation and any severe side effects.

Fig. 14 No severe tipping and rotation of the retracted canines

The anchorage loss

The anchorage loss during the canine retraction from this study had the lower rate of anchorage loss from previous studies (Table 9). Although there were anchorage preparations such as Nance application[37], headgear usage[35] during canine retraction the anchorage loss can occur. The less anchorage loss that reviewed was Rajcich and Sadowsky[23] that used differential moment during canine retraction.

The amount of anchorage loss per month in the experimental side was less than the result from the study of Lotzof[22] which retracted canine without any anchorage preparation. In this study, the second molars were bonded and coligated posterior teeth as a unit to increase tooth number for canine retraction. Londhe et al in 2010[38] has introduced the advantages of including second molar in treatment to decrease the anchorage loss.

Table 9 Comparison of anchorage loss between differential anchorage preparation methods

Study	Anchorage preparation	Duration (month)	Anchorage loss (mm)	Anchorage loss (mm/month)
This study	Coligate posterior teeth	4	0.87	0.22
Shapck *et al*, 2008[37]	Nance application	5	1.40	0.28
Hasler *et al*, 1997[35]	High pull headgear	3	1.53	0.51
Lotzof *et al*, 1996 [22]	No anchorage preparation	2.9	2.33	0.80
Thiruvenkatachari *et al*, 2006 [28]	No detailed	5	1.60	0.32
Yee *et al*, 2009[27]	No detailed	3	1.11	0.37
Sueri and Turk, 2006[24]	No detailed	2.5	1.93	0.76

The common side effects from this technique

1. Anterior teeth spacing after canine retraction after 2-3 months later because of the gingival fiber contraction form canine movement. After there are enough space for aligning anterior teeth, the researchers recommends ligating incisors together to prevent the anterior teeth spacing that effect to the esthetic.

2. Posterior open bite. There were four subjects (4/13 cases) that found the little posterior open bite at second premolars region. This side effect was correlated to the amount of tipping of canine but in some cases the canine tipping more than 10 degree (2/14 cases) there are not posterior open bite. When this side effect occurs, the increased arch wire diameters should be placed and continued retracted canines with light force.

Fig. 15 Posterior open bite was at second premolars region

3. Buccal tipping of second molars. In the initial protocol of this study the posterior teeth were coligeted with elastomeric chain that caused the buccal tipping of second molars. So in the adjusted protocol, the posterior teeth were co-ligated ligature wire.

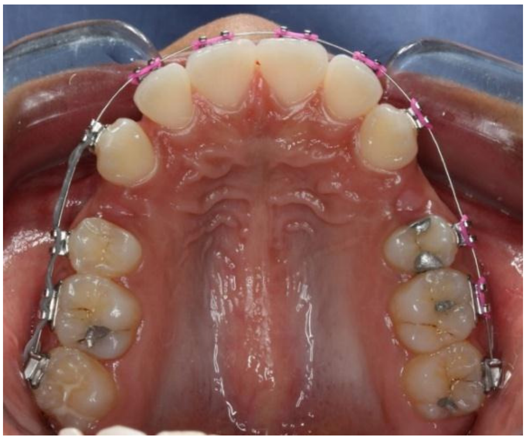


Fig. 16 Buccal tipping of right second molars

The study designs

This study was experimental split mouth design to compare the tooth movement in the same individuals. The canines and molars tipping and rotation before the study were the same. And the patient age was in narrow range. So the individual variations were control to decrease the method errors. However, the subjects of this study were quite small sample sizes (13 subjects). Future study would be should be conducted in a larger sample size.

The measurement errors

The major problem of the model analysis was the occlusal plane change in the leveling phase. This leaded to error in the model scanning process that made the various in the measurement of the tooth movement. So the research was designed to have a direct measurement on the models with reference palatal plug. Although, the measurement errors would be inevitably but these were reduced by random measurement, re-measurement and intra-examiner calibration
The intra-examiner reliability was tested to compare the initial and re-measurement 2 weeks later of the changes in study models and lateral cephalometric radiographs. There was no statistically significant difference between the two measurements. And the measurement errors were acceptable.

Clinical implication

Case selection

This technique can imply to use in the patients with moderate crowding and protrusion of anterior teeth that required first premolars extraction with maximum anchorage (posterior teeth mesial move less than ¼ of extraction space). The canines were not rotation, severe tipping or ectopic eruption
And from the observation, posterior occlusions with good intercuspation are the candidate in prevention of anchorage loss[39].

Clinical managements

From this study, we have suggested the new technique using the routine orthodontic treatment combined with the biological response of bone resorption to decrease treatment time in the leveling and canine retraction phases. The Canine Retraction in Leveling phase with Light force (CRLL) should start immediately or within 7 days after first bicuspid extraction to facilitate the bone resorption from the inflammation of extraction site or Regional Accelerated Phenomenon[40] (RAP). To move or retract the canine, the small nickel titanium wire usually is not recommended because the canine could be moved to inappropriate direction such as tipping, tilting and rotation. In spite of that this is the study to use 18 grams which is very light force and the result shows that CRLL is able to move or retract canine in the appropriate direction and rate of tooth movement same as that in the other techniques.

The step of treatment was in the clinical managements in the Chapter 2. For using in clinical treatment, the CRLL can use both side of canine. In case of no anterior teeth crowding, the incisors should be coligated together with ligature wire at the initial of the treatment.

Benefits

The CRLL was simple mechanics that can cooperate with conventional orthodontic treatment. This technique will gain space after canine retraction in leveling phase to correct the anterior crowding which should decrease treatment time. Moreover, the light force will not be any harm to periodontium and teeth.

Limitations and suggestions of the study

First, this study was conducted only in non-growing patients, so the study in growing patients will be difference in the rate of tooth movement. Second, CRLL technique was studied unilaterally within 4 months, for evaluation of side effects of treatment and overall treatment time the CRLL should be used to retract the canines on both sides. And third, CRLL technique was tested in only one arch wire size (0.012" nickel titanium arch wire). It was interesting to study the effects of CRLL in the larger leveling arch wire, for the chance to anterior retraction immediately after finished canine retraction phase.

CHAPTER 5

CONCLUSIONS

1. The maxillary canine retraction with light force in initial leveling phase can be introduced in straight wire technique.

2. The rate of CRLL was 0.8 mm/month, the range of tipping and rotation is within the limit of Andrews' six keys to normal occlusion and the anchorage loss was minimal.

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APPENDICES

ที่ ศธ 0521.1.03/ 151

คณะทันตแพทยศาสตร์
มหาวิทยาลัยสงขลานครินทร์
ตู้ไปรษณีย์เลขที่ 17
ที่ทำการไปรษณีย์โทรเลขคอหงส์
อ.หาดใหญ่ จ.สงขลา 90112

หนังสือฉบับนี้ให้ไว้เพื่อรับรองว่า

โครงการวิจัยเรื่อง "การศึกษาการเคลื่อนฟันเขี้ยวในขากรรไกรบน ด้วยแรงขนาดเบาในระยะปรับระดับฟัน"

หัวหน้าโครงการ ทันตแพทย์สุรจิต สมงาม

สังกัดหน่วยงาน นักศึกษาหลังปริญญา ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์

ได้ผ่านการพิจารณาและได้รับความเห็นชอบจากคณะกรรมการจริยธรรมในการวิจัย (Ethics Committee) ซึ่งเป็นคณะกรรมการพิจารณาศึกษาการวิจัยในคนของคณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ แล้ว ในคราวประชุมครั้งที่......1/2553..........เมื่อวันที่.....29 มกราคม 2553.....

ให้ไว้ ณ วันที่ 23 กุมภาพันธ์ 2553

(รองศาสตราจารย์ ทพ.นพ.ธงชัย นันทนรานนท์)
รองคณบดีฝ่ายวิจัย
ประธานกรรมการ

....กรรมการ
(ผู้ช่วยศาสตราจารย์ ดร.ทพญ.สุวรรณา จิตภักดีบดินทร์)

....ไม่ได้เข้าประชุม....กรรมการ
(ผู้ช่วยศาสตราจารย์ ทพญ.สรียา ศรีสินทร)

....กรรมการ
(ผู้ช่วยศาสตราจารย์ ทพ.นพ.สุรพงษ์ วงศ์วัชรานนท์)

....กรรมการ
(ผู้ช่วยศาสตราจารย์ นพ.พรชัย สถิรปัญญา)

....กรรมการ
(ผู้ช่วยศาสตราจารย์ ดร.ทพญ.อังคณา เธียรมนตรี)

....ไม่ได้เข้าประชุม....กรรมการ
(อาจารย์วศิน สุวรรณรัตน์)

ใบเชิญชวน

ขอเชิญเข้าร่วมโครงการวิจัยเรื่อง การศึกษาการเคลื่อนฟันเขี้ยวในขากรรไกรบน ด้วยแรงขนาดเบาในระยะปรับระดับฟัน

เรียน ท่านผู้อ่านที่นับถือ

ข้าพเจ้า ทพ.สุรจิต สมงาม กำลังศึกษาระดับปริญญาโท สาขาทันตกรรมจัดฟัน ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ ใคร่ขอเล่าถึงโครงการวิจัยที่กำลังทำอยู่ และขอเชิญชวนท่านเข้าร่วมโครงการนี้

โครงการวิจัยนี้จะทำการศึกษาการเคลื่อนฟันเขี้ยวในขากรรไกรบนด้วยแรงขนาดเบาในระยะปรับระดับฟัน เปรียบเทียบกับการปรับระดับฟันตามปกติตามปกติ โดยมีประโยชน์ที่จะได้หลังจากการศึกษาคือ เพื่อลดความเสี่ยงในการเกิดกระดูกบริเวณรากฟันมีรอยแยก รากฟันละลาย และเพื่อทำให้ระยะเวลาในการรักษาสั้นลง

โดยขั้นตอนของการวิจัยคือ ถอนฟันกรามน้อยซี่ที่หนึ่งไม่เกิน 1 สัปดาห์ก่อนทำการศึกษา ติดเครื่องมือจัดฟันชนิดติดแน่นและทำการเคลื่อนฟันเขี้ยวข้างที่ทำการศึกษาโดยใช้ยางให้แรงขนาด 18 กรัม และปรับเครื่องมือทุก 1 เดือนจนกระทั่ง เป็นเวลารวม 4 เดือน เก็บข้อมูลสำหรับการศึกษาโดยการพิมพ์ฟัน ก่อน ระหว่าง และหลังการศึกษา และ จากภาพถ่ายรังสีกระโหลกศรีษะด้านข้าง ก่อน และหลังการศึกษา ข้อมูลที่ได้จะนำมาประเมินการเปลี่ยนแปลงของฟันเขี้ยวและฟันกราม

สำหรับความเสี่ยงที่อาจจะเกิดอันตรายขึ้นจากการถ่ายภาพรังสีมีน้อยมากซึ่งอยู่ในระดับที่ปลอดภัย สำหรับค่าใช้จ่ายที่ผู้ป่วยจะต้องรับผิดชอบประกอบด้วย ค่าทำประวัติ 600 บาท ค่ารักษาทางทันตกรรมจัดฟันในอัตราปกติ และค่าถ่ายภาพรังสี โดยปกติจะถ่ายก่อนการรักษา ระหว่างการรักษา และหลังการรักษา สำหรับค่าถ่ายภาพรังสีกระโหลกศรีษะด้านข้าง และการพิมพ์ฟันเพิ่มเติมจากการรักษาปกติทางคณะผู้วิจัยจะเป็นผู้รับผิดชอบ

ถ้าท่านตัดสินใจเข้าร่วมโครงการวิจัยฯนี้ จะมีขั้นตอนของการวิจัยที่จำเป็นต้องขอความร่วมมือของท่านตามที่กล่าวมาข้างต้น ซึ่งจะไม่ก่อให้เกิดความเจ็บปวดและอันตรายต่อเนื้อเยื่อใดๆ ที่นอกเหนือจากการรักษาทางทันตกรรมจัดฟันตามปกติ โดยผู้เข้าร่วมโครงการวิจัยฯต้องมารับการรักษาและติดตามผล ณ คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ ตามระยะเวลาที่กำหนดอย่างเคร่งครัด

ไม่ว่าท่านจะเข้าร่วมในโครงการวิจัยนี้หรือไม่ ท่านจะยังคงได้รับการรักษาที่ดีเช่นเดียวกับผู้ป่วยคนอื่นๆ และถ้าท่านต้องการที่จะถอนตัวออกจากการศึกษานี้เมื่อใดท่านก็สามารถกระทำได้

อย่างอิสระ ถ้าท่านมีคำถามใดๆ ก่อนที่จะตัดสินใจเข้าร่วมโครงการนี้ โปรดซักถามจากคณะผู้วิจัยได้อย่างเต็มที่

ขอขอบคุณเป็นอย่างสูง

ทพ. สุรจิต สมงาม

หมายเหตุ: - กรุณาอ่านข้อความให้เข้าใจก่อนเซ็นชื่อยินยอมเข้าร่วมโครงการ

แบบยินยอมเข้าร่วมการศึกษา

โครงการวิจัยเรื่อง การศึกษาการเคลื่อนฟันเขี้ยวในขากรรไกรบน ด้วยแรงขนาดเบาในระยะปรับระดับฟัน

วันที่…………………....เดือน.......…..………..พ.ศ……...………

ข้าพเจ้า……………………………………..…………………..…อายุ……..……....…ปี อาศัยอยู่บ้านเลขที่………………..…….ถนน…………………ตำบล……………….......…………. อำเภอ………………………จังหวัด…………………….…………

ได้อ่าน/ได้รับการอธิบายจากผู้วิจัยถึงวัตถุประสงค์ของการวิจัย วิธีการวิจัย อันตรายหรืออาการที่อาจเกิดขึ้นจากการวิจัยหรือจากยาที่ใช้ รวมทั้งประโยชน์ที่จะเกิดขึ้นจากการวิจัยอย่างละเอียดและมีความเข้าใจดีแล้ว

หากข้าพเจ้ามีข้อสงสัยประการใดหรือเกิดผลข้างเคียงจากการวิจัยสามารถติดต่อกับ ทพ. สุรจิต สมงาม ซึ่งสามารถติดต่อได้ที่ ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ หมายเลขโทรศัพท์ 074-287601 หรือเมื่อมีปัญหาใด ๆ เกิดขึ้นเนื่องจากการทำวิจัยในเรื่องนี้ข้าพเจ้าสามารถร้องเรียนไปที่คณบดีคณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ อ.หาดใหญ่ จ.สงขลา 90112 โทรศัพท์ 074-287510

หากผู้วิจัยมีข้อมูลเพิ่มเติมทั้งด้านประโยชน์และโทษที่เกี่ยวข้องกับการวิจัยนี้ ผู้วิจัยจะแจ้งให้ข้าพเจ้าทราบอย่างรวดเร็ว โดยไม่ปิดบัง

ข้าพเจ้ามีสิทธิที่จะของดการเข้าร่วมโครงการวิจัยโดยมิต้องแจ้งให้ทราบล่วงหน้าโดยการงดการเข้าร่วมการวิจัยนี้ จะไม่มีผลกระทบต่อการได้รับบริการหรือการรักษาที่ข้าพเจ้าจะได้รับแต่ประการใด

ผู้วิจัยรับรองว่าจะเก็บข้อมูลเฉพาะที่เกี่ยวกับตัวข้าพเจ้าเป็นความลับ จะไม่เปิดเผยข้อมูลหรือผลการวิจัยของข้าพเจ้าเป็นรายบุคคลต่อสาธารณชน จะเปิดเผยได้เฉพาะในรูปแบบที่เป็นสรุปผลการวิจัย หรือการเปิดเผยข้อมูลต่อผู้มีหน้าที่ที่เกี่ยวข้องกับการสนับสนุนและกำกับดูแลการวิจัย

ข้าพเจ้าได้อ่าน/ได้รับการอธิบายข้อความข้างต้นแล้ว และมีความเข้าใจดีทุกประการ จึงได้ลงนามในใบยินยอมนี้ด้วยความเต็มใจ โดยนักวิจัยได้ให้สำเนาแบบยินยอมที่ลงนามแล้วกับข้าพเจ้า เพื่อเก็บไว้เป็นหลักฐาน จำนวน 1 ชุด

ลงชื่อ…………………………………..……………………….....ผู้ยินยอม

( )

ลงชื่อ……………………………………..…… ผู้รับผิดชอบโครงการวิจัย

(ทันตแพทย์สุรจิต สมงาม)

ลงชื่อ………………..……………...………….บิดา/ผู้ใช้อำนาจปกครอง

( )

ลงชื่อ…………………………..……..……….มารดา/ผู้ใช้อำนาจปกครอง

( )

ลงชื่อ …………………………..……………….………..…………พยาน

( )

ลงชื่อ……………………….....……......………..………..………….พยาน

( )

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