Comparative Study of Maxillary Canine Movement between Low Friction Brackets and Conventional Brackets in Corticotomy-Assisted Orthodontic Patients

การศึกษาเปรียบเทียบการเคลื่อนฟันเขี้ยวบนระหว่างการใช้แบร็คเกตชนิดแรงเสียดทานต่ำกับแบร็คเกตทั่วไปในผู้ป่วยที่ได้รับการผ่าตัดกระดูกทึบร่วมกับการรักษาทางทันตกรรมจัดฟัน

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ABSTRACT

The study was performed in 9 patients with skeletal class I and dental class I malocclusion with severe crowding who undergone first premolars extraction and corticotomy at maxillary canines area. All patients were randomly placed conventional bracket on one canine and a low friction bracket on another side. After leveling and aligning until 0.018 inches stainless steel, c-chain with 150 g were used to retract canines and impression were taken for study models every month until obtained proper position. Wilcoxon signed-ranks test was used to compare difference between two groups. Treatment result showed the rate of maxillary canine movement of the low friction bracket group was 1.62 $\pm$ 0.27 mm/month and the conventional bracket was 1.37 $\pm$ 0.39 mm/month. The rate of maxillary canine movement between 2 groups was not significantly difference ($p>0.05$)

บทคัดย่อ

การศึกษานี้ทำในผู้ป่วย 9 ราย ที่มีความสัมพันธ์ของโครงสร้างกระดูกขากรรไกรแบบที่ 1 และมีลักษณะฟันซ้อนเกระดับรุนแรง ได้รับการถอนฟันกรามน้อยบนซี่แรกร่วมกับการผ่าตัดกระดูกทึบที่บริเวณฟันเขี้ยวทั้งสองข้าง ผู้ป่วยทุกรายจะได้รับการสุ่มติดแบร็คเกตทั่วไปข้างหนึ่งและแบร็คเกตชนิดแรงเสียดทานต่ำอีกข้างหนึ่ง หลังจากปรับระดับฟันจนถึงลวดเหล็กกล้าไร้สนิมชนิดกลมขนาด 0.018 นิ้ว ใช้ยางดึงฟันแรงโดยวัดขนาดแรงเท่ากับ 150 กรัม เพื่อใช้ในการดึงฟันเขี้ยวบน ทำการพิมพ์ปากทุกเดือนจนกระทั่งเคลื่อนฟันมาในตำแหน่งที่เหมาะสม เปรียบเทียบระหว่างสองกลุ่มโดยใช้การทดสอบวิลคอคสัน ผลการศึกษาพบว่าอัตราการเคลื่อนที่ของฟันเขี้ยวในกลุ่มแบร็คเกตชนิดแรงเสียดทานต่ำมีค่า 1.62 $\pm$ 0.27 มิลลิเมตร/เดือน และในกลุ่มแบร็คเกตทั่วไปมีค่า 1.37 $\pm$ 0.39 มิลลิเมตร/เดือน โดยไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติของอัตราการเคลื่อนฟันเขี้ยวระหว่างทั้งสองกลุ่ม ($p>0.05$)

Key Words: Low friction bracket, Conventional bracket, Corticotomy

คำสำคัญ: แบร็คเกตชนิดแรงเสียดทานต่ำ แบร็คเกตทั่วไป การผ่าตัดกระดูกทึบ

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Introduction

In part of conventional orthodontic treatment, patient who had severe crowding of anterior teeth often required premolar extraction and retraction of canine into extracted spaces. In case of inadequate bone support like in ectopic or severely displaced canine undesirable side effects such as bone loss, dehiscence, fenestration and gingival recession may occur. Chung et al. (2006) found that the result of prolonged treatment in an adult despite extraction of four premolars, loss of a marginal alveolar bone and root exposure occurred during canine retraction when the root of a canine was being retracted on an arch wire by conventional methods. This was due to resorption of the labial alveolar bone caused by friction between the root surface and the alveolar bone.

To reduce risk from these complications and meet the patient's demand for short treatment time, surgically-assisted orthodontics such as corticotomy should be considered. Corticotomy, or the intentional injury of cortical bone, although first described in 1892 and reintroduced by Kole in 1959 as a surgical procedure to facilitate subsequent orthodontic treatment penetrating the buccal and palatal cortical layers at different points while leaving the spongiosa intact. Wilcko et al. (2001) have noted that orthodontic tooth movement is accelerated by the increase of bone turnover and decrease of bone density because osteoclasts and osteoblasts are increased by a regional acceleratory phenomenon (RAP) that first described by Frost HM in 1989 (Frost, 1989), Wilcko et al. (2001) and Wilcko et al. (2009) also developed a patented technique called Accelerated Osteogenic Orthodontics (AOO) or Periodontally Accelerated Osteogenic Orthodontics (PAOO). This technique is similar to conventional corticotomy except a resorbable bone graft is placed over the surgical sites to augment the confining bone during tooth movement. They claimed that decortications combined with augmentation grafting created greater alveolar volume which eliminated bony dehiscence and fenestrations. Nowadays, corticotomy- facilitated orthodontic treatment is widely known as rapid and effective technique used for accelerate tooth movement, with corticotomy, an orthodontic treatment time can be reduced (Wilcko et al., 2001; Wilcko et al., 2009; Bertossi et al., 2011; Vercellotti and Podesta, 2007)

In addition, other factors that may effected treatment time are timing of treatment, distance of tooth movement, technique employed, extraction or non-extraction treatment (Mavreas and Athanasiou, 2008) and factor that mainly effected canine movement by sliding mechanics was friction (Koleilat and Hasbini, 1997).

Self-ligating brackets has been used in orthodontics since 1935 and gaining popularity in recent years (Harradine, 2008; Wright et al., 2011; Harradine, 2003; Miles, 2009; Rinchuse and Miles, 2007). From previous studies, a consistent agreement was found among the reviewed studies that compared with conventional brackets, self-ligating brackets produced lower friction when coupled with small round archwires (Ehsani et al., 2009; Pizzoni et al., 1998; Thorstenson and Kusy 2001; Thorstenson and Kusy 2002; Hain, 2006). Regarding differences in friction between passive and active self-ligating brackets, many studies (Sims et al., 1993; Voudouris, 1997; Thomas et al., 1998; Kim et al., 2008; Smith et al., 2003) reported that passive brackets generated a lower level of friction compared with the active group.

The benefit of low friction bracket systems may facilitate tooth movement in sliding mechanics.

Many previous studies showed that self-ligating brackets required an average lower treatment time and fewer appointments than conventional brackets (Harradine, 1996; Eberting et al., 2001, Pandis et al., 2007; Turnbull and Birnie, 2007). Despite claims about the advantages of self-ligating brackets, evidence is generally lacking (Chen et al., 2010).

At present, many orthodontists expect to develop the faster technique in orthodontic tooth movement. However, the comparative studies of low friction brackets and conventional brackets are still controversy and studies of corticotomy-assisted orthodontics are almost in case reported. The study about rate of canine movement between low friction brackets and conventional brackets in corticotomy-assisted orthodontic patient has not been documented. The aim of this study was to compare the rate of maxillary canine movement between low friction brackets and conventional brackets in corticotomy-assisted orthodontics treatment patients. This study was therefore undertaken.

Objective of the study

The objective of this study was to compare the rate of maxillary canine movement between low friction brackets and conventional brackets in corticotomy-assisted orthodontic patients

Materials and Methods

Sample selection

The patients were recruited from Orthodontic clinic, dental hospital, Faculty of Dentistry, Prince of Songkla University. The patient inclusion criteria for this study were healthy patients, age between 18-30 years, skeletal class I, dental class I malocclusion with severe crowding (Little's irregularity index > 7) and require therapeutic extraction of upper first premolars in treatment plan and had inadequate bone support in upper canine-premolar area.

Treatment technique

Each subject was randomly placed a 0.022-inch slot conventional bracket (pre-adjusted edgewise brackets; Roth™ system) on one canine and a 0.022-inch slot low friction bracket (passive self-ligating bracket; Damon ™ system) placed on the other with the left or right side using a randomization sequence, brackets were placed in all teeth except incisors, second molars were bonded with buccal tubes. 0.012" NiTi arch wire and temporary anchorage devices or TADs (AbsoAnchor™ system) were placed 1 week prior to surgery. The locations of TADs placement are between second premolar and first molar.

Upper first premolars were extracted and maxillary canines area were decorticated and grafted with demineralized freeze-dried bone allograft (DFDBA) and autogenous bone graft by same surgeon.

Two weeks after alveolar decortications, upper teeth were leveled and aligned with 0.012"and 0.016" NiTi archwire for 1 month. After that, canine retraction started with 150 g of force (Sueri and Turk, 2006) along the 0.018"stainless steel wire by c-chain used between canine brackets and TADs. The patients have to follow up every 2 weeks and impression were taken before canine retraction (T0) and every month for 3 months (T1, T2, T3) for the reference model. The movements of the canines were performed directly on the dental casts. An acrylic palatal plug fabricated from acrylic with reference wires (0.018 inch stainless steel) extended to

the cusp tips of canines (Fig 1). This plug could thus be transferred from initial cast (T0) to the cast of the same patient from T1-T3 that allowed for direct observation of the amount of canine movement (Mezomo et al, 2011).

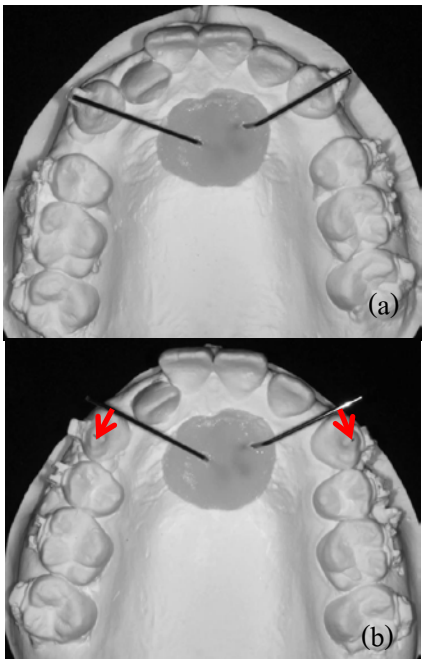

Fig 1 Canine movement were measured on the dental casts with an acrylic palatal plug and reference wires (a) before canine movement (T0), (b) end of canine movement (T3)

The canine distal movement was measured from the point of cusp tip to reference point on the wire with a digital caliper by the same investigator.

Statistical analysis

The measurement of all study models and were repeated 1 month later and the mean of these re-measurement was compared to the mean of the initial measurements using a paired t-test. There was no statistically significant difference between these two results. The differences of canine movement between the low-friction side and the conventional side were evaluated by Wilcoxon signed-ranks test with significant level of 0.05

Result

A total of 18 extraction sites from 9 patients were compared. There were 3 males and 6 females with average age at 18.77± 1.09 years Table 1 showed the distance of canine movement between low-friction bracket and conventional bracket in 3 months period. (T0 to T3). The mean of total canine movement in low-friction group was 4.87±0.81 mm. and the mean of total canine movement in conventional group was 4.09±1.21 mm. There were no significant difference between 2 groups ($p>0.05$)

The rate of canine movement in 3 months period was shown in Table 2. The rate of canine movement in low-friction bracket group at T1, T2 and T3 were 1.41 ± 0.64 mm., 1.46 ± 0.92 mm. and 2.00 ± 0.89 mm. respectively, and the rate of canine movement in conventional bracket group were 1.42 + 0.77, 1.10 + 0.56 and 1.20 ± 0.79 respectively. The difference of the rates of canine movement between groups in T1, T2 and T3 were not statistically significant at $p\text{-value}<0.05$

Table 1 Mean ± Standard deviation of the distance of canine movement between low-friction bracket and conventional bracket in 3 months period

Bracket Types (n=9)	Accumulative distance of canine movement (mm.)			
	T0	T1	T2	T3
Low-friction	0	1.41±0.64	2.87±1.16	4.87±0.81
Conventional	0	1.42±0.77	2.78±0.92	4.09±1.21

Table 2 Rate of canine movement between low-friction bracket and conventional bracket in 3 months period

Bracket type	Rate of canine movement (mm/month)		
	T1	T2-T1	T3-T2
Low-friction	1.41 ± 0.64	1.46 ± 0.92	2.00 ± 0.89
Conventional	1.42 ± 0.77	1.10 ± 0.56	1.20 ± 0.79
P	NS	NS	NS

P < 0.05 level

Discussion

From the previous clinical studies about self-ligating brackets and conventional brackets are still controversies, in the leveling stage in non-extraction patients with mild mandibular crowding. Scott et al., 2008 and Fleming et al., 2009 found that self-ligating bracket was no more efficient than conventional ligated preadjusted brackets in initial or overall rate of mandibular incisor alignment but Pandis et al., 2007 reported no significant difference in the time required to correct mandibular crowding was found between the 2 groups. However, for an irregularity index value <5, self-ligating had 2.7 times faster correction. In extraction patient, Few clinical studies have compared space closure with self-ligating and conventional brackets. Miles, 2006 found similar rates of tooth movement whether self-ligating or conventional brackets were used for en mass retraction of the six anterior teeth and the study of Mezomo et al., 2011 in rate of canine retraction between self-ligating brackets and conventional brackets found no significant different between two groups.

Similar to this study, there were no significant difference in rate of canine movement between self-ligating brackets and conventional brackets; the rate of tooth movement was ranging from 1.37 to 1.62 mm/month, when compare with previous study found that the rate of canine movement was 0.84 to 0.90 mm/month. The rate of canine movement in this study was higher than previous study because this study was performed in corticotomy-assisted orthodontic patients that the rate of tooth movement was higher than the conventional method. Aboul-Ela et al., 2011 found that rate of canine retraction in corticotomy-assisted orthodontic patients was 0.89-1.89 that nearly the rate of canine movement in this study.

However, an important factor that affects frictional resistance in the sliding mechanics was angulation of the wire to the bracket (Ehsani et al., 2009) the efficiency of canine movement may be effect by the initial angulation and rotation of the canine, the study of angulation and rotational changes should be included in the further study.

Conclusions

Distance and rate of canine movement were similar in corticotomy-assisted orthodontic patient with both low-friction and conventional brackets

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