

# การเอียงตัวของฟันในแนวแก้มลิ้นและแนวใกล้กลางใกล้กลาง ของคนไทยภาคเหนือที่มีการสบฟันดี

## Crown Inclination and Crown Angulation of Northern Thais with Good Occlusion

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### บทคัดย่อ

การศึกษามีวัตถุประสงค์เพื่อหาค่าเฉลี่ยการเอียงตัวของฟัน ในแนวแก้มลิ้นและแนวใกล้กลางใกล้กลาง ของฟันของคนไทยภาคเหนือที่มีการสบฟันดี กลุ่มตัวอย่างเป็นกลุ่มที่การเจริญเติบโตสูงสุดสิ้นสุดแล้ว และไม่เคยได้รับการจัดฟันมาก่อน วัดค่าการเอียงตัวของฟันแต่ละซี่ (ยกเว้น ฟันกรามซี่ที่สาม) จากแบบจำลองฟันของกลุ่มตัวอย่างจำนวน 60 คน (ชาย 30 คน หญิง 30 คน) โดยใช้เครื่องมือที่ดัดแปลงมาจากเครื่องสำรวจความขนานและไม่โปรแทรกเตอร์ที่ใช้ในงานช่าง การวัดจะกระทำ 2 ครั้งในฟันแต่ละซี่ นำค่าทั้งสองมาหาค่าเฉลี่ยในการคำนวณค่าทางสถิติ ผลการศึกษาเป็นดังนี้

1) ค่าเฉลี่ยการเอียงตัวของฟันในแนวแก้มลิ้นในขากรรไกรบนของฟันตัดซี่กลาง, ฟันตัดซี่ข้าง, ฟันเขี้ยว, ฟันกรามน้อยซี่ที่หนึ่ง, ฟันกรามน้อยซี่ที่สอง, ฟันกรามซี่ที่หนึ่ง, ฟันกรามซี่ที่สอง มีค่าเท่ากับ 8.20, 6.27, -5.95, -8.04, -9.50, และ -8.38 องศาตามลำดับ

2) ค่าเฉลี่ยการเอียงตัวของฟันในแนวแก้มลิ้นในขากรรไกรล่างของฟันตัดซี่กลาง, ฟันตัดซี่ข้าง, ฟันเขี้ยว, ฟันกรามน้อยซี่ที่หนึ่ง, ฟันกรามน้อยซี่ที่สอง, ฟันกรามซี่ที่หนึ่ง, ฟันกรามซี่ที่สอง มีค่าเท่ากับ 5.36, 2.26, -3.77, -13.91, -18.93, -25.17 และ -34.69 องศาตามลำดับ

### Abstract

The study aims to investigate the mean values of crown inclinations and crown angulations of northern Thais with good occlusion. All samples had passed the active growth period and never had any orthodontic treatment. Measurements of each tooth (except third molars) from the study models of 60 samples (30 males and 30 females) were performed twice by using modified surveyor and protractor. The average values of the first and the second measurements were used for statistical analysis.

The results were as follows.

1. The means of the crown inclinations of maxillary central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar were 8.20, 6.27, -5.95, -8.04, -8.2, -9.50 and -8.38 degrees respectively.

2. The means of the crown inclinations of mandibular central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar were 5.36, 2.26, -3.77, -13.19, -18.93, -25.17 and -34.69 degrees respectively.



3. ค่าเฉลี่ยการเอียงตัวของฟันในแนวใกล้กลางใกล้กลางในขากรไกรบนของ ฟันตัดซี่กลาง, ฟันตัดซี่ข้าง, ฟันเขี้ยว, ฟันกรามน้อยซี่ที่หนึ่ง, ฟันกรามน้อยซี่ที่สอง, ฟันกรามซี่ที่หนึ่ง, ฟันกรามซี่ที่สอง มีค่าเท่ากับ 3.45, 4.77, 2.45, -1.34, -0.18, -2.19 และ -7.48 องศาตามลำดับ

4. ค่าเฉลี่ยการเอียงตัวของฟันในแนวใกล้กลางใกล้กลางในขากรไกรล่างของฟันตัดซี่กลาง, ฟันตัดซี่ข้าง, ฟันเขี้ยว, ฟันกรามน้อยซี่ที่หนึ่ง, ฟันกรามน้อยซี่ที่สอง, ฟันกรามซี่ที่หนึ่ง, ฟันกรามซี่ที่สอง มีค่าเท่ากับ -0.18, -0.57, -0.02, 0.89, 3.63, 5.58 และ 7.57 องศาตามลำดับ

**คำไขหรัส :** การเอียงตัวของฟัน, คนไทยภาคเหนือ, การสบฟันปกติ

3. The means of the crown angulations of maxillary central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar were 3.45, 4.77, 2.45, -1.34, -0.18, -2.19 and -7.48 degrees respectively.

4. The means of the crown angulations of mandibular central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar were -0.18, -0.57, -0.02, 0.89, 3.63, 5.58 and 7.57 degrees respectively.

**Key Words :** Crown inclination, Crown angulation, Northern Thais, Good occlusion

## Introduction

In contemporary edgewise appliances, the Straight-Wire Appliances are very popular. The appliance considerably minimizes the difficulty in wire bending by producing a custom bracket for each tooth in which a combination of varying thicknesses of the bracket base, angulation, and inclination of the bracket slot is used. As a result, the first, second and third order bends, in theory, are unnecessary. However, the angulation, the inclination and the thickness of the bracket base come from the average values of a specific population possessing ideal occlusion. These three values vary among each population. The measurements of crown inclination and crown angulation of each tooth of populations with good occlusion are crucial for treatment planning, and can be used for the construction of particular brackets for certain population.

Andrews<sup>(1)</sup> studied 120 models of nonorthodontic patients with normal occlusion and presented "Six Keys of Normal Occlusion". The six keys were the goals of orthodontic treatment. The two most important keys in designing Straight-Wire Appliances were

crown angulation and crown inclination as described by Andrews and others<sup>(1-5)</sup>.

Dellinger<sup>(6)</sup> studied crown inclination values of 25 nonextraction and 25 extraction cases. His study showed crown inclination values that differed from those of Andrews' study. The crown inclinations of central incisors and lateral incisors were smaller than those of Andrews' study, but the others were greater.

Vardimon and Lambertz<sup>(7)</sup> studied the models from 54 ideal occlusion subjects (34 orthodontically treated and 20 untreated cases). The objectives of the study were to evaluate the crown inclination values of subjects and to predict individual crown inclination values from crown inclination value of any other teeth. The result of that study was in close agreement with Andrews' mean crown inclination values except those for the upper incisors. No agreement was found when compared to Ricketts' crown inclination data.

There were many systems of preadjusted appliances<sup>(8)</sup> such as Alexander, Burstone, Hasund, Hilger, Ricketts and Roth. The crown inclination and crown angulation values varied from one study to the others. Therefore, the crown inclinations and crown angula-



tions of each population should be specific. In the northern Thais, there was no study that described these values. The purpose of this study was to find the crown inclination and crown angulation of each tooth, except third molar, of northern Thais with good occlusion.

## Materials and Methods

### Materials

The materials comprised plaster models of sixty northern Thais (30 males and 30 females) from the collection of the Department of Orthodontics, Faculty of Dentistry, Chiang Mai University, Thailand. The age distribution of samples is shown in table 1.

Table 1 Age (years) distribution by sex

	X	SD	Min.	Max	Total (no.)
male	20.81	1.60	16.30	25.90	30
female	19.19	2.62	15.60	28.80	30
sex combined	20.00	2.30	15.60	28.80	60

The subjects were selected by purposely sampling on the basis of occlusion. Arrangements were made for preliminary clinical examination of more than 6,800 subjects from the Institute of Commerce, Institute of Fine Art, a military camp, and some colleges in Chiang Mai province. All subjects were born and had lived in the northern part of Thailand up to the time of the investigation.

Some particular criteria were used to select the subjects. Each subject should have an excellent or good occlusion, with no or slight incisor crowding, good or pleasing soft tissue profile, no increased overjet or overbite, and no proximal caries or extensive restoration. None of the subjects had previous orthodontic treatment or accident.

The models and the full face and intraoral slides of each subject were evaluated in the final examination by seven orthodontists in order to exclude subjects

with unacceptable facial profile and with unacceptable occlusion.

## Methods

In this study, the crown inclination and the crown angulation of the study models were measured by the measuring instrument that was modified from a surveyor (NEY GOLD, The J.M. Company) and a protractor (CCKL CREATOR, U.S. PAT. 4,766,675). The crown inclination and the crown angulation were measured according to the concept of Andrews<sup>(1)</sup>. The long axis of the clinical crowns (LACC) and the midpoint of clinical crowns (LA point) were drawn according to the method described by Andrews<sup>(1)</sup>. The horizontal occlusal line (HOL)<sup>(6)</sup> was drawn for the occlusal plane (Figure 1).

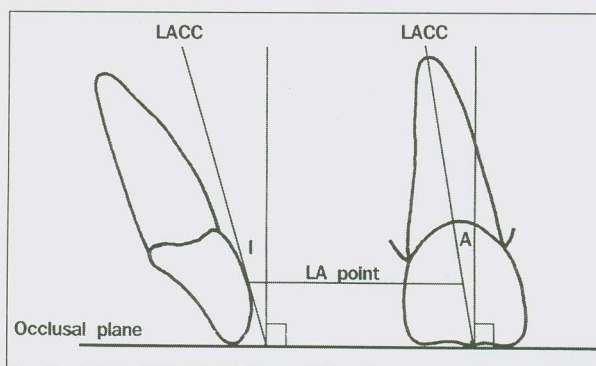


Figure 1 : The long axis of the clinical crowns (LACC), the midpoint of clinical crown (LA point), crown angulation (A), and crown inclination (I)

The measuring procedures were as follows:

- 1) The LACC was drawn on the labial surface of the clinical crowns of every tooth except third molars.
- 2) The LA point was marked on the long axis of the clinical crown of each tooth. The LA point was constructed by bisecting the height of the clinical crown (add 1 mm. of gingival sulcus) on the long axis of the clinical crown.
- 3) The Horizontal occlusal line (HOL) of each model was set to be parallel to the surveying platform.



The HOL represents an imaginary line connecting left and right mid-crown molar points and the average of the clinical mid-crown points of the left and right central incisors. The three points of each model were set to be parallel to the surveying platform by adjustment of the surveying table until the three points were at the same level as the end of the horizontal arm of the protractor.

4) The HOL was used as the occlusal plane. The horizontal arm of the protractor was parallel to the platform, while the vertical arm of the protractor was at zero degree when it was set perpendicular to the horizontal arm. With the posterior surface of the vertical arm touching the buccal surface of the tooth, the lateral surface of the vertical arm was then aligned with the LACC. The crown angulation was measured by reading the deviation of the vertical arm from the zero degree position (Figure 2).

5) With the lateral surface of the vertical arm touching the buccal surface of the tooth at the LA point, the crown inclination was measured by reading the deviation of the vertical arm from the zero degree position (Figure 3).

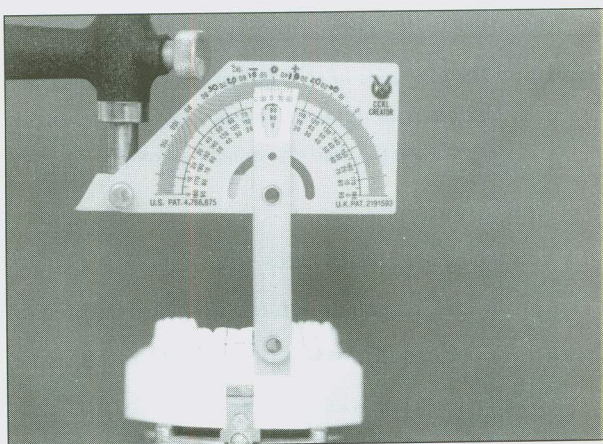


Figure 2 : The crown angulation was measured by setting the posterior surface of the vertical arm to touch the buccal surface of the tooth. The lateral surface of the vertical arm was then aligned with the LACC.

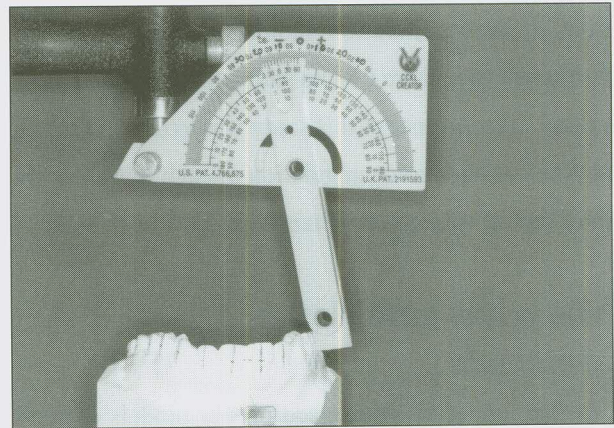


Figure 3 : The crown inclination was measured by setting the lateral surface of the vertical arm to touch the buccal surface of the tooth at the LA point.

## Statistical methods

The crown inclination and crown angulation of each tooth were measured twice and the mean value for each tooth was used in the statistical analysis. The second measurement was performed approximately two months after the first to reduce errors.

## Results

The means and standard deviations of the crown angulations and crown inclinations are shown in table 2.

Table 2 Means and standard deviations ( $\bar{X}(SD)$ ) of crown angulation (A) and crown inclination (I) (sexes and sides combined)

	Upper teeth		Lower teeth	
	A	I	A	I
Central incisor	3.45(2.08)	8.20(2.28)	-0.18(2.11)	5.36(5.76)
Lateral incisor	4.77(2.28)	6.27(4.61)	-0.57(2.49)	2.26(5.09)
Canine	2.45(4.22)	-5.95(5.86)	-0.02(3.67)	-3.77(5.65)
First premolar	-1.34(3.23)	-8.04(5.72)	0.89(3.43)	-13.91(6.47)
Second premolar	-0.18(2.88)	-8.20(5.39)	3.63(2.94)	-18.93(6.20)
First molar	-2.19(3.31)	-9.50(5.49)	5.58(2.97)	-25.17(5.62)
Second molar	-7.48(4.13)	-8.38(5.86)	7.57(3.90)	-34.69(7.32)



The more posterior teeth had more negative angulation values. In the lower teeth, the posterior teeth showed positive angulation values, and the more posterior teeth showed more positive angulation values. In the upper anterior teeth, the crown angulations showed positive values. In the lower anterior teeth, the crown angulations showed minimal negative values.

In both the upper and the lower arches, the crown inclination of the central and lateral incisors showed positive values. The crown inclinations of upper and lower central incisors were greater than those of lateral incisors. The crown inclinations of the upper and lower canines showed negative values. In the upper arch, the crown inclinations of posterior teeth showed rather similar negative values. In the lower arch, the crown inclinations of the lower teeth showed greater negative values in relation to those of the upper posterior teeth. In addition, the more posterior teeth showed more negative values.

## Discussion

In this study, the crown angulations of upper posterior teeth were more distoangulated when the teeth were more posterior, while lower posterior teeth had increasing mesioangulation in more posterior teeth. This showed the characteristic of the curve of Spee. The upper anterior teeth were slightly mesioangulated. The lateral incisors had the highest value, while the canines had the lowest. All of the lower anterior teeth had slightly negative values. This showed that the crowns were in the upright positions.

The crown inclination of central incisors and lateral incisors in both upper and lower arches had positive values (central incisors greater than lateral incisors). The crown inclinations of the upper posterior teeth showed continuous lingual crown torque. Those of the lower posterior teeth showed progressive lingual crown torque.

A comparison between the crown angulations of this study and the crown angulations of Andrews' study is presented in table 3. The crown angulations of the present study in the upper arch were smaller than those of Andrews' study. In the lower arch, the crown angulations of the incisors and canines of the present study were smaller than those of Andrews' study. In the posterior teeth, except the first premolars, the crown angulations of the present study were greater than those of Andrews' study.

Table 3 Comparison between the crown angulations (degrees) of Andrews' study<sup>(1)</sup> and the present study.

	Upper teeth		Lower teeth	
	Andrews'	Present study	Andrews'	Present study
Central incisor	5	3.45	2	-0.18
Lateral incisor	9	4.77	2	-0.57
Canine	11	2.45	2	-0.02
First premolar	2	-1.34	2	0.89
Second premolar	2	-0.18	2	6.63
First molar	5	-2.19	2	5.58
Second molar	5	-7.48	2	7.57

A comparison of the crown inclinations of Andrews<sup>(1)</sup>, Dellinger<sup>(6)</sup>, Vardimon & Lambertz<sup>(7)</sup> and those of the present study is presented in tables 4 and 5. In table 4, the crown inclinations of the upper teeth were similar to those of Andrews' study. However, the crown inclinations of the lateral incisors in the present study was greater than those of Andrews' study. The crown inclinations of the upper teeth were similar to those of Vardimon and Lambertz's study. However, the crown inclinations of the central and lateral incisors in the present study were greater than those of Vardimon and Lambertz's study. All of the crown inclinations were slightly different from those of Dellinger's study.

In table 5, for the lower teeth, the crown inclinations of the central incisors, the lateral incisors and the

**Table 4** Comparison of the crown inclination (degrees) of Andrews<sup>(1)</sup>, Dellinger<sup>(6)</sup>, Vardimon & Lambertz<sup>(7)</sup> and the present study of upper teeth.

	Upper teeth			
	Andrews	Dellinger	Vardimon & Lambertz	Present study
Central incisor	7	2.27	0.32	8.20
Lateral incisor	3	0.06	-1.90	6.27
Canine	-7	-8.40	-9.15	-5.95
First premolar	-7	-5.77	-9.90	-8.04
Second premolar	-7	-10.02	-8.53	-8.20
First molar	-9	-16.15	-11.55	-9.50
Second molar	-9	-24.60	-8.70	-8.38

canines in the present study were greater than those of the previously mentioned studies. However, the crown inclinations of the posterior teeth were similar to those of the previously mentioned studies.

**Table 5** Comparison of the crown inclination (degrees) of Andrews<sup>(1)</sup>, Dellinger<sup>(6)</sup>, Vardimon & Lambertz<sup>(7)</sup> and the present study of lower teeth.

	Lower teeth			
	Andrews	Dellinger	Vardimon & Lambertz	Present study
Central incisor	-1	-0.80	1.26	5.36
Lateral incisor	-1	-2.82	-1.35	2.26
Canine	-11	-12.70	-9.00	-3.77
First premolar	-17	-18.60	-15.90	-13.91
Second premolar	-22	-22.48	-21.16	-18.93
First molar	-30	-29.60	-26.00	-25.17
Second molar	-35	-30.46	-32.82	-34.69

## Conclusion

The means of the crown inclinations and the crown angulations of each tooth except the third molars in this study were shown as follows:

1. The means of the crown inclinations of maxillary central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar teeth were 8.20, 6.27, -5.95, -8.04, -9.50 and -8.38 degrees respectively.

2. The means of the crown inclinations of mandibular central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar teeth were 5.36, 2.26, -3.77, -13.19, -18.93, -25.17 and -34.69 degrees respectively.

3. The means of the crown angulations of maxillary central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar teeth were 3.45, 4.77, 2.45, -1.34, -0.18, -2.19 and -7.48 degrees respectively.

4. The means of the crown angulations of mandibular central incisor, lateral incisor, canine, first premolar, second premolar, first molar and second molar teeth were -0.18, -0.57, -0.02, 0.89, 3.63, 5.58 and 7.57 respectively.

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