The Effects of Lower Incisors Intrusion in Class II Growing Patients

Charnwit Tantikalyaporn

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Oral Health Sciences

Prince of Songkla University

2014

Thesis Title	The Effects of Lower Incisors Intrusion in Class II Growing Patients
Author	Mr.Charnwit Tantikalyaporn
Major Program	Oral Health Sciences

Major Advisor :

.....

(Assoc.Prof.Dr.Chairat Charoemratrote)

Examining Committee :

.....Chairperson

(Prof.Smorntree Viteporn)

.....

(Assoc.Prof.Dr.Chairat Charoemratrote)

.....

(Asst.Prof.Dr.Sukanya Tianviwat)

The Graduate School, Prince of Songkla University, has approved this thesis as partial fulfillment of the requirements for the Master of Science Degree in Oral Health Sciences

.....

(Assoc.Prof.Dr.Teerapol Srichana)

Dean of Graduate School

This is to certify that the work here submitted is the result of the candidate's own investigations. Due acknowledgement has been made of any assistance received.

.....Signature

(Assoc.Prof.Dr.Chairat Charoemratrote)

Major Advisor

.....Signature

(Mr.Charnwit Tantikalyaporn)

Candidate

I hereby certify that this work has not been accepted in substance for any degree, and is not being currently submitted in candidature for any degree.

.....Signature

(Mr.Charnwit Tantikalyaporn)

Candidate

ชื่อวิทยานิพนธ์ ผลของการกดฟันหน้าล่างในผู้ป่วยสบฟันผิดปกติประเภทที่ 2 ที่มีการเจริญเติบโต

ผู้เขียน นายชาญวิทย์ ตันติกัลยาภรณ์

สาขาวิชา วิทยาศาสตร์สุขภาพช่องปาก

ปีการศึกษา 2556

บทคัดย่อ

บทนำ: การสบลึกสามารถรักษาได้โดยการกดฟันหน้าล่างแต่การล้มเอียงมาด้านหน้าของฟันหน้าล่างเป็นผลข้างเคียงที่สามารถพบได้จากการออกแบบและการปรับเครื่องมือ และการศึกษาเกี่ยวกับการตอบสนองของกระดูกรองรับด้านใกล้ริมฝีปากภายหลังการกดฟันยังไม่เป็นที่ทราบแน่ชัด **วัตถุประสงค์**: เพื่อพัฒนาวิธีการกดฟันหน้าล่างที่ลดผลกระทบของล้มเอียงมาด้านหน้าของฟันหน้าล่าง นำเสนอผลการเคลื่อนของฟันจากเครื่องมือและการเปลี่ยนแปลงของกระดูกเบ้าฟันด้านใกล้แก้มภายหลังการกดฟันหน้าล่าง **ระเบียบวิธีวิจัย**: ผู้เข้าร่วมวิจัย 22 คน (อายุเฉลี่ย 11.4± 0.8 ปี)ที่มีข้อบ่งชี้การกดฟันหน้าล่างถูกแบ่งเป็นกลุ่มศึกษาและกลุ่มควบคุม ลวดทีเอ็มเอขนาด 0.017x 0.025 นิ้วที่ดัดวงรูปตัวแอลร่วมขั้นยกไร้แรง 2 ระดับถูกใช้แก้ไขการสบลึกในกลุ่มศึกษา ประเมินการเคลื่อนของฟันหน้าล่าง ฟันกรามน้อยล่างซี่ที่หนึ่งและฟันกรามล่างซี่ที่หนึ่งทั้งในกลุ่มศึกษาและกลุ่มควบคุมโดยภาพถ่ายด้านข้างกระโหลกศีรษะ เปรียบเทียบผลการศึกษาภายในแต่ละกลุ่มโดยใช้สถิติ paired *t* test ประเมินผลความแตกต่างระหว่างกลุ่มจากผลต่างระหว่างผลการเจริญเติบโตในกลุ่มควบคุม (เปรียบเทียบผลการเคลื่อนของฟันก่อนและหลังศึกษา (T0 และ T1 ตามลำดับ)) และผลการรักษาในกลุ่มศึกษา (T1 and T2 ตามลำดับ)) โดยสถิติ independent *t* test. และใช้ CBCT scan วิเคราะห์ความแตกต่างของกระดูกเบ้าฟันด้านใกล้ลิ้นก่อนและหลังรักษาในกลุ่มศึกษาเป็น 3 ระดับ **ผลการศึกษา**: ในกลุ่มควบคุมพบการยกตัวของฟันหน้าล่าง 0.7± 0.3 มม.และล้มเอียงด้านลิ้น 0.7± 0.2 องศา อย่างไม่มีนัยสำคัญทางสถิติ พบการยกตัวของฟันกรามน้อยล่างซี่ที่หนึ่งและฟันกรามล่างซี่ที่หนึ่ง 0.4± 0.3 มม. และ0.2± 0.2 มม. ตามลำดับ ในกลุ่มศึกษาสามารถกดฟันหน้าล่างได้ 2.5± 0.2 มม.และฟันหน้าล่างล้มเอียงด้านลิ้น 1.5± 0.7 องศา.อย่างมีนัยสำคัญทางสถิติ การยกตัวของฟันกรามน้อยล่างซี่ที่หนึ่งและฟันกรามล่างซี่ที่หนึ่งมีค่าใกล้เคียงกับผลของกลุ่มควบคุม อัตราการกดฟันหน้าล่างของเครื่องมือเท่ากับ 0.4 มม./เดือน เมื่อเปรียบเทียบผลการศึกษาระหว่างกลุ่มพบผลต่างการกดฟันหน้าล่าง 3.3± 0.1 มม. ฟันหน้าล่างล้มเอียงด้านลิ้น 0.8± 0.2 องศา อย่างมีนัยสำคัญทางสถิติ และไม่พบความแตกต่างการยกตัวของฟันหลังระหว่างกลุ่ม อัตราการกดฟันหน้าล่างหลังหักล้างผลการเจริญเติบโตเท่ากับ 0.5 มม./เดือน ภายหลังการกดฟันพบการลดลงของกระดูกเบ้าฟันด้านใกล้ลิ้นที่ระดับคอฟันเฉลี่ย -0.2± 0.2 มม.พบ

การเพิ่มขึ้นที่ระดับปลายรากฟันเท่ากับ 0.4 ± 0.6 มม.**บทสรุป**: เครื่องมือนี้สามารถกดฟันหน้าล่างและล้มฟันหน้าล่างเข้าด้านลิ้นได้โดยมีผลกระทบต่อการยกของฟันหลังเพียงเล็กน้อย หลังกดฟันหน้าล่างรากฟันสามารถเคลื่อนเข้าสู่กระดูกเบ้าฟันที่มีความกว้างขึ้นยกเว้นที่บริเวณระดับสันกระดูกที่มีความหนาของกระดูกลดลง

Thesis Title The Effects of Lower Incisor Intrusion in Class II Growing Patients

Author Mr. Charnwit Tantikalyaporn

Major Program Oral Health Sciences

Academic Year 2013

ABSTRACT

Introduction: Deepbite can be treated orthodontically by lower incisor intrusion but the flaring of lower incisors is common side effect that might come from the design of appliances and technique of activation. Therefore, the labial alveolar bone response for this intrusion are unclear. **Objectives**: the aims of this study were to develop a technique for lower incisor intrusion which minimized the effect of proclination, present the treatment effects of tooth movements and investigate the changes of labial alveolar bone thickness (LBT) after lower incisor intrusion. **Material and methods**: the 22 subjects (mean age 11.4± 0.8 years) being indicated of lower incisors intrusion were divided into 2 groups, treatment and control groups. A 0.017x 0.025 inch TMA with L loop and 2 passive steps up was used to correct deepbite. The changes of tooth movements, the lower incisors, the lower first premolar and the lower first molars in control and study groups were assessed by lateral cephalograms and the differences within group were evaluated by paired *t* test. The growth effect in control group (comparison between before and after observation (T0 and T1 respectively)) and the treatment effect in study group (comparison between before and after intrusion (T1 and T2 respectively)) were evaluated by independent *t* test for the differences between groups. The CBCT scan was used to assess the labial bone thickness changes between before and after intrusion in 3 slices within study group. **Results**: In control group, the lower incisor extruded by about 0.7± 0.3 mm retroclined at about 0.7°± 0.2°and but not of significance. The lower first premolar and first molar extruded 0.4± 0.3 mm and significantly showed an increase of vertical direction at about 0.4± 0.3 mm and 0.2± 0.2 mm respectively. In study group, the lower incisor was intruded 2.5± 0.2 mm and retroclined at about 1.5°± 0.7° significantly. The treatment outcomes of posterior teeth movement was nearly the same results as in control group. Rate of lower incisor intrusion was 0.4 mm/month. When differentiated the growth effect from the treatment effect, the lower incisor was intruded 3.3±0.1 mm and retroclined at about 0.8°± 0.2° significantly, thus the rate of lower incisor intrusion was 0.5 mm/month. The LBT at marginal level was decreased -0.2± 0.2 mm (*p* value <0.01) but the

LBT at apical level was increased 0.4 ± 0.6 mm (p value <0.03). **Conclusion**: This intrusion technique could intruded and retroclined the lower incisors with minimal adverse effect of posterior teeth extrusion. The lower incisor was moved downward into the more alveolar bone housing especially at the mid root and apex level but there was decreased labial bone thickness at marginal level. However, the longer period of observation is needed for completed remodeling process.

ACKNOWLEDGEMENTS

This thesis would not have been possible unless the support and help from my supervisor Assoc. Prof. Dr. Chairat Chalermratrote, who encouraged, adviced and supported from the preliminary to the concluding level enabled me to understand the philosophy of treatment in those patients.

I also give the gratitude to all of my patients who participated in this study and also being my teachers. I would like to thanks to my colleauges; Natthawee and Neeranat who taking care of the cases in this study, especially Dr. Neungruthai and Dr. Arthit who devoted their time for consultation.

And the special thanks for the support through the thesis from the staff of the Orthodontic clinic, Department of Preventive Dentistry, and Oral Radiology at Faculty of Dentistry, Prince of Songkla University. Grant from the Graduate school and the Faculty of Dentistry, Prince of Songkla University.

Charnwit Tantikalyaporn

CONTENTS

LISTS OF TABLE

LIST OF DIAGRAMS/ FIGURES

LIST OF ABBREVATIONS AND SYMBOLS

mm	=	millimeter
et al.	=	and others
g	=	gram
CBCT	=	cone beam computed tomography
NiTi	=	nickel titanium
/	=	per
CEJ	=	cementoenamel junction
°	=	degree

CHAPTER 1

INTRODUCTION

Background and rationale

Deepbite can be treated orthodontically by intrusion or flaring of the incisors, extrusion or passive eruption of the buccal segments, or a combination of these. Intrusion of the maxillary incisors is not indicated in patients with normal incisal display and with normal or long lower facial height[1] but in class II malocclusion patients with deepbite and a large overjet, supraeruption and a more proclination of lower incisors particularly presented, especially in growing children,[2] and the upper half of the anterior part of the symphysis being resorbed and move backward simultaneously.[3] Moreover, there was lower incisor proclination even though in non-growing class II patients[2]. The lower incisors intrusion technique is one of the treatment strategies correcting this problem using an utility arch,[4-6] a Burstone's intrusive arch,[7-8] a Connecticut intrusive arch (CIA),[9-10] a reverse curve of Spee arch wire,[11] a step down arch wire or mini-implants anchorage supported for intrusion etc.

In order to intruded the lower incisors, because of the less total root surface area and the sharp point of force exertion at the apex, the light optimum force level generally used to prevent the apical root resorption.[11-14] Therefore many treatment modalities exist including proclined the lower anterior teeth instead of pure intrusion. This proclination of the lower incisors causes the gingival recession due to the lack of space and the position of those teeth was moved out beyond the anatomical limit of alveolar bone housing at lower anterior region.[15-16]

The side effects of lower incisors intrusion technique from many previous studies might came from the design of the intrusion technique and activation. From the studies of deepbite correction,[1,6] the prevention of the adverse side effect from intrusion technique was purposed in many treatment modalities, using the lower intrusion force level less than the optimal force level which had been claimed by many authors,[7-9,14,17] moved back the point of force application closer to the center of resistance of lower anterior teeth as possible, made the counter clockwise moment in the anterior bracket to create the lingual crown torque or else reinforced the posterior buccal segment.

In order to move the teeth in vertical direction, the vertical loops might be one of this treatment modalities but the shape and position of the different loop types might create the various effect. L loop is one of designs that created an extrusion force on the short end and an intrusion force on the long, this response might be useful for patients with a deepbite, when the L shape can be directed toward the posterior teeth.[18] L loop is one of the design that would being adjusted and activated to move downward the opposite portion of the L loop. Moreover, the study of Rabound, Faulkner, Lipsett and Haberstock[19] found that the more length of L loop portion could exert the lower force level. Even though the L loops showed the highest moment-to-force ratios on closing brackets, the addition of a coil increases the length of the loop slightly lowered the vertical force and load/deflection compared with loops without coils when being activated and also generally reduced the stiffness of the archwire(load/deflection). The beta titanium alloy archwire, which exerts the lower load/deflection ratio and has high formidability capable to perform this ability.

Otherwise of the L loops, the design of a step bend in a rectangular archwire was used for many years to resist proclination and control the lower incisor inclination during intrusion. Developing a new technique from this knowledge and well-design treatment sequence could produce a lower incisor intrusion with the minimal effect of lower incisor proclination and this is the purpose of this study.

Review of the literature

Management of deepbite occlusion with the lower incisor intrusion appliances

1. Lower intrusion arch and biomechanics

Burstone[7] first described intrusion arch mechanics as part of the segmented arch technique which were made of stainless steel wires with the helical springs in front of the molars to reduce the load deflection rate. In 1980, beta-titanium alloys replaced stainless steel, eliminating the need for a helical spring due to the titanium wire's low stiffness. The objective of using auxiliary springs, such as an intrusion arch, is the improved control of the applied forces, both relative to the quantitative and qualitative force systems. The design of the intrusion arch allows accurate prediction of the directions of the forces that the springs exert on the teeth. Spring of this design are statistically determinant, i.e. it is possible to measure the magnitude of all the force on the incisors is balanced by an equal but opposite extrusive force at the molar tube. These two forces produce an "interbracket" couple which is opposed by an "intrabracket" couple of equal magnitude but in an opposite direction at the molar tube. The biomechanics factors are important in understanding intrusive mechanics as follow[8]:

- **Magnitude of force**: Which is by about 8-10 g at central and lateral lower incisors, 25 g at the lower canine?

- **Force constancy/ load deflection rate**: The segmented springs exert forces in a range greater than the intended tooth movement. The deflection of the spring engaging it to the incisors exceeds the amount of deepbite correction. This feature both reduces the magnitude of the applied force and improves its constancy. A more continuous, low force allows increased time intervals between adjustments and may be gentler on the responding tissues.

- **Point of force application**: This is most often at the central incisors a bracket. This point and the line of action determine the tendency for the force to produce rotational movement. When the line action was applied passing through the center of resistance of the tooth produces pure bodily movement. The effect of this force vector on the incisor is both a downward movement and a crown-labial/ root apex-lingual rotation due to the moment of this force. But when the force applied to the flared tooth, the rotational effect would be increased the moment of the force because this

moment is the product of the force magnitude times the distance of the line of action to the tooth's center of resistance. By the way, when the intrusive force passes lingual to the center of resistance, producing the small moment with a crown-lingual/ root-labial direction then the force would tend to increase their uprightness. The point of force application is determined by selecting the appropriate tie-in point which produced different clinical effects depending on the specific circumstances of its use. To vary the line of force, applying additional force especially in the distal direction is necessary. Clinically, the distal force can be applied by cinchback of the intrusion arch in the molar tube the cinchback minimizes the potential for the overjet to increase by fixing the point of rotation of the intrusion arch spring, without the cinchback, the intrusion arch is free to slide forward, with the potential for lower incisors proclination. When applied the greater distal force direction which being not greater than the intrusive force, a resultant vector would follows the long axis of the tooth. The combination of deepbite correction and overjet reduction can be achieved at the same time.

- **Molar tipback moment**: An intrusive incisor force balances the extrusive force on the molar. Additionally, the spring delivers a tipback moment on the molar. The magnitude of this moment is calculated by multiplying the distance between the molar tube and the point of attachment at the incisors, which ranged between 25-40 mm. with an intrusive force of 40 g, the tip back moment acting on the molars may range from 1000-1600 g-mm. The moment magnitude is sufficient to produce a small amount of mesial lower molar movement. This tipback moment aids in the correction of class II molar relationships.

2. The lower utility arch

Late in the 1950' Ricketts[20] and others attempted to counteract the tipping that occurred in the buccal segments in extraction cases by utilizing the immutable lower incisors as an anchor unit to hold the lower second premolars and molars upright in the canine retraction process. This arch is best fabricated from 0.016x 0.016 inch Blue Elgiloy wire. The development of the lower utility arch is dictated by the requirement that the light force by about 75 g could be delivered in a continuous manner off of long lever arm from the molar to the incisors. The arch is stepped down at the molar, lies in the buccal vestibule and is stepped back up at the incisors to avoid interference from the forces of occlusion that would distort it. This buccal bridge section flared slightly buccally to prevent tissue irritation opposite the vertical steps as the arch approaches the tissue and the incisor

teeth being intruded. The design of this appliance as follow: 1) 30° to 45° Tip back bend applied to the lower molar in order to produce the intrusion force therefore, an excessive over rotation of these teeth might be occurred. Some authors found that there was molar extrusion. The posterior teeth extrusion particularly came about from the reciprocal extrusion force at the buccal segment during anterior teeth intrusion even though using light force[1]. 2) 30° to 45° buccal root torque applied to the lower molar to enhance the posterior anchorage system by the heavy cortical plate. 3) 10° to 15° labial root torque is applied to the anterior portion of the utility arch to prevent flaring of lower incisors which was due to an anterior point of force application in front of the center of resistance.

3. Reverse curve of Spee archwire

Reverse curve of Spee wire correct deepbite primarily by extrusion of posterior teeth, along with flaring of the lower incisors. Both extrusion and flaring may be unstable movements in many patients due to their effect on the facial neuromuscular balance. Reverse curve of Spee also alter the axial inclinations of posterior teeth, which may also contribute to relapse.[8]

Hong, Hong and Koh[11] found that weather using the technique which the intrusive force being closed to the center of resistance of the lower incisors, a reverse curve of Spee stainless steel arch wire, the proclination of the lower incisors after treatment still remained but produced the minimal side effect at the posterior teeth. Some lower incisors proclination was seen at about 1.2± 3.1°, and the lower molar was extruded 0.3± 0.6 mm but not of significance. The success of orthodontic treatment was claimed on the control of reaction forces, the undesirable reaction forces generate during intrusion seem to be neutralized by the buccal stabilizing segment of the lower first and second molar.

Flaring of lower anterior teeth can effectively decrease deepbite which secondary to the rotational movement of the incisor crowns. For mild-to moderate correction this approach may be very effective. This option may be indicated in patients with lingual tipped incisors, such as in class II division 2 patients, or class III malocclusion with that can withstand flaring of the lower incisors.[8] The risk of flaring teeth include stability of proclined incisors because of the possible disturbance of the perioral neuromuscular balance. In nonextraction patients with anterior crowding, arch expansion and alignment takes place by proclination of the incisors as well as widening of the arch circumference.

4. Step down bends

Placement of step down bends in the archwire is also commonly used to correct deepbite. This method of correction combines extrusion of the adjacent cuspids and posterior teeth and perhaps some intrusion of the incisor. The force system from step bends has been described by Burstone and Koenig.[21] In addition to the vertical forces, the step bends create two moments in the same direction causing changes in the axial inclinations of teeth and cant of the occlusal planes that being shown as Fig 1. Step bends are indicated when there is a step between the anterior and posterior occlusal planes, in cases with moderate-to-minimal incisal display, class I occlusion. The primary drawback of this approach is the resultant indiscriminate posterior extrusion versus anterior intrusion and the change in cant of the occlusal plane towards a deeper bite.

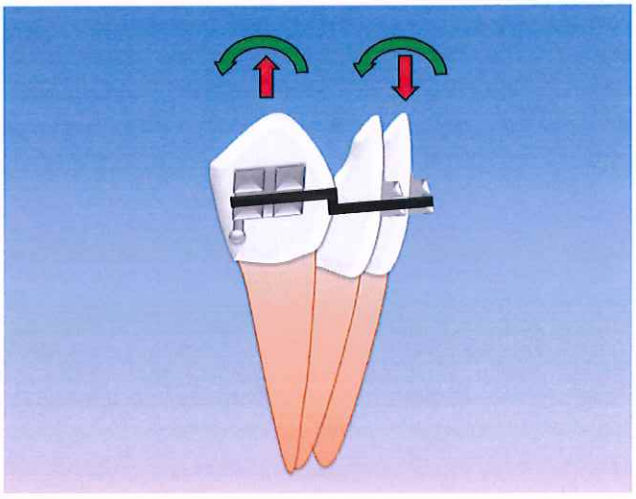

Fig. 1 forces and moments in step down bend.

5. The nickel titanium intrusion arch (CIA) and beta titanium intrusion arch (CNA)

The CIA[8] arch are fabricated from nikel-titanium wire, providing the advantages of low force magnitude and force constancy from the memory and springback charactistics of the material. This arch wire bypass the canine and premolar brackets with insertion into the molar auxiliary tube and the preactivation bend is located anterior to the molar tube. The CIA and CNA[8] are available in two dimensions (0.016x 0.022 and 0.017x 0.025 inch). The CIA also available in short and long size in both maxillary and mandibular arch. The length of span are based on the moment bends placed in front of the molars. The CNA wire are fabricated from beta-titanium alloys which are advantageous due to their lower elastic modulus compared to stainless steel while being bent, which being not possible with the nikel-titanium wire. And The CNA wire also produces the higher force maginitude compared to nickel-titanium wire. Adjusting the preactivation bends allows the clinician to control the magnitude of force.

Preparation for lower intrusive arch mechanics needs the double tube molar attachment for accessory spring. This allows use of the auxiliary tube for the active intrusion spring and the main slot of the tube can be used for primary archwires or buccal segments. Typically the four incisors are bracketed for intrusive mechanics. A rigid anterior segment joining the incisors is ideal for intrusion as it minimizes the interincisors movement. At the same time, four incisors can move as one multirooted tooth. The use of buccal segments on posterior teeth redistribute the reactive extrusive and molar tipback effects to several teeth, limited their expression. The buccal segment is not needed when the greater amount of molar correction was preferred. However, the buccal segment may not always eliminate the molar tipback and extrusion. Within the buccal segment, there is greater risk of extrusive tooth movement of the teeth anterior to the molar. The combination of the tipback rotation and extrusion is magnified in teeth more mesial to the molar tube. This effect could be problematic with respect to the canines.

Intrusion of incisors and apical root resorption

A major risk factor associated with orthodontic treatment is external apical root resorption. The specific concern is the amount of root loss in response to the direction of movement, especially incisors intrusion. But from the study of Baumrind *et al*[22] there was an average of < 0.06

mm of root shortening per mm intrusion but not of significant associations between the directional variables of intrusion and root resorption. Similarly, in the study of Deshields,[23] Kaley and Phillips[24] did not show any cause and effect relationship related to intrusion and resorption of lower incisors intrusion. However, heavy force application produced significantly more root resorption than light force application or control. During orthodontic treatment, progress radiographs obtained after 6 to 12 months might detect early root resorption. In patients in whom root resorption has been identified, there is some evidence that a 2 to 3 month treatment pause (with a passive archwire) decreases further root resorption.[25]

Objectives

1. To develop a technique for lower incisor intrusion with minimal effect of labial proclination.
2. To evaluate the tooth movement at the lower incisors, lower first premolar and lower first molars compared with the growth effect particularly being treated in growing patients.
3. To evaluate the labial alveolar bone thickness changes after the lower incisor intrusion.

Hypothesis

1. The posterior teeth of this lower incisor intrusion technique is extruded after treatment.
2. The alveolar bone thickness at each root level was not changed after lower incisor intrusion.

Significance of this study

If the study support the hypothesis that this lower incisor intrusion technique prevented the posterior teeth extrusion either lower first premolar or lower first molar, the lower incisors rate of tooth movement, changes of the inclination, initial alveolar bone thickness, and amount of intrusion are related to alveolar bone changes after lower incisor intrusion. Pre-therapeutic evaluation of bone structure and tooth conditions may be necessary to predict the treatment effects and undesirable effects after lower incisor intrusion. The comparison between the study and match-paired control group could identify the pure treatment outcomes of this appliance.

The limitation of this study

This study was performed under the limitation of time and sample size, thus the long term response of the alveolar bone could not be investigated. A longitudinal follow up study would be beneficial in explaining. The larger sample size would provide more powerful evidence in explaining the correlation between those factors.

CHAPTER 2

RESEARCH METHODOLOGY

Samples

The study was approved by the ethical committee of Faculty of Dentistry, Prince of Songkla University. The population for this study was selected from the orthodontic clinic at the dental hospital, Faculty of dentistry, Prince of Songkla University. Subjects were randomly selected from the new patient pool based on the following inclusion criteria.

1. Deep curved of Spee > 3 mm.
2. Skeletal class I or class II malocclusion with hypodivergent (SN-GoMe < 28°) or normodivergent pattern (SN-GoMe = 33± 5°).
3. Growing status indicated Cervical Vertebrae Maturation Index (CVM) stage 3-4.[26]
4. Good general health, no underlying disease altering bone metabolism such as hyperthyroidism, hypothyroidism and etc.
5. No history of trauma on the lower anterior teeth.
6. Good cooperation for in-office daytime period.

The exclusion criteria were:

1. Skeletal class I or class II malocclusion with hyperdivergent pattern (SN-MP > 38°).
2. No remaining growth from Cervical Vertebrae Maturation Index, indicated which being not in stage 5-6.
3. Present underlying disease such as hyperthyroidism, hypothyroidism.
4. Present history of trauma on the lower anterior teeth.
5. Lack of cooperation and compliance for in-office daytime period.

All the patients and their parents were informed about the purposal of the study and signed the consent form. 22 subjects were selected from the patients pools, each subject was inform about the study objectives, procedures and risk-benefit of the participation in this study. The consent form was signed prior to the study by their parents. The 22 subjects were stratified into male and

female groups, then they were selected into control group and study group with double-blind balanced randomized allocation. All of the patients were instructed the oral hygiene care for the use of dental floss and tooth brushing technique before and during treatment.

Material and methods

Development of this appliance

In order to move the teeth in vertical direction, L loop is one of designs that created an extrusion force on the short end and an intrusion force on the long end, the L loop activation would represent the step bends effect that create two moments in the same direction causing changes in the axial inclinations of teeth as shown in Fig. 2. Moreover, L loops would be adjusted and activated to move downward the opposite portion. The L shape was directly toward the posterior teeth. In order to use the archwire which exerted the lower force level while being bent and activated, the beta titanium alloy archwire was used. The various dimensions of L loops were tested with the universal testing machine for optimal force level. The L loop size 4x6 mm could exert the amount of forces by 25-30 g at the canine position and 55-60 g at the lower incisor region when being activated for intrusion by 0.5 mm. The activation of L loop was illustrated as shown in Fig 3.

Treatment sequences and appliances

Treatment protocol

Before the treatment, the patients were treated with preadjusted edgewise fixed appliances as per Roth's prescription, being a bidimensional technique (with 0.018 x 0.025 inches slot size at the lower incisors and 0.022 x 0.028 inches slot size at the lower canine and posterior teeth). The lower teeth were bonded and being aligned with round NiTi wire until finished with 0.016x 0.022 NiTi inches wire with the passive 2 step up, at the lower canine and lower incisor regions, to keep the curve of Spee before intrusion. 0.017x 0.025 inches wire with L loops mesial to the right and left lower first premolars and passive step up at the lower incisors was placed for intrusion technique and being shown as Fig 4. This wire was placed 1 month before intrusion in the oral cavity which being shown as Fig. 5. The patients were recalled for routine checks every 4 weeks. The arch

wires were adjusted at the L loops to intrude lower canines 1 mm/visit until achieving the same level as the lower first premolars (the force level is 55-60 grams approximately) and then reducing the step up of lower incisors simultaneously every visit until achieving flat a curve of Spee.

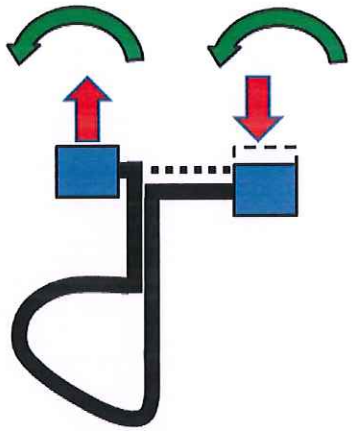

Fig. 2 Forces and moments create by L loop activation.

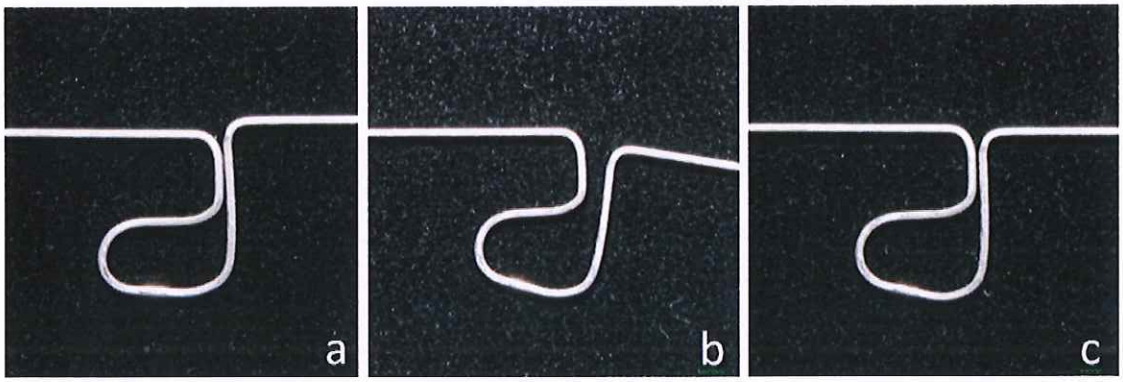

Fig. 3 L loop activation to intrude the anterior portion. **a**, before activation. **b**, open the loop by open the distal L shape then the anterior portion move downward and forward. **c**, move the anterior vertical leg upward and backward into original horizontal position.

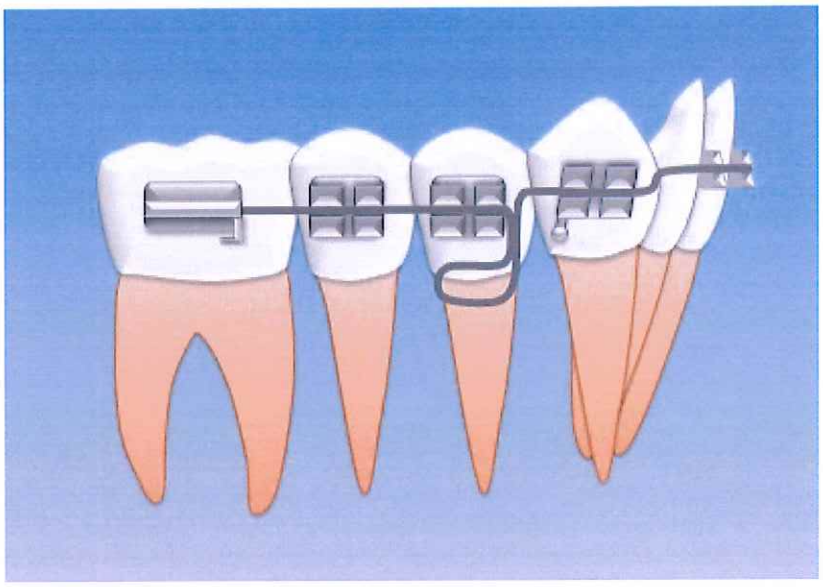

Fig. 4 A lower intrusion arch wire with L loops in this study.

Records and data analysis

The analysis of the tooth movement in control and study groups were derived from cephalogram tracing. The registrations from the lateral cephalograms were performed on acetate tracing paper. To evaluate the changes of tooth movement, the vertical jigs with rectangular and circular loops were placed at the same right and left first premolars and molars respectively in study and control groups. The comparison of the two lateral cephalograms were evaluated before and after intrusion in study group (T1 and T2 respectively), before and after observation period in control group T0 and T1 respectively). The T1 cephlograms in study group was shown as Fig. 6. All cephalograms were taken with the same calibrated cephalostat. The magnification factor of the lateral cephalograms was similar both study and control group. The measurement of each parameter was made with a digital vernier caliper. Linear measurements were made to the nearest 0.5 mm and 0.5°.

Reference lines

- MP (mandibular plane): the line through the menton to the lower border of the most posterior inferior of the angle of the mandible.
- ASP (anterior aspect of internal border of the symphysis plane): The line through the anterior border of the internal border of the symphysis perpendicular to the mandibular plane.

- PSP (The most posteroinferior aspect of internal border of the symphysis plane): The line through the posterior border of the internal border of the symphysis perpendicular to the mandibular plane.

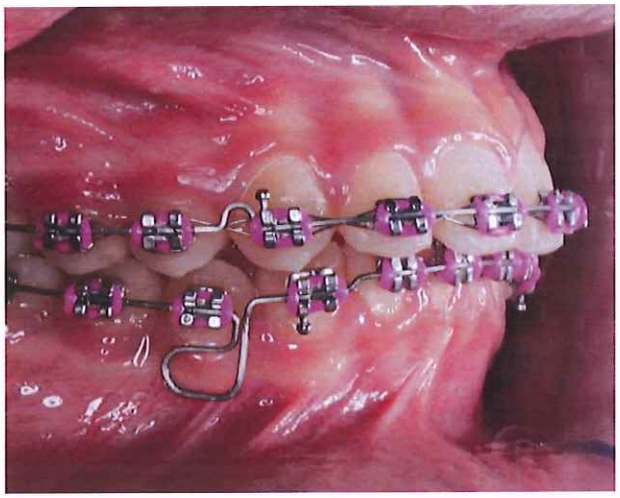

Fig. 5 Intraoral appliance before intrusion in study group (T1).

Fig. 6 A lateral cephalogram before intrusion in study group (T1).

Cephalometric analysis

From tracing cephalometric radiographs, parameters were measured in distances and angles evaluated the movement of the lower incisor, the lower first premolar and the lower first molar horizontally and vertically, as shown on Fig. 7 with the following parameters:

- LIMP: The angle between the lower incisors and the MP line.
- LIi_Horizontal: The horizontal distance between the lower incisal tip perpendicular to the ASP line.
- LIi_Vertical: The vertical distance between the lower incisal tip perpendicular to the MP line.
- LIA_Horizontal: The horizontal distance between the lower incisal apex perpendicular to the ASP line.
- LIA_Vertical: The vertical distance between the lower incisal apex perpendicular to the MP line.
- L4i_Horizontal: The horizontal distance between the cusp tip of the lower first premolar perpendicular to the ASP line.
- L4i_Vertical: The vertical distance between the cusp tip of the lower first premolar perpendicular to the MP line.
- L4A_Horizontal: The horizontal distance between the mesial root apex of the lower first premolar perpendicular to the ASP lineL4A_Vertical: The vertical distance between the mesial root apex of the lower first premolar perpendicular to the MP and ASP line.
- L6i_Horizontal: The horizontal distance between the mesiobuccal cusp tip of the lower first molar perpendicular to the ASP line.
- L6i_Vertical: The vertical distance between the mesiobuccal cusp tip of the lower first molar perpendicular to the MP line.
- L6A_Horizontal: The horizontal distance between the mesial root apex of the lower first molar perpendicular to the ASP line.
- L6A_Vertical: The vertical distance between the mesial root apex of the lower first molar perpendicular to the MP The MP and ASP line.

From T1 in study group or T0 in control group, the references grid was performed in each case. The grid was ASP and MP line. This reference grid that was transferred from T1 to T2 in

study group, from T0 to T1 in control group. The superimposition landmark registed at the posterior part of posterior and inferior internal border of cortex of the symphysis and internal border of mandibular canal.[27-28]

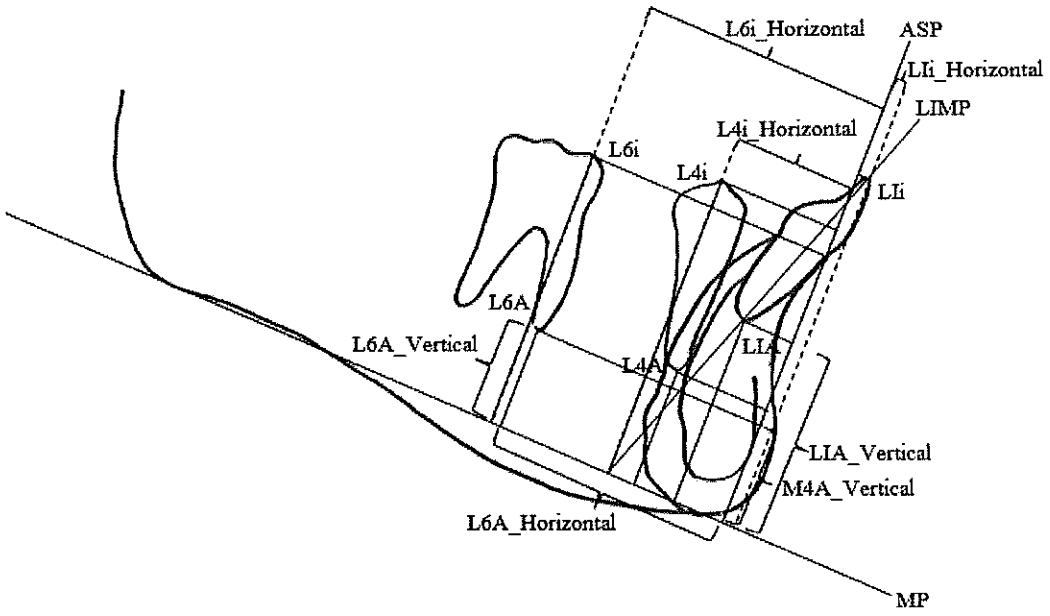

Fig. 7 Cephalometric landmarks, linear and angular measurement for evaluated treatment effects.

The labial alveolar bone thickness of the lower incisors (LBT)

The change of labial alveolar bone thickness in study group was evaluated using CT scan (3D Accuitomo 170 (J. Morita Corp., 90 kv, 70 mA, 17500 mS, resolution 80 μm voxel size (0.125 mm/slice)). The line of measurement was perpendicular to the long axis of the lower incisor. The lower incisor of each case was randomly selected for measurement before and after intrusion (T1 and T2 respectively). Measurement[29] was taken at the site adjacent to the widest point of labiolingual root in 3 slices separated by 3 mm. from CEJ, (S1, S2 and S3). The researcher compared the labial alveolar bone thickness change after intrusion at labial aspect of marginal level (S1), mid root level (S2) and apical level (S3) which was being shown as Fig 8.

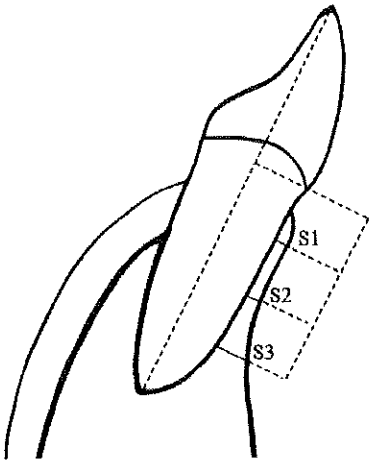

Fig. 8 Location of bone thickness measurements before and after intrusion.

Before lower incisor intrusion (T1), all CT scan was taken 3 measurements on the labial aspect of the root. The same measurement was repeated after completed lower intrusion (T2). All measurement of the CT scan was traced by the same investigator using the same level as those at T1, using the same CEJ level.

All data was analyzed with the SPSS 17.0 statistical program. The means and standard deviations were evaluated. The differences in probabilities of less than 5% ($P<0.05$) were considered statistically significant.

1. The differences between the lower incisors, first premolar and first molar movement before treatment (T1) and after intrusion (T2) of study group were evaluated by Pair t test.

2. The differences of labial bone thickness of the lower incisors movement before treatment (T1) and after intrusion (T2) of study group were evaluated by Pair t test.

3. The differences between the lower incisors, first premolar and first molar movement before and after treatment (T1 and T2 respectively) of study group and control group were evaluated by the independent t test.

Statistical analysis

The Sharpiro-Wilk test was used to evaluate the normal distribution of the data. The paired *t* test or Wilcoxon sign rank test was applied to evaluate the growth effect and treatment effect within each group. The independent *t* test or Mann-Whitney U test was applied to evaluate the differences between groups with a 0.05 significant level.

The reproducibility of measurement of the tooth angulation and the labial bone thickness was assessed by calculating method error from the difference between two measurements taken at least two weeks apart. The measurement error was calculated from the formula of Dahlberg:[30] and the reliability of the data was evaluated by the intraclass correlation coefficients.

$$\text{Method error} = \sqrt{\sum d^2 / 2n}$$

d = the difference between the duplicate measurements

n = the number of duplicate measurements

CHAPTER 3

RESULT

At the beginning of the study there were 22 subjects participating in this study. The samples in this study eventually included 14 males and 8 females. The subjects were simple randomly divined into study and control groups, each group consisted of 7 males and 4 females. The mean age of control group and study group was 11.2± 0.8 and 11.5± 0.8 years respectively, ranging from 10-13 years. The observation time in control group was 6.7± 1.6 months and the treatment time in study group was 6.3±1.3 months.

Measurement error analysis

Before research and clinical practice, the prerequisite of identification errors of landmarks by Trpkova *et al* [31] was 0.5 mm and 0.5° from linear distances and angulation measurement respectively. In this study, the 10 lateral cephalograms were randomly selected from both groups and all measurement being repeated 2 weeks apart and calculated to determine the intra observer reliability. Dahlberg's error was 0.41 mm ranging from 0.0 to 0.5 mm for the distance measurement from lateral cephalograms, 0.06 mm, ranging from 0.0 to 0.46 mm for the distance measurement from computed tomography, and 0.4°, ranging from 0.0° to 1.0° for the angular measurement. The intraclass correlation coefficients were performed to assess the reliability of the measurements. The reliability of measurements was found to be within 0.81-0.85, and the method was found an acceptable level.

The lateral cephalometric analysis

The result of comparison of lateral cephalometric analysis between the study group and control group showed that there were not statistically differences of skeletal and dental parameters between these groups as being shown in table 1.

Table 1 Cephalomtric parameters comparision between control group and study group.

Parameters	Control groups (Mean±SD)	Study group (Mean±SD)	*p*-value
FH-SN	6.4±2.2	8.8±3.6	0.07
SNA	83.8±1.7	82.3±4.0	0.28
SNB	79.1±1.7	77.7±3.3	0.24
ANB	4.6±2.0	4.6±1.8	1.00
AO_BO	-0.5±2.7	-0.4±3.2	0.94
A_NPerp	-0.1±2.9	-0.5±2.8	0.76
Pg_NPerp	-8.2±4.1	-8.2±3.5	1.00
SN_GoMe	32.8±2.4	32.8±3.3	1.00
FMA	26.4±2.0	24.2±4.9	0.18
Occl_SN	17.6±2.4	19.9±3.9	0.11
NS_Gn	66.5±2.7	68.0±2.7	0.21
UI_NA	34.3±9.0	38.4±9.4	0.31
UI-NAmm	10.0±4.0	10.4±3.6	0.80
LI_NB	30.2±8.1	27.7±7.9	0.46
LI_NBmm	7.8±3.1	7.5±2.6	0.83
UI_LI	111.1±8.1	108.1±6.7	0.36
UIPP	125.8±8.0	129.9±9.4	0.29
LIMP	98.2±8.6	98.5±7.8	0.93
OB	4.5±0.7	4.6±0.8	0.58
OJ	6.2±1.9	7.1±2.3	0.33
COS	3.1±0.3	3.4±0.7	0.24
LFH	71.6±2.3	71.6±1.3	0.96

In control group, there was statistically significant forward movement of the lower incisor apex 0.5 mm ($p = 0.04$), and the lower incisor retroclined by about 0.7°± 0.2°and extruded by about 0.7± 0.3 mm but being not statistically significant. The lower first premolar significantly showed an increase of vertical direction by about 0.4± 0.3 mm ($p = 0.01$). A little bit lower first molar extrusion was seen (0.2± 0.2 mm) which was not of significance.

Table 2 The growth effects in control group.

Parameters	Before (T0)		After (T1)		T1-T0		Sig
	Mean	SD	Mean	SD	Mean	SD	
LIMP(°)	99.9	7.4	99.2	7.3	-0.7	0.2	0.89
LIi_Vertical(mm)	42.0	2.4	42.8	2.4	0.7	0.3	0.08
LIi_Horizontal(mm)	-2.0	4.1	-2.1	4.0	-0.1	0.6	0.49
LIA_Vertical(mm)	21.4	8.0	21.9	7.9	0.5	0.4	0.31
LIA_Horizontal(mm)	-7.0	1.9	-6.5	1.8	0.5	0.8	0.40
L4i_Vertical(mm)	35.7	2.5	36.6	2.5	0.4	0.3	<0.01*
L4i_Horizontal(mm)	-15.8	2.4	-16.0	2.4	-0.1	0.3	0.19
L4A_Vertical(mm)	13.7	2.4	14.5	2.5	0.4	0.3	<0.01*
L4A_Horizontal(mm)	-10.4	9.2	-10.5	9.2	-0.2	0.3	0.10
L6i_Vertical(mm)	32.4	2.4	32.7	2.3	0.2	0.2	0.11
L6i_Horizontal(mm)	-30.6	1.8	-30.7	1.8	0.0	0.0	-
L6A_Vertical(mm)	11.9	2.9	12.2	2.8	0.1	0.2	0.17
L6A_Horizontal(mm)	-30.6	2.5	-30.6	2.4	-0.4	0.2	0.34

*Significant value $p < 0.05$

In the study group, as shown in table 3, there was statistically significant retroclination of the lower incisor by about 1.5°± 0.7° ($p < 0.01$). This lower incisor intrusion technique could significantly intruded lower incisors by about 2.5± 0.2 mm ($p < 0.01$) and moved the apex downward more than the incisal region (2.9± 0.4 mm, $p < 0.05$). Some lower first premolar extrusion was statistically significant (0.4 mm, $p < 0.01$).

On the lower first molars, there was a little bit of extrusion by about 0.2± 0.3 mm but not of significance, and the movement in the horizontal direction was not seen. This intrusion technique showed that there was no clinical and statistically significant movement of the posterior anchorage any direction as shown in Fig. 9 and Fig 10.

Fig. 9 A lateral cephalogram after intrusion (T2).

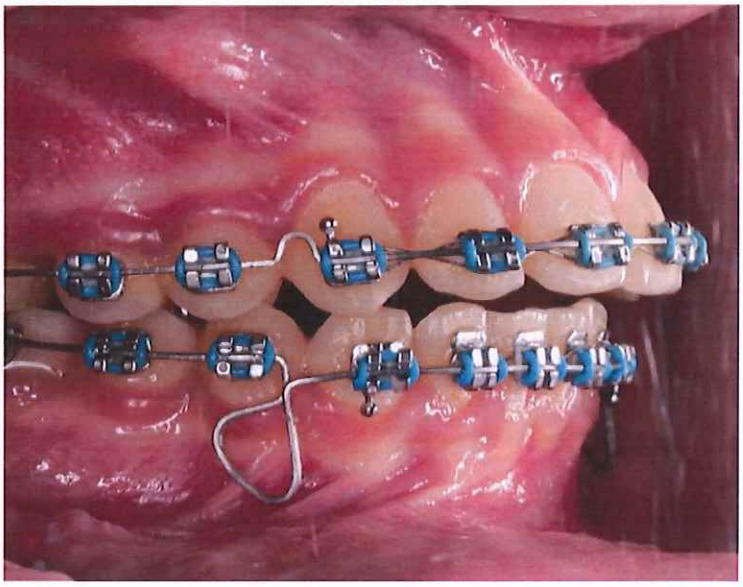

Fig. 10 Intraoral appliances after activation in study group (T2).

Table 3 The treatment effects in study group.

Parameters	Before (T1)		After (T2)		T2-T1		Sig
	Mean	SD	Mean	SD	Mean	SD	
LIMP(°)	99.2	7.1	97.6	6.9	-1.5	0.7	<0.01*
LIi_Vertical(mm)	43.2	2.4	40.7	2.3	-2.5	0.2	<0.01*
LIi_Horizontal(mm)	-3.5	3.4	-3.6	3.5	-0.2	0.6	0.34
LIA_Vertical(mm)	22.9	7.4	19.9	7.5	-2.9	0.4	0.01*
LIA_Horizontal(mm)	-7.0	1.5	-6.6	1.6	0.5	0.8	0.07
L4i_Vertical(mm)	36.8	2.5	37.3	2.5	0.4	0.3	<0.01*
L4i_Horizontal(mm)	-16.7	1.8	-16.8	1.8	0.0	0.0	-
L4A_Vertical(mm)	14.9	2.2	15.4	2.2	0.4	0.3	<0.01*
L4A_Horizontal(mm)	-13.3	2.0	-13.4	2.2	-0.1	0.3	0.34
L6i_Vertical(mm)	32.9	2.2	33.1	1.2	0.2	0.3	0.38
L6i_Horizontal(mm)	-30.8	1.2	-30.8	2.4	0.0	0.0	-
L6A_Vertical(mm)	12.8	2.4	13.0	2.3	0.2	0.3	0.38
L6A_Horizontal(mm)	-30.3	2.3	-30.3	1.2	0.0	0.0	-

*Significant value $p < 0.05$

The amount of tooth movement and direction in study group were compared with the control group to analyze the exact effect of this appliance being treated in growing patient. From the Table 4, the lower incisor inclination in study group was significantly retroclined more than the control group by about 0.8°± 0.2 ° ($p < 0.01$). The amount of lower incisor movement in vertical direction between two groups was significant, the difference between normal vertical growth and intrusion effect at lower incisal region and apex was 3.3± 0.1 mm ($p < 0.01$) mm and 3.4± 0.2 mm ($p < 0.01$) respectively, the horizontal movement was not of significance. At the lower first premolar, there was not of difference in vertical direction between groups but a little bit difference in horizontal movement at the apex. The lower first molar also showed the same results. The rate of tooth movements was showed in Table 5.

Table 4 Differences between growth observation in control group and treatment effect in study group.

Parameters	Control group T1-T0		Study group T2-T1		Differences between groups		Sig
	Mean	SD	Mean	SD	Mean	SD	
LIMP(°)	-0.7	0.2	-1.5	0.7	-0.8	0.2	<0.01*
LIi_Vertical(mm)	0.7	0.3	-2.5	0.2	-3.3	0.1	<0.01*
LIi_Horizontal(mm)	-0.1	0.6	-0.2	0.6	-0.1	0.3	0.86
LIA_Vertical(mm)	0.5	0.4	-2.9	0.4	-3.4	0.2	<0.01*
LIA_Horizontal(mm)	0.5	0.8	0.5	0.8	-0.1	0.3	0.78
L4i_Vertical(mm)	0.4	0.3	0.4	0.3	0.0	0.0	1.00
L4i_Horizontal(mm)	-0.1	0.3	0.0	0.0	-0.1	0.1	0.17
L4A_Vertical(mm)	0.4	0.3	0.4	0.3	0.0	0.0	1.00
L4A_Horizontal(mm)	-0.2	0.3	-0.1	0.3	-0.1	0.1	0.53
L6i_Vertical(mm)	0.2	0.2	0.2	0.3	0.0	0.1	1.00
L6i_Horizontal(mm)	0.0	0.0	0.0	0.0	0.0	0.0	-
L6A_Vertical(mm)	0.1	0.2	0.2	0.3	0.1	0.1	0.66
L6A_Horizontal(mm)	0.0	0.2	0.0	0.0	0.1	0.1	0.33

*Significant value $p < 0.05$

Table 5 Rate of tooth movements in control group and study group.

	Growth effect per month in control group	Treatment effect per month in study group	Mean differences	*p* value
Lii_Vertical	0.13 ± 0.06	-0.43 ± 0.06	-0.55 ± 0.02	<0.01*
L4i_Vertical	0.07 ± 0.05	0.08 ± 0.04	0.01 ± 0.02	0.61
L6i_Vertical	0.03 ± 0.05	0.03 ± 0.05	0.00 ± 0.02	1.00

*Significant value $p < 0.05$

The computed tomography analysis

Shapiro-Wilk test was used to test of normality, and found that mean labial alveolar bone thickness was normal distribution. When the labial bone thickness was evaluated by CT scan after intrusion in study group as shown in Table 6, there was significance reduction of the bone at the marginal level (S1) by about -0.2± 0.2 mm ($p < 0.01$). However, the bony was increased at the mid root level by about 0.1± 0.2 mm but not of significance. The apical level (S3) showed the similarities increased bony thickness by about 0.4± 0.6 mm ($p < 0.01$)

Table 6 Difference between growth observation in control group and treatment effect in study group.

Parameters	Before (T1)		After (T2)		Differences (T2- T1)		Sig
	Mean	SD	Mean	SD	Mean	SD	
S1	0.2	0.2	0.1	0.2	-0.2	0.2	<0.01*
S2	0.5	0.5	0.6	0.6	0.1	0.2	0.06
S3	1.7	1.7	2.1	1.4	0.4	0.6	0.03*

*Significant value $p < 0.05$

CHAPTER 4

DISCUSSION

The lower incisors intrusion is the most suitable deepbite treatment in such a case indicated deep curve of Spee. Especially in class II patients which the lower posterior teeth was infraeruption and the lower anterior teeth was supraeruption. The treatment plan in this case is suitable for both intrusion and extrusion of posterior teeth. But the side effects of many treatment modalities were lower incisor proclination. Even though where there were mechanics preventing the side effect of lower incisor proclination controlled by using the light force level, or else lingual crown torque in the anterior portion, the lower incisors proclination might have occurred. To achieve this objective, the counter clockwise moment at the lower anterior teeth brackets would encountered this adverse effect and the reciprocal force intruding the lower incisor might enhanced the posterior teeth extrusion. This study is not involved growing patients with long vertical dimensions; therefore, the effect of posterior extrusion might be not worsen the facial opening rotation of mandible and this technique enhanced the normal mandibular forward movement.

The success of the prevention of this lower incisor proclination could be explained from three reasons. First, the step down bend was used in order to intrude the lower incisor, extruded the posterior teeth and the counter clockwise moment at the anterior portion would encounter flaring of lower incisor. The second, changes of the geometry of L loops during activation, which were placed between the canines and the lower first premolars, could tipped the canine crown backward during intrusion because of the effect of step bend which being shown in Fig 11. Then the lower incisors would retroclined simultaneously which being shown in Fig 12. And third, the light force level of intrusion and activation could reduce the chance of lower incisor proclination but the reciprocal force reaction of the posterior teeth might be reduced. However, the exactly amount of moments either the anterior or the posterior units could not be measured directly.

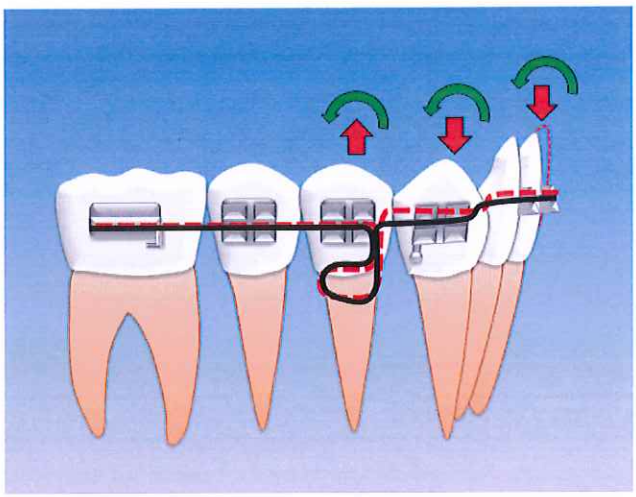

Fig. 11 The effect of L loop activation.

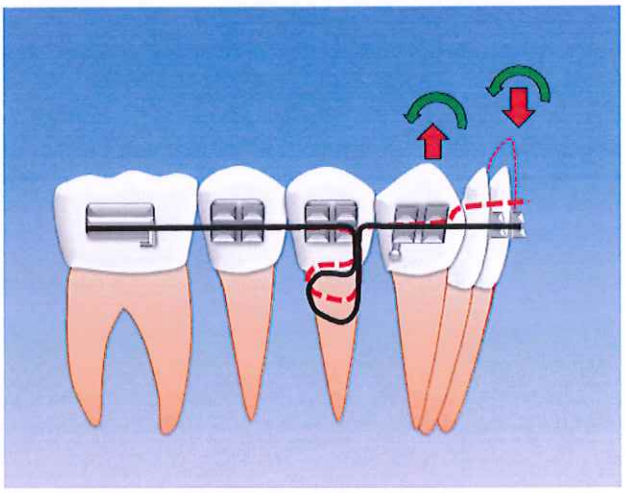

Fig. 12 The effect of step bend activation.

The amount of intrusion distance was similar to other studies[1, 4-6] but there was different methods of measurement in this explanation. Varlik[1] could intruded lower incisors by utility arch by about 2.6± 1.4 mm, using center of resistance as reference landmark, whereas Aydogdu and Oszoy[6] could intruded lower incisor by about 1.5± 0.6 mm but they used the center of resistance and clinical crown tip as the references. In both techniques there was slightly relative intrusion because the inclination of the lower incisors was more proclined. From this study, the lower incisor tip and apex were used to clearify the manner of tooth movement both vertical and horizontal directions. The lower incisors were retroclined in which the incisal tips being moved downward and backward whereas the lower incisor apex being moved downward and slightly forward instead. In vertical

direction, the lower incisors apex was move downward more than the lower incisal tips, indicated that there was a retroclination of the lower incisor during intrusion

The side effect of posterior extrusion might be occur in any technique of lower incisors intrusion. In this technique, there was less posterior teeth extrusion because of the L loop design and activation of this technique. The little amount of loop activation by about 0.5 mm/month exerted the lower intrusion force level which reduced the reciprocal extrusion force and the step of intrusion in which to flat the canine level as same as the posterior unit before the lower incisor intrusion being completed might be increased the posterior anchorage unit by included the lower canines as if the posterior unit simultaneously. In which mandibular incisor intrusion was performed with segmental or sectional arches[1] the posterior teeth extrusion would occurred in the mandibular molars. In the study of Dake and Sinclair,[32] when the mandibular incisors were intruded with utility arches, they reported 2.6 mm of mandibular molar extrusion. Al Buraiki *et al*[33] used lever arches and reported 1.6 mm of mandibular molar extrusion. The lower molar extrusion could be explained in which these 3 studies were conducted with growing subjects who had a likelihood of continuing molar eruption[34] and used higher force level more than in this study. Moreover, the intrusion force used in this study was higher than that was used by some researcher,[1,32-33] but an intrusion force of 55-60 g being used by this technique might not have affected the posterior vertical anchorage.

Aydogdu and Ozsoy[6] found that there was lower incisors proclination after treatment because the point of force application was applied in front of the center of resistance of the lower incisors and the initial angulation of the lower incisors were more proclined before treatment. However, in this study, the point of force application was still applied at the facial aspect of lower incisors, but the effect of distal tipping of canine from geometry changes of step bends after L loops activation could control and retroclined the lower incisors encountering this adverse effect on proclination during treatment. The retroclination of lower incisors from this study would prevent the lower incisor proclination which more pronounced in class II adults or non-growing patients.

The posterior teeth eruption might be occur in growing patient but in class II deepbite patients there was infraeruption of posterior teeth that lead to promote the posterior teeth eruption in those cases during growth period which the growth could catch up the forward movement of the mandible. Baccetti, Franchi and McNamara Jr[34] found that in class II deepbite patients, there was 1.6 mm of lower first molar eruption during pubertal growth period of 3 years observation and Stahl *et al.*[2] found that there was a infraeruption of posterior teeth in class II patients compared with

the normal occlusion. In this studt, a little bit of lower first molar eruption was shown in control group by about 0.2± 0.2 mm. The eruption of this study was lower than other studies because of the difference of observation times and type of subjects. The lower first premolars also showed the significant normal eruption by about 0.4 ± 0.2 mm and the lower incisors were erupted by about 0.7 ± 0.3 mm but not of significance.

The comparison between treatment effect and growth effect was useful to explain the effect of this mechanic in this study. The result of treatment effect in the study group after compared with the growth effect in control group could reveal the pure intrusion with less of posterior teeth eruption. The reason why the lower incisal tips could be flatten as same as the level of the average initial curve of Spee in the study group because this technique could intruded and overcame the normal vertical eruption of the lower incisors. And this comparison between groups indicated that this intrusion technique being not extruded either the lower first premolars or the lower first molars but a few amount of extrusion came from normal vertical eruption.

Cephalometric radiographs are midsagittal projection; thus the actual limit of the labial bone thickness of the symphysis at the midline may be narrower than the trace image.[35] CBCT is now use to qualitatively and quantitatively assess this bony area. Fuhrmann *et al*[36] showed that quantitative evaluation of alveolar bone plates is accurate to a minimum bone thickness less than 0.5 mm and CT findings have proven to be statistically similar to histologic measurements. Considering this, CT measurements is more accurately for bone-width changes evaluation.

The result demonstrated that this technique could move the lower incisors downward into more alveolar bone housing especially mid root and apex region. Although the apex was moved a little bit forward but the amount of intrusion was greater. This intrusion could cause the marginal alveolar bone loss. This loss would be more pronounced at the marginal region because of the root shape, the wider labio-lingual width at the upper level. When the tooth was moved downward, the limit extent of the marginal region could be reduced even though there was some retroclination. The reason that the reduced marginal bone level might be occur due to the heavy force of intrusion. Although the forces exertion by this archwire was measured and controlled during study period, the individual biological tooth response might be different, or else, the CBCT was performed immediately after completed intrusion, there was progress of bone remodeling process in this period. Fuhrmann *et al*[36] suggested that the labial bone thickness changes could be reevaluated 4-6 months for completed remodeling process.

From the results of this technique, the important clinical application is that this technique could be used in the cases the lower incisor intrusion and the minimal posterior teeth extrusion being indicated or else the clockwise rotation of the mandible was not preferred. However, this technique was not altered the normal posterior teeth eruption in the growing patients, then changes of skeletal configuration would came from their remaining skeletal and dentoalveolar growth compensation. The expletive treatments or alternative treatments modalities might be used in order to heighten the posterior teeth. To achieve this lower incisor intrusion technique, the passive step up at the canines and lower incisors must being obtained during leveling phase before intrusion because when flat the curve of Spee in each sequences the step bend effect would be perform effectively with the remaining vertical steps.

CHAPTER 5

CONCLUSION

1. This intrusion technique could intrude and retrocline lower incisors with the minimal effect of posterior teeth extrusion.

2. The lower incisor was moved downward into the more alveolar bone housing especially at the mid root and apex level but there was decreased labial bone thickness at marginal level. However, the longer period of observation is needed for completed remodeling process.

REFERENCES

1. Varlik SK, Alpakan OO, Turkoz Ç. Deepbite correction with incisor intrusion in adults: A long-term cephalometric study. ***Am J Orthod Dentofacial Orthop*** 2013; 144: 414-419.
2. Stahl S, Baccetti T, Franchi L, McNamara JA Jr. Longitudinal growth changes in untreated subjects with class II division 1 malocclusion. ***Am J Orthod Dentofacial Orthop*** 2008; 134: 125-137.
3. Buschang PH, Julien K, Sachdeva R, Demirjian A. Childhood and pubertal growth changes of the human symphysis. ***Angle Orthod*** 1922; 62(3): 203-209.
4. Ricketts RM. Bioprogressive therapy as an answer to orthodontic needs: Part I. ***Am J Orthod*** 1976; 70: 241-248.
5. Amasyali M, Sagdic D, Olmez H, Akin E, Karacay S. 2005. Intrusive effects of the Connecticut intrusion arch and the utility intrusion arch. ***Tur J Med Sc.*** 2005; 3: 407-417.
6. Aydogdu E, Ozsoy OP. Effects of mandibular incisor intrusion obtained using a conventional utility arch vs bone anchorage. ***Angle Orthod*** 2011, 81: 767-775.
7. Burstone CJ. Deep overbite correction by intrusion. ***Am J orthod*** 1977; 72: 1-22.
8. Burstone CJ. Biomechanics of deep overbite correction. ***Semin Orthod*** 2001; 7: 26-33.
9. Nanda RS. Biomechanics and esthetic strategies in clinical orthodontics. 2005; Sauders: 140.
10. Nanda RS, Tosun YS. Biomechanics in orthodontics: Principles and practice. Quintessence publishing. 2007.
11. Hong RK, Hong HP, Koh HS. Effect of reverse curve mushroom archwire on lower incisors in adult patients: A prospective study. ***Angle Orthod*** 2001; 71: 425–432.
12. Bellamy LJ, Kokich VG, Weissman JA. Using orthodontic intrusion of abraded incisors to facilitated restoration; The technique's effects on alveolar bone level and root length, ***JADA*** 2008; 139(6): 725-733.
13. Ramirez-Echave, J. I., Buschang PH, et al. Histologic evaluation of root response to intrusion in mandibular teeth in beagle dogs. ***Am J Orthod Dentofacial Orthop*** 2011; 139(1): 60-69.
14. Melsen B, Agenbæk N, Markenstam G. Intrusion of incisors in adult patients with marginal bone loss. ***Am J Orthod Dentofacial Orthop*** 1989; 96: 232-241.
15. Ruf S, Hansen K et al., Does orthodontic proclination of lower incisors in children and

adolescents cause gingival recession?, ***Am J Orthod Dentofacial Orthop*** 1998, 114(1): 100-106.

16. Erkan M, Pikdoken L et al., Gingival response to mandibular incisor intrusion, ***Am J Orthod Dentofacial Orthop*** 2007: 132(2).
17. Proffit WR. Contemporary orthodontics. 4th edition Mosby. 2007.
18. Raboud D, Faulkner G, Lipsett B, Haberstock D. Three-dimensional force systems from vertically activated orthodontic loops. ***Am J Orthod Dentofacial Orthop*** 2001; 119: 21-29.
19. Techalertpaisarn P, Versluis A. Mechanical properties of opus closing loops, L-loops, and T-loops investigated with finite element Analysis ***Am J Orthod Dentofacial Orthop*** 2013; 143: 675-83.
20. Ricketts RM. Bioprogressive therapy: Book 1 1976. Rocky Mountain. 111-118.
21. Burstone CJ, Koenig HA. Creative wire bending-the force system from – step and V bends. Am J Orthod Dentofacial Orthop 1988; 93: 59-67.
22. Baumrind S, Korn EL, Boyd RL. Apical root resorption in orthodontically treated adults. ***Am J Orthod Dentofacial Orthop*** 1996; 110: 311-320.
23. DeShields RW, A study of root resorption in treated class II, Div 1 malocclusion. ***Angle Orthod*** 1969; 39: 231-245.
24. Kayley JP, Phillips C. Factors related to root resorption in edgewise practice. ***Angle Orthod*** 1991; 61:125-132.
25. Weltman B, Vig KW, Fields HW, Shanker S, Kaizar EE. Root resorption associated with orthodontic tooth movement: A systematic review. ***Am J Orthod Dentofacial Orthop*** 2010; 137(4): 462-76.
26. Ball G, Tompson B, Hunter WS, Posluns J. Relationship between cervical vertebral maturation and mandibular growth. ***Am J Orthod Dentofacial Orthop*** 2011; 139(5): 455-461.
27. Ricketts RM. Perspectives in the clinical application of cephalometrics, the first fifty years. ***Angle Orthod*** 1981; 51:115-50.
28. McNamara JA Jr. A method of cephalometric evaluation. ***Am J Orthod*** 1984; 86: 449-69.
29. Sarikaya S, Hayder B, Ciger S, Ariyurek M. Changes in alveolar bone thickness due to retraction of anterior teeth. ***Am J Ortho Dentofacial Orthop*** 2002; 122: 15-26.
30. Dahlberg G. Statistical methods for medical and biological students. London, United Kingdom:

G. Allen & Unwin; 1940.

31. Trpkova B, Majorv P, Prasad N, Nebbe B. Cephalometric landmarks identification and reproducibility: A Meta-analysis. ***Am J Ortho Dentofacial Orthop*** 1997; 112: 165-170.
32. Dake ML, Sinclair PM. A comparison of the Ricketts and Tweed-type arch leveling techniques. *Am J Orthod Dentofacial Orthop* 1989; 95: 72–78.
33. Al-Buraiki H, Sadowsky C, Schneider B. The effectiveness and long-term stability of overbite correction with incisor intrusion mechanics. ***Am J Orthod Dentofacial Orthop*** 2005; 127: 47–55.
34. Baccetti T, L. Franchi L, McNamara JA.Jr. Longitudinal growth changes in subjects with deepbite. ***Am J Orthod Dentofacial Orthop*** 2011; 140: 202–209.
35. Handelman CS. The anterior alveolus: its importance in limiting orthodontic treatment. ***Angle Orthod*** 1996; 2: 95-110.
36. Fuhrmann RAW, Wehrbein H, Langen HJ, Diedrich PR. Assessment of the dentate alveolar process with high resolution computed tomography. ***Dentomaxillofac Radiol*** 1995; 24: 50-4.

APPENDICES

ใบเชิญชวน

ขอเชิญเข้าร่วมโครงการวิจัยเรื่อง โครงการวิจัยเรื่อง ผลของการกดฟันหน้าล่างในผู้ป่วยสบฟันผิดปกติประเภทที่ 2 ที่มีการเจริญเติบโต

เรียนท่านผู้อ่านที่นับถือ

ข้าพเจ้า ทพ.ชาญวิทย์ ตันติกัลยาภรณ์ นักศึกษาระดับปริญญาโท สาขาทันตกรรมจัดฟัน ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ ใคร่ขอเล่าถึงโครงการวิจัยที่กำลังทำอยู่และขอเชิญชวน ท่านเข้าร่วมโครงการนี้ ดังนี้

โครงการวิจัยนี้ทำขึ้นเพื่อพัฒนาวิธีการที่ใช้ในการแก้ไขการสบฟันผิดปกติประเภทที่ 2 ที่มีการสบลึก ในผู้ป่วยที่มีการเจริญเติบโตด้วยเครื่องมือที่ใช้การกดฟันตัดหน้าล่างซึ่งระบบดังกล่าวจะสามารถแก้ไขตำแหน่งของฟันหน้าล่างจนได้ตำแหน่งปกติอย่างปลอดภัย

ผู้ป่วยที่เข้าร่วมโครงการวิจัยจะถูกเลือกเข้ากลุ่มแบบสุ่ม ให้เป็นผู้ป่วยในกลุ่มควบคุมหรือกลุ่มวิจัยอย่างใดอย่างหนึ่ง โดยกลุ่มควบคุม ผู้ป่วยจะได้รับการติดตามการเจริญเติบโต (growth monitoring) เป็นเวลา 6 -12 เดือน โดยจะทำการบันทึกข้อมูล ได้แก่ การถ่ายภาพรังสีกะโหลกศีรษะด้านข้าง 2 ครั้ง ระยะเวลาห่างกันเป็นเวลา 6-12 เดือน เพื่อติดตามการเจริญเติบโตในผู้ป่วย (Growth monitoring project) คลินิกทันตกรรมจัดฟัน มหาวิทยาลัยสงขลานครินทร์ หลังจากนั้นผู้ป่วยจะได้รับการรักษาแยกการรักษาจากคิวปกติ

กลุ่มวิจัยจะได้รับการจัดฟันโดยเครื่องมือจัดฟันชนิดติดแน่นร่วมกับระบบการเคลื่อนฟันตัดหน้าล่างโดยวิธีการกดฟัน ผู้ป่วยที่เข้าร่วมวิจัยจะได้รับการรักษาทางทันตกรรมจัดฟันโดยได้รับการแยกรักษาจากคิวรักษาปกติเช่นกัน ได้รับการตรวจและบันทึกข้อมูลซึ่งประกอบด้วยการซักประวัติ เช่น ข้อมูลทั่วไป ประวัติทางทันตกรรม ประวัติการแพทย์ ได้รับการตรวจนอกช่องปากและภายในช่องปาก การถ่ายภาพภายนอกและภายในช่องปาก การถ่ายภาพรังสีด้านข้างกะโหลกศีรษะ ภาพถ่ายรังสีพานอรามิก ภาพถ่ายรังสีคอมพิวเตอร์ในช่องปาก และการพิมพ์ปากเพื่อทำแบบจำลองฟัน โดยขั้นตอนการวิจัยดังกล่าวเป็นส่วนหนึ่งของแผนการรักษาโดยรวมซึ่งมีขั้นตอนในการรักษาดังนี้

- บันทึกข้อมูลเบื้องต้นก่อนการรักษา
- ติดเครื่องมือจัดฟันติดแน่น
- ปรับระดับฟัน
- บันทึกข้อมูลก่อนการเคลื่อนฟันตัดหน้าล่างโดยวิธีการกดฟันเข้าในกระดูกเบ้าฟัน
- เคลื่อนฟันตัดหน้าล่างเข้าสู่กระดูกเบ้าฟันโดยวิธีการกดฟันบันทึกข้อมูลหลังเคลื่อนฟันตัดหน้าล่างเข้าสู่กระดูกเบ้าฟันโดยวิธีการกดฟัน
- ให้การรักษาความผิดปกติของการสบฟันในตำแหน่งอื่นตามแผนการรักษาจนรักษาเสร็จ

ในช่วงการรักษาจัดฟันที่เป็นงานวิจัยซึ่งเป็นส่วนหนึ่งของแผนการรักษาทั้งหมด ผู้เข้าร่วมวิจัยต้องมารับการรักษาจัดฟันอย่างน้อย 12 ครั้ง เดือนละ 1 ครั้ง ตลอดระยะเวลาในงานวิจัยรวม 12 เดือน โดยมาปรับระดับฟันประมาณ 6 ครั้ง เคลื่อนฟันตัดหน้าล่างโดยการกดฟัน 6 ครั้ง หลังจากนั้นจะให้แผนการรักษาตามแผนการรักษา ต่อเนื่องจนเสร็จซึ่งระยะเวลาในการรักษาขึ้นกับแผนการรักษาในผู้ร่วมวิจัยแต่ละราย

ในกรณีที่ระบบการเคลื่อนฟันที่ออกแบบในงานวิจัยไม่สามารถเคลื่อนฟันตามทิศทางที่กำหนดได้ในระยะเวลา 3 เดือนซึ่งสามารถเกิดขึ้นได้ในกรณีที่ให้การรักษาทางทันตกรรมโดยทั่วไป ทางผู้วิจัยจะเปลี่ยนวิธีการรักษาโดยการให้แรงที่อยู่ในช่วงแรงปกติที่ใช้ในการเคลื่อนฟันหรือใช้เครื่องมือชนิดอื่นที่มีความเหมาะสมต่อไป

ผู้เข้าร่วมวิจัยต้องเสียค่าใช้จ่ายในการจัดฟันตามปกติโดยมีค่าใช้จ่ายใน 1) การเก็บข้อมูล, พิมพ์ปาก, ถ่ายรูป, การจัดฟันแบบติดแน่นและ ภาพถ่ายรังสีในการรักษา ซึ่งเป็นค่ารักษาในอัตราปกติของคลินิกทันตกรรมจัดฟันและแผนกรังสีโรงพยาบาลทันตกรรม คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ ในกรณีที่ต้องเปลี่ยนการรักษาเพราะงานวิจัยไม่สำเร็จจะไม่มีการเสียค่าใช้จ่ายในการรักษาเพิ่ม ส่วนค่าใช้จ่ายเพื่อการวินิจฉัยเพิ่มเติมจากการรักษาปกติ 2) หลังปรับระดับฟันก่อนการเคลื่อนฟันตัดหน้าล่างโดยวิธีการกดฟัน สำหรับภาพถ่ายรังสีกระโหลกศีรษะด้านข้าง ภาพถ่ายรังสีในช่องปากในขั้นตอน 3) หลังการหลังเคลื่อนฟันโดยวิธีการกดฟันหน้าล่างทางคณะผู้วิจัยจะรับผิดชอบค่าใช้จ่ายในส่วนนี้ให้ครึ่งหนึ่งและผู้เข้าร่วมวิจัยต้องเสียค่าใช้จ่ายในส่วนภาพถ่ายรังสีคอมพิวเตอร์ในช่องปากครึ่งหนึ่ง

ในแง่การควบคุมความเสี่ยงที่อาจเกิดขึ้น เนื่องจากปริมาณแรงที่ใช้ในการเคลื่อนฟันเป็นแรงขนาดเบาแต่มากพอที่ทำให้เกิดการเคลื่อนฟัน จึงมีความปลอดภัยในการเคลื่อนฟันไม่แตกต่างจากการเคลื่อนฟันด้วยวิธีการรักษาปกติ อย่างไรก็ดีผู้เข้าร่วมวิจัยจะได้รับการตรวจประเมินอาการและอาการแสดงที่บ่งชี้ว่ามีความผิดปกติจะหยุดการรักษาในทันที

ถ้าท่านและบุตรหลานของท่านตัดสินใจเข้าร่วมโครงการวิจัยนี้จะมีขั้นตอนของการวิจัยที่จำเป็นต้องขอความร่วมมือของท่านและบุตรหลานตามที่กล่าวมาข้างต้นซึ่งจะไม่ก่อให้เกิดความเจ็บปวดและอันตรายต่อเนื้อเยื่อมากไปกว่าการใช้เครื่องมือจัดฟันติดแน่นชนิดอื่นแต่อย่างใด โดยผู้เข้าร่วมโครงการต้องมารับการรักษา ณ คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ และติดตามผลการรักษาอย่างเคร่งครัด

หากท่านมีข้อสงสัยประการใด หรือเกิดผลข้างเคียงจากการวิจัยจะสามารถติดต่อกับ ทพ.ชาญวิทย์ตันติกัลยาภรณ์ ได้ที่ ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ หมายเลขโทรศัพท์ 084-135-4532 หรือเมื่อมีปัญหาใดๆ เกิดขึ้นเนื่องจาก

การทำวิจัยในเรื่องนี้ ท่านสามารถร้องเรียนได้ที่คณบดี คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ อ.หาดใหญ่ จ.สงขลา 90112 หมายเลขโทรศัพท์ 074-287500

ไม่ว่าท่านจะเข้าร่วมโครงการวิจัยนี้หรือไม่ ท่านจะยังคงได้รับการรักษาที่ดีเช่นเดียวกับผู้ป่วยอื่นๆและถ้าท่านต้องการที่จะถอนตัวออกจากการศึกษานี้เมื่อใดท่านก็สามารถกระทำได้อย่างอิสระ

หากท่านมีคำถามใดๆก่อนที่จะตัดสินใจเข้าร่วมโครงการนี้โปรดซักถามจากคณะผู้วิจัยได้อย่างเต็มที่

ขอขอบคุณเป็นอย่างสูง

ทพ.ชาญวิทย์ ตันติกัลยาภรณ์

หัวหน้าโครงการ

หมายเหตุ: กรุณาอ่านข้อความให้เข้าใจก่อนเซ็นยินยอมเข้าร่วมโครงการ

ใบยินยอมเข้าร่วมการศึกษา

โครงการวิจัยเรื่อง ผลของการกดฟันหน้าล่างในผู้ป่วยสบฟันผิดปกติประเภทที่ 2 ที่มีการเจริญเติบโต

วันที่.....เดือน.....พ.ศ.....

ข้าพเจ้า.....ผู้ปกครองของ ด.ช./ด.ญ./นาย/น.ส .....อายุ.....ปี อาศัยอยู่บ้านเลขที่ .....ถนน.....ตำบล .....อำเภอ.....จังหวัด..... ได้อ่าน/ได้รับการอธิบายจากผู้วิจัยถึงวัตถุประสงค์ของการวิจัย วิธีการวิจัย อันตรายหรือ อาการที่อาจเกิดขึ้นจากการวิจัยหรือจากยาที่ใช้ รวมทั้งประโยชน์ที่เกิดจากการวิจัยอย่างละเอียดและมี ความเข้าใจดีแล้ว

หากข้าพเจ้าได้รับผลข้างเคียงจากการวิจัยข้าพเจ้าจะได้รับการปฏิบัติ/ชดเชย ดังนี้ ข้าพเจ้าจะได้รับการยกเลิกวิธีการรักษาที่ใช้ในงานวิจัยและได้รับการรักษาทางทันตกรรมจัดฟันด้วยวิธีการรักษาปกติสิ้นสุดการรักษาต่อไป โดยผู้รับผิดชอบโครงการวิจัยนี้คือ ทพ.ชาญวิทย์ ตันติกัลยาภรณ์ ภาควิชาทันตกรรมป้องกัน คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ หมายเลขโทรศัพท์ 084-135-4532 หรือเมื่อมีปัญหาใดๆ เกิดขึ้นเนื่องจากการทำวิจัยในเรื่องนี้ ท่านสามารถร้องเรียนได้ที่คณบดี คณะทันตแพทยศาสตร์ มหาวิทยาลัยสงขลานครินทร์ อ.หาดใหญ่ จ.สงขลา 90112 หมายเลขโทรศัพท์ 074-287500

หากผู้วิจัยมีข้อมูลเพิ่มเติมทั้งที่มีประโยชน์และโทษที่เกี่ยวข้องกับการวิจัยนี้ผู้วิจัยจะแจ้งให้ข้าพเจ้าทราบอย่างรวดเร็วโดยไม่ปิดบัง

ข้าพเจ้ามีสิทธิ์ที่จะของดการเข้าร่วมโครงการวิจัยโดยไม่ต้องแจ้งให้ทราบล่วงหน้าโดยงดการเข้าร่วมการวิจัยนี้ จะไม่มีผลกระทบต่อการได้รับบริการหรือการรักษาที่ข้าพเจ้าจะได้รับแต่ประการใด

ผู้วิจัยขอรับรองว่าจะเก็บข้อมูลเฉพาะที่เกี่ยวกับตัวข้าพเจ้าเป็นความลับ จะไม่เปิดเผยข้อมูลหรือผลการวิจัยของข้าพเจ้าเป็นรายบุคคลต่อสาธารณชน จะเปิดเผยได้เฉพาะในรูปที่เป็นสรุปผลการวิจัยหรือการเปิดเผยข้อมูลต่อผู้ที่มีหน้าที่ที่เกี่ยวข้องกับการสนับสนุนและกำกับดูแลการวิจับ

ข้าพเจ้าได้อ่าน/ได้รับการอธิบายข้อความข้างต้นแล้ว และมีความเข้าใจดีทุกประการจึงได้ลงนามในใบยินยอมนี้ด้วยความเต็มใจโดยนักวิจัยได้ให้สำเนาแบบยินยอมที่ลงนามแล้วกับข้าพเจ้าเพื่อเก็บไว้เป็นหลักฐานจำนวน 1 ชุด

ลงชื่อ.....ผู้ยินยอม

ลงชื่อ.....ผู้บิดา/มารดา/ผู้มีอำนาจปกครอง

ลงชื่อ.....หัวหน้าโครงการ

ลงชื่อ.....พยาน

ลงชื่อ.....พยาน

หมายเหตุ: ผู้เข้าร่วมโครงการที่ยังไม่บรรลุนิติภาวะและสามารถเขียนหนังสือได้ให้เซ็นชื่อยินยอมเข้าร่วมโครงการด้วย

RESEARCH ETHICS COMMITTEE (REC)
BUILDING 1 5TH FLOOR ROOM 504
TEL. 66-74-287533, 66-74-287504
FAX. 66-74-287533

FACULTY OF DENTISTRY
PRINCE OF SONGKLA UNIVERSITY
HADYAI, SONGKHLA 90112, THAILAND
TEL. 66-74-212914, 66-74-429871, 66-74-287500
FAX. 66-74-429871, 66-74-212922

Documentary Proof of Ethical Clearance

Research Ethics Committee (REC)

Faculty of Dentistry, Prince of Songkla University

The Project Entitled The Effect of Lower Incisor Intrusion in Class II Growing Patients

REC Project No. : EC5506-23-P

Principal Investigator : Mr. Charnwit Tantikalyaporn

Approved by Research Ethics Committee (REC), Faculty of Dentistry, Prince of Songkla University.

This is to certify that REC is in full Compliance with International Guidelines for Human Research Protection such as the Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP).

Date of Approval : **20 NOVEMBER 2012**

(Asst. Prof. Dr. Srisurang Suttapreyasri)
Chairman of Research Ethics Committee

(Asst. Prof.Surapong Vongvatchranon)

(Asst. Prof. Dr. Angkana Thearmontree)

(Assoc. Prof. Pornchai Sathirapanya)

(Mr. Kamolphan Nuangsri)

(Mr. Wasin Suwannarat)

(Dr. Supatcharin Piwat)

VITAE

Name Mr. Charnwit Tantikalyaporn

Student ID 5510820008

Educational Attainment

Degree	Name of Institution	Year of Graduation
Doctor of Dental Surgery	Prince of Songkla University	2007

Work-Position and Address

Dental Department, Vachira Phuket hospital, Phuket, Thailand

List of Publication and Proceeding

Tantikalyaporn C, Chareomratrote C. The lower incisor intrusion technique using an archwire with L loops in correcting class II malocclusion with deepbite. Proceedings of The 15th Graduate Research Conference; 2014 March 28; Khon Kaen,Thailand. Khon Kaen University; 2014