การศึกษาค่าปกติจากภาพถ่ายรังสีกะโหลกศีรษะด้านข้างของเด็กหญิงและเด็กชายไทย อายุ 12-14 ปี ในจังหวัดขอนแก่นซึ่งมีรูปใบหน้าด้านข้างที่ยอมรับว่าสวยงาม

Lateral Cephalometric Norms for 12-14 Year Thai Girls and Boys in Khon Kaen Who Have Acceptable Facial Profiles

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บทคัดย่อ

การศึกษานี้มีจุดมุ่งหมายเพื่อหาค่าปกติจากภาพถ่ายรังสีกะโหลกศีรษะด้านข้างของเด็กหญิงและเด็กชายไทยอายุ 12-14 ปีในจังหวัดขอนแก่นซึ่งมีรูปใบหน้าด้านข้างที่ยอมรับว่าสวยงาม รวมทั้งศึกษาความแตกต่างของลักษณะโครงสร้างใบหน้าระหว่างเพศ กลุ่มตัวอย่างของการวิจัยเป็นเพศหญิงจำนวน 106 คน ซึ่งมีอายุเฉลี่ย 13.1 ปี และเพศชายจำนวน 67 คนซึ่งมีอายุเฉลี่ย 13.0 ปี คุณสมบัติของตัวอย่างจะต้องมีรูปใบหน้าด้านข้างที่ยอมรับว่าสวยงาม การซ้อนเกหรือช่องห่างของฟันหน้าไม่เกิน 3 มิลลิเมตร การซ้อนทับของฟันหน้าในแนวระนาบและแนวดิ่งมีขนาด 1 ถึง 4 มิลลิเมตร และไม่เคยได้รับการรักษาทางทันตกรรมจัดฟันมาก่อน ผลการศึกษาแสดงในรูปค่าเฉลี่ยและค่าเบี่ยงเบนมาตรฐานของตัววัดจำนวน 53 ค่าแยกตามเพศ ซึ่งแบ่งออกเป็น 4 กลุ่มย่อยคือ ตัววัดความสัมพันธ์ของกระดูกกะโหลกศีรษะด้านข้างในแนวหน้า-หลัง ตัววัดความสัมพันธ์ของกระดูกกะโหลกศีรษะด้านข้างในแนวดิ่ง ตัววัดความสัมพันธ์ของฟัน ตัววัดความสัมพันธ์ของเนื้อเยื่ออ่อนรูปหน้าด้านข้าง ผลพบว่าลักษณะโครงสร้างที่แตกต่างกันอย่างมีนัยสำคัญ ($P<0.05$) ระหว่างเพศคือ บางตัววัดของโครงสร้างกระดูกกะโหลกศีรษะและเนื้อเยื่ออ่อนรูปหน้าด้านข้าง ในส่วนโครงสร้างกระดูกที่เป็นขากรรไกรบนและขากรรไกรล่างของเด็กหญิงยื่นมากกว่าเด็กชายเมื่อเทียบกับฐานกะโหลกศีรษะด้านหน้าและระนาบวัดใบหน้าส่วนกลาง ในขณะที่เด็กชายมีขนาดของส่วนฐานกะโหลกศีรษะด้านหน้า ขากรรไกรบนและขากรรไกรล่างใหญ่กว่าเด็กหญิง นอกจากนี้เด็กชายยังมีความสูงของใบหน้าด้านหน้าส่วนล่างมากกว่าเด็กหญิง รวมทั้งมีความชันของส่วนฐานกะโหลกศีรษะด้านหน้ามากกว่าเด็กหญิง ในส่วนของเนื้อเยื่ออ่อนรูปหน้าด้านข้างเด็กหญิงมีตำแหน่งคางยื่นไปข้างหน้า (G-Pog′) มากกว่าเด็กชาย ในขณะที่เด็กชายมีรูปหน้าด้านข้างอูมกว่า ริมฝีปากบนหนากว่า ขนาดของริมฝีปากบนและล่างยาวกว่า และจุดหว่ำใต้ริมฝีปากล่างอยู่ลึกกว่าเด็กหญิง

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ผลการศึกษาในครั้งนี้แสดงให้เห็นถึงความแตกต่างของลักษณะโครงสร้างใบหน้าระหว่างเด็กหญิงและเด็กชาย ดังนั้นจึงควรพิจารณาใช้ค่าปกติจากภาพถ่ายรังสีกะโหลกศีรษะด้านข้างของเด็กอายุ 12-14 ปีในจังหวัดขอนแก่น แยกเฉพาะสำหรับเด็กหญิงและเด็กชาย

Abstract

The purpose of this study was to develop lateral cephalometric norms for 12-14 year Thai girls and boys in Khon Kaen Province who had acceptable facial profiles and to compare lateral cephalometric norms between genders. The subjects evaluated in the study included 106 girls with a mean age of 13.1 years and 67 boys with a mean age of 13.0 years who had esthetically acceptable profiles, no more than 3 mm. crowding or spacing of anterior teeth, 1-4 mm. overjet and overbite, and no previous orthodontic treatment. Mean and standard deviation of each of 53 lateral cephalometric measurements, which were separated into four subgroups including skeletal sagittal and vertical relationships, dental and soft tissue relationships, for both sexes are presented. Significant differences ($P<0.05$) between girls and boys were found in some skeletal and soft tissue measurements. In skeletal pattern, the girls had more protrusive maxillae and mandibles relative to anterior cranial base and midfacial plane than the boys, whereas the boys had larger sizes of anterior cranial bases, maxillae, mandibles, lower anterior facial heights, and slightly steeper anterior cranial bases than the girls. For soft tissue measurements, the girls had more chin prominences (G-Pog′) than the boys, while the boys had more facial convexities (G-Sn- Pog′), thicker upper lips, longer upper and lower lips, and deeper mentolabial sulci, than the girls. Sexual dimorphism was indicated for this study. It appears that separate sex cephalometric norms are required for patients between 12 and 14 years of age in Khon Kaen.

คำสำคัญ : ค่าปกติจากภาพถ่ายรังสีกะโหลกศีรษะด้านข้าง ค่ามาตรฐานจากภาพถ่ายรังสีกะโหลกศีรษะด้านข้าง การวิเคราะห์ภาพถ่ายรังสีกะโหลกศีรษะด้านข้าง

Key words : Lateral Cephalometric Norms Cephalometric Standards Cephalometric Analyses

Introduction

The lateral cephalometric radiograph is one of the diagnostic records in orthodontics registering the anteroposterior and vertical configuration of the facial skeleton, soft tissue, and dental occlusion. Since Broadbent (Broadbent, 1981) introduced cephalometric radiography as a research tool in orthodontics in 1931, many others have developed cephalometric analyses to assess skeletal, dental and soft tissue patterns in terms of their linear dimensions and angular relationships (Downs, 1948; 1952; 1956; Steiner, 1953; 1959; 1960; Ricketts, 1957; 1969; 1981; Ricketts et al., 1972; McNamara, 1984; Burstone, 1967; Burstone et al., 1978; Holdaway, 1983; Legan and Burstone, 1980. Many of these measurements have been subsequently used in the diagnosis and treatment planning of dentofacial malrelationships.

In orthodontics, diagnosis is the determination of significant deviations from the normal. Norms define ideal cephalometric measurements for a patient, based on such factors as race, sex, age, and facial type. If the patient deviates from a norm by a margin greater than that prescribed by the clinician (usually one standard deviation), this information should influence diagnostic and treatment planning procedures. Previous investigations have shown that there are differences of the cephalometric mean values among racial groups (Altemus, 1960; Drummond, 1968; Nanda and Nanda, 1969), sexes (Broadbent et al., 1975; Riolo et al., 1974), ages (Bishara, 1981; Broadbent et al., 1975; Riolo et al., 1974), and facial types (Bishara and Jakobsen, 1985; Sunthoncharu et al., 2000).

There have been several cephalometric studies of adult Thai groups (Suchato and Chaiwat, 1984; Mathurasai, 1975; Satravaha and Schlegel, 1987; Dechkunakorn et al, 1994), but only a few studies in children (Chengprapakorn, 1981; Jindarochanakul, 1982; Nitipavachon, 1985). Most of them were conducted in Bangkok Metropolis; two studies in Chiang Mai Province were located, but none of these studies provided norms for other parts of Thailand. There is also lack of cephalometric Thai norms of soft tissue profile measurements.

It was the purpose of this study to develop lateral cephalometric standards for Thai girls and boys in Khon Kaen Province at age 12-14 years who have acceptable facial profiles and to compare cephalometric norms between girls and boys within these ages.

Material and Methods

The research design was a descriptive study. All subjects were recruited from 2,004 students in primary and secondary schools in Amphoe Muang, Khon Kaen Province, Thailand.

Subject Selection

The inclusion criteria for selecting subjects were as follows:

1. Native Thai children at age of 12-14 years in Khon Kaen Province. Native Thai children in Khon Kaen means children who have Thai nationality like their parents, and have lived and studied in Khon Kaen.

2. An esthetically acceptable facial profile.

3. No more than 3 mm. crowding or spacing of anterior teeth.

4. 1-4 mm. overjet and overbite.

5. No previous orthodontic treatment, maxillofacial or plastic surgery.

6. The absence of obvious craniofacial deformity, systemic disease, history of trauma or other factors affecting craniofacial growth and development.

Photographs of facial profile were taken from subjects with inclusion criteria of overjet, overbite, crowding and spacing condition of anterior teeth as mentioned above. The head orientation used was the subject looking straight ahead. The subjects held the teeth in centric occlusion and the lips were relaxed. Then, the photographic profile outlines were converted to silhouettes using computer-generated silhouettes of the photographs. All silhouettes included only facial profiles without hairstyles and were adjusted to similar size. The profile attractiveness of each subject was

assessed by four judges who comprised two experienced orthodontists and two lay persons, on a Likert 5-point scale as: 1) very unacceptable, 2) unacceptable, 3) acceptable, 4) very acceptable, and 5) extremely acceptable. The subjects with an esthetically acceptable facial profile needed at least the sum of scores equal to or above 12 by the four judges. At this stage, all the subjects were checked from their dental models to ensure that they met all inclusion criteria of occlusion. Finally, 173 subjects comprising 106 girls and 67 boys were accepted.

Cephalometric Measurements

There were 173 lateral cephalometric radiographs from the selected subjects above. All 173 cephalograms were traced and the selected landmarks were marked by the researcher (Ruksujarit T.) and then checked by three orthodontists.

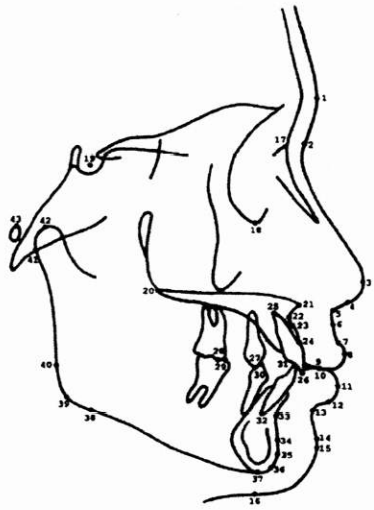
Forty-three landmarks (Figure 1) marked on tracings of cephalometric radiographs were digitized with a transparent pad (Numonics Accugrid). A commercial cephalometric program (Dentofacial Planner Plus version 2.02, Dentofacial Software Inc.) calculated 53 cephalometric measurements, categorized into four subgroups including skeletal measurements in sagittal relationship, skeletal measurements in vertical relationship, dental measurements, and soft tissue measurements.

Reliability of the Measurements

1. Intra-rater reliability of four judges for profile evaluation. Ninety silhouettes were randomly selected and duplicated. Then, four judges repeated the profile scoring for these new sets of 90 profiles. The intraclass correlation coefficient (ICC) model 3 was used for testing reliability from the same judge by comparing the profile scores given at the first and second times.

2. Inter-rater reliability of four judges for profile evaluation. Ninety silhouettes were randomly selected. Then, ICC model 2 was used to test the agreement among four judges.

3. Reliability of landmark identification and measurement of lateral cephalograms. Thirty-five lateral cephalograms were selected at random and retraced by the researcher. Then, the reliability of measurements was calculated by use of ICC model 3 comparing the measurements made at the first and second times.



1 = G, 2 = N′, 3 = Prn, 4 = Cm, 5 = Sn, 6 = A3′, 7 = Ls, 8 = ULa, 9 = Stms, 10 = Stmi, 11 = LLa, 12 = Li, 13 = Si, 14 = PM′, 15 = Pog′, 16 = Gn′, 17 = N, 18 = Or, 19 = S, 20 = PNS, 21 = ANS, 22 = A point, 23 = A3, 24 = U1la, 25 = UIA, 26 = Is, 27 = U4 tip, 28 = U6 tip, 29 = L6 tip, 30 = L4 tip, 31 = Ii, 32 = LIA, 33 = B point, 34 = PM, 35 = Pog, 36 = Gn, 37 = Me, 38 = IGo, 39 = Go, 40 = PGo, 41 = Ar, 42 = Co, 43 = Po.

Figure 1 43 Lateral cephalometric landmarks used in this study.

Statistical Analyses

1. Mean and standard deviation werecalculated for each cephalometric measurement, separately for the girls and boys.

2. The independent-sample t-test was applied to identify sex difference for each cephalometric measurement. Differences in the mean values were regarded as significant if $P<0.05$, 95% confidence intervals.

Results

The findings are as follows:

1. The intra-rater reliability test indicated that two orthodontists had better agreement between their own evaluation (ICC of .81 and .79) than two lay persons (ICC of .63 and .67). The inter-rater reliability test found only moderate agreement for esthetically acceptable soft tissue profiles among the four judges with ICC of .69. In addition, the reliability of landmark identification and measurements was good, ranging from .85 to .99 for 53 measurements used in this study. As a general guideline for interpreting the ICC, Portney and Watkins (Portney and Watkins, 2000) suggested that values above .75 were indicative of good reliability, and those below .75 poor to moderate reliability. However, judgements must be made within the context of each individual study.

2. Mean and standard deviation of each of 53 cephalometric measurements separately for 12-14 year Thai girls and boys in Khon Kaen who had acceptable facial profiles are presented in Table 1.

3. Differences of mean values, 95% CI, and p-value of each of 53 cephalometric measurements between 12-14 year Thai girls and boys in Khon Kaen are shown in Table 2. There were significant differences ($P<0.05$) in some skeletal and soft tissue measurements between girls and boys, but not in dental measurements. In skeletal pattern, the girls had more protrusive maxillae and mandibles relative to the anterior cranial base and midfacial plane than the boys, whereas the boys had larger sizes of anterior cranial bases, maxillae, mandibles, lower anterior facial heights, and slightly steeper anterior cranial bases than the girls. For soft tissue measurements, the girls had more chin prominences (G-Pog′) than the boys, while the boys had more facial convexities (G-Sn- Pog′), thicker upper lips, longer upper and lower lips, and deeper mentolabial sulci than the girls.

Discussion

1. Considering the large number of measurements (53) compared in this study, only a minority (19) of differences was found between boys and girls. The findings of certain specific differences in measurements between girls and boys in this study are supported by the Thai study of Jindarochanakul (Jindarochanakul, 1982) and Nitipavachon (Nitipavachon, 1985), which also indicated more protrusive maxillae and mandibles in Thai girls. Thai girls have the adolescent growth spurt at the approximate age of 12 years and complete growth at the approximate age of 14 years whereas Thai boys start the growth spurt later at age of 14 years and their growth cease at age of

16 years (Mathurasai and Viteporn, 1983). The results from this study show more jaw growth in girls than in boys between 12 and 14 years, which may imply sexual dimorphism. It appears that separate sex cephalometric norms are required for patients between 12 and 14 years of age in Khon Kaen.

2. Compared with results in previous Thai studies of children (Chengprapakorn, 1981; Jindarochanakul, 1982; Nitipavachon, 1985), the mean values of some measurements showed that both Khon Kaen girls and boys had larger dimensions of midface and mandible, more protrusive mandibles, flatter mandibular plane angles, more retroclined and retrusive maxillary and mandibular incisors, and less protrusive lower lips than the Thai children in those previous studies. Boys in the present study also showed larger anterior cranial base length and lower anterior facial height than those of previous studies. There are differences of dentofacial patterns between Khon Kaen children in the present study and those in previous studies in other parts of Thailand. Specific lateral cephalometric norms are recommended for diagnosis of Khon Kaen patients. Further comparative study for lateral cephalometric norms from each part of Thailand, which use the same selection criteria and lateral cephalometric measurements, is still required to confirm the differences among Thai populations.

3. Comparing the mean dentofacial measurements in Thai children from the present study with those in Caucasians (Taylor and Hitchcock, 1966), American Blacks (Alexander and Hitchcock, 1978), Chinese (So et al., 1990), and Japanese (Miura et al., 1965) children, indicated that Thai children had more prognathic maxillae and mandibles, flatter occlusal plane angles, and flatter mandibular plane angles compared with other racial groups. The dental pattern of Khon Kaen children was similar to that of Caucasian children, but with more retroclined and retrusive incisors compared with Black, Chinese, and Japanese children. There are differences in dentofacial relationships among racial groups, which are in general agreement with the findings from previous studies. Therefore, orthodontists should use Thai norms for diagnosing Thai patients.

4. Due to lack of cephalometric norms in soft tissue profile measurements in Thai children, the norms derived from this study may valuable for evaluating soft tissue profile abnormalities of an individual patient between 12 and 14 years of age.

Conclusion

There are differences in lateral cephalometric measurements between genders and among racial groups. Therefore, lateral cephalometric norms for Khon Kaen children separated by sex are more appropriate for diagnosing Khon Kaen patients than other norms. It should be also kept in mind that orthodontic treatment should be planned according to the individual needs and expections of each patient, using the radiographs only as a guide along with the clinical examination and patient records.

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Table 1 Lateral cephalometric norms of 12-14 year Thai girls and boys in Khon Kaen who have acceptable facial profiles.

References	Measurements	12-14 yr Girls (N = 106)	12-14 yr Boys (N = 67)
		Mean ± SD	Mean ± SD
I. Skeletal Measurement			
Sagittal:			
Jarabak and Fizzell (1972)	Anterior cranial base (SN) (mm)	67.5 ± 2.8	70.9 ± 2.9
Steiner (1953)	SNA (deg)	84.9 ± 3.0	82.4 ± 3.0
Ricketts (1972)	FH - NA (deg)	91.8 ± 2.8	90.1 ± 2.7
McNamara (1984)	A - N perp. (mm)	1.9 ± 2.9	0.1 ± 2.9
McNamara (1984)	Midfacial length (Co - A) (mm)	89.3 ± 3.7	91.4 ± 4.9
Steiner (1953)	SNB (deg)	81.8 ± 3.1	79.6 ± 2.7
Jarabak and Fizzell (1972)	SN - Pog (deg)	82.3 ± 3.0	80.3 ± 2.8
Downs (1948)	Facial angle (FH - NPog) (deg)	89.2 ± 2.8	87.9 ± 2.5
Steiner (1953)	Pog - NB (mm)	0.9 ± 1.2	1.4 ± 1.2
McNamara (1984)	Pog - Nperp. (mm)	-1.7 ± 5.4	-4.0 ± 4.9
McNamara (1984)	Mandibular length (Co - Gn) (mm)	117.2 ± 4.4	119.4 ± 5.8
Steiner (1953)	ANB (deg)	3.1 ± 1.6	2.8 ± 1.7
Jacobson (1976)	Wits appraisal (AO - BO) (mm)	-2.1 ± 2.9	-1.7 ± 2.9
Downs (1948)	Y-axis (SGn - FH) (deg)	60.1 ± 2.9	60.4 ± 2.5
Vertical:			
Bell et al (1980)	SN - FH (deg)	6.9 ± 2.5	7.7 ± 2.6
Steiner (1953)	SN - OP (deg)	16.1 ± 4.0	17.3 ± 4.2
Bell et al (1980)	SN - PP (deg)	7.6 ± 3.4	8.4 ± 3.1
Ricketts (1972)	FH - PP (deg)	0.7 ± 3.0	0.7 ± 3.1
Di Paolo et al (1983)	PP - MP (Go - Gn) (deg)	22.6 ± 3.9	22.6 ± 4.1
Steiner (1953)	SN - MP (Go - Gn) (deg)	30.2 ± 4.2	31.0 ± 4.1
Tweed (1954)	FMA (FH - MP) (deg)	23.7 ± 4.0	23.8 ± 3.7
McNamara (1984)	LAFH (ANS - Me) (mm)	65.9 ± 3.9	67.8 ± 4.2
Wylie and Johnson (1952)	Facial height (UAFH : LAFH)	44.9:55.1 ± 1.6	45.3:54.7 ± 1.6
Jarabak and Fizzell (1972)	PFH (S - cGo) : AFH (N - cGn) (%)	66.5 ± 3.8	65.9 ± 3.6
Jarabak and Fizzell (1972)	Gonial angle (Ar - cGo - cGn) (deg)	118.9 ± 5.5	118.7 ± 5.5

Table 1 Lateral cephalometric norms of 12-14 year Thai girls and boys in Khon Kaen who have acceptable facial profiles (Cont.).

References	Measurements	12-14 yr Girls (N = 106)	12-14 yr Boys (N = 67)
		Mean ± SD	Mean ± SD
II. Dental Measurement			
Jarabak and Fizzell (1972)	U1 - SN (deg)	106.4 ± 5.7	104.9 ± 5.4
Steiner (1953)	U1 - NA (deg)	21.5 ± 4.8	22.6 ± 5.3
Steiner (1953)	U1 - NA (mm)	4.5 ± 2.0	4.7 ± 2.2
Ricketts (1972)	U1 - APog (deg)	27.4 ± 4.4	27.2 ± 4.8
Ricketts (1972)	U1 - APog (mm)	6.8 ± 1.8	6.6 ± 1.9
Tweed (1954)	IMPA (L1 - MP) (deg)	96.2 ± 5.9	96.3 ± 6.3
Tweed (1954)	FMIA (L1 - FH) (deg)	60.2 ± 5.6	59.9 ± 6.1
Steiner (1953)	L1 - NB (deg)	28.5 ± 4.9	27.3 ± 5.5
Steiner (1953)	L1 - NB (mm)	6.2 ± 1.8	5.7 ± 2.1
Ricketts (1972)	L1 - APog (deg)	25.8 ± 4.1	25.5 ± 4.9
Ricketts (1972)	L1 - APog (mm)	3.8 ± 1.8	3.3 ± 2.1
Steiner (1953)	Interincisal angle (U1 - L1) (deg)	126.8 ± 7.3	127.3 ± 8.3
III. Soft tissue measurement			
Legan and Burstone (1980)	Facial convexity angle (G-Sn-Pog') (deg)	9.3 ± 4.2	10.8 ± 4.1
Legan and Burstone (1980)	Nasolabial angle (Cm-Sn-Ls) (deg)	92.7 ± 9.2	94.8 ± 10.7
Jarabak and Fizzell (1972)	U-lip to E-line (mm)	1.5 ± 1.6	1.8 ± 1.8
Jarabak and Fizzell (1972)	L-lip to E-line (mm)	2.3 ± 1.7	2.2 ± 1.9
Burstone (1967)	U-lip to Sn-Pog' (mm)	7.8 ± 1.4	8.0 ± 1.6
Burstone (1967)	L-lip to Sn-Pog' (mm)	5.9 ± 1.6	5.9 ± 1.7
Holdaway (1983)	Basic U-lip thickness (mm)	14.3 ± 1.2	15.6 ± 1.5
Holdaway (1983)	U-lip strain (mm)	-1.4 ± 0.9	-1.2 ± 1.1
Burstone (1967)	U-lip length (Sn - Stms) (mm)	22.3 ± 1.6	23.1 ± 2.1
Burstone (1967)	L-lip length (Stmi - Gn') (mm)	46.9 ± 3.1	47.9 ± 2.9
Burstone (1967)	Lip length ratio (L-lip/U-lip)	2.1 ± 0.2	2.1 ± 0.2
Legan and Burstone (1980)	Interlabial gap (Stms - Stmi) (mm)	0.2 ± 0.6	0.2 ± 0.6
Legan and Burstone (1980)	Maxillary incisor exposure (Stms - Is) (mm)	2.9 ± 1.4	2.9 ± 1.4
Legan and Burstone (1980)	Mandibular prognathism (G - Pog') (mm)	1.1 ± 6.2	-3.1 ± 5.9
Holdaway (1983)	Chin thickness (Pog - Pog') (mm)	12.5 ± 1.7	12.4 ± 1.8
Legan and Burstone (1980)	Mentolabial sulcus (Si to Li-Pog') (mm)	4.8 ± 0.9	5.4 ± 1.0

Table 2 Differences of lateral cephalometric norms between 12-14 year Thai girls and boys in Khon Kaen who have acceptable facial profiles.

References	Measurements	Mean diff	95% CI		P-value
			Lower	Upper	
I. Skeletal Measurement					
Sagittal:					
Jarabak and Fizzell (1972)	Anterior cranial base (SN) (mm)	-3.45	-4.34	-2.57	<0.001*
Steiner (1953)	SNA (deg)□	2.60	1.60	3.60	<0.001*
Ricketts (1972)	FH - NA (deg)	1.74	0.90	2.58	<0.001*
McNamara (1984)	A - N perp. (mm)	1.80	0.91	2.69	<0.001*
McNamara (1984)	Midfacial length (Co - A) (mm)	-2.07	-3.46	-0.69	0.004*
Steiner (1953)	SNB (deg)	2.19	1.29	3.11	<0.001*
Jarabak and Fizzell (1972)	SN - Pog (deg)	1.98	1.08	2.88	<0.001*
Downs (1948)	Facial angle (FH - NPog) (deg)□	1.10	0.30	1.90	0.009*
Steiner (1953)	Pog - NB (mm)	-0.47	-0.85	-0.10	0.013*
McNamara (1984)	Pog - Nperp. (mm)□	2.10	0.60	3.80	0.008*
McNamara (1984)	Mandibular length (Co - Gn) (mm)	-2.19	-3.84	-0.54	0.009*
Steiner (1953)	ANB (deg)	0.35	-0.15	0.86	0.171
Jacobson (1976)	Wits appraisal (AO - BO) (mm)	-0.41	-1.30	0.48	0.359
Downs (1948)	Y-axis (SGn - FH) (deg)	-0.29	-1.13	0.55	0.503
Vertical:					
Bell et al (1980)	SN - FH (deg)	-0.80	-1.58	-0.03	0.043*
Steiner (1953)	SN - OP (deg)	-1.21	-2.47	0.04	0.058
Bell et al (1980)	SN - PP (deg)	-0.86	-1.88	0.15	0.094
Ricketts (1972)	FH - PP (deg)	-0.06	-0.99	0.88	0.901
Di Paolo et al (1983)	PP - MP (Go - Gn) (deg)	0.04	-1.19	1.26	0.954
Steiner (1953)	SN - MP (Go - Gn) (deg)	-0.84	-2.12	0.44	0.197
Tweed (1954)	FMA (FH - MP) (deg)	-0.07	-1.27	1.12	0.903
McNamara (1984)	LAFH (ANS - Me) (mm)	-1.84	-3.08	-0.59	0.004*
Wylie and Johnson (1952)	Facial height (UAFH : LAFH)	-0.35	-0.84	0.15	0.172
Jarabak and Fizzell (1972)	PFH (S - cGo) : AFH (N - cGn) (%)	0.62	-0.53	1.78	0.290
Jarabak and Fizzell (1972)	Gonial angle (Ar - cGo - cGn) (deg)	0.25	-1.46	1.95	0.776

* Significance at P<0.05.

□Data that do not form a normal distribution are presented as median differences, 95%CI of median difference, and P-value using Mann-Whitney U-Test.

Table 2 Differences of lateral cephalometric norms between 12-14 year Thai girls and boys in Khon Kaen who have acceptable facial profiles (Cont.).

References	Measurements	Mean diff	95% CI		P-value
			Lower	Upper	
II. Dental Measurement					
Jarabak and Fizzell (1972)	U1 - SN (deg)	1.48	-0.24	3.19	0.091
Steiner (1953)	U1 - NA (deg)	-1.07	-2.62	0.48	0.176
Steiner (1953)	U1 - NA (mm)	-0.25	-0.90	0.39	0.438
Ricketts (1972)	U1 - APog (deg)□	0.40	-1.00	1.80	0.561
Ricketts (1972)	U1 - APog (mm)□	0.10	-0.50	0.70	0.785
Tweed (1954)	IMPA (L1 - MP) (deg)	-0.11	-1.98	1.76	0.909
Tweed (1954)	FMIA (L1 - FH) (deg)□	0.20	-1.70	2.00	0.858
Steiner (1953)	L1 - NB (deg)	1.19	-0.38	2.78	0.136
Steiner (1953)	L1 - NB (mm)	0.43	-0.17	1.02	0.159
Ricketts (1972)	L1 - APog (deg)□	-0.10	-1.50	1.40	0.884
Ricketts (1972)	L1 - APog (mm)	0.45	-0.14	1.05	0.134
Steiner (1953)	Interincisal angle (U1 - L1) (deg)□	-0.10	-2.50	2.20	0.921
III. Soft tissue measurement					
Legan and Burstone (1980)	Facial convexity angle (G-Sn-Pog′) (deg)	-1.55	-2.83	-0.28	0.017*
Legan and Burstone (1980)	Nasolabial angle (Cm-Sn-Ls) (deg)	-2.10	-5.12	0.91	0.171
Jarabak and Fizzell (1972)	U-lip to E-line (mm)	-0.28	-0.79	0.23	0.281
Jarabak and Fizzell (1972)	L-lip to E-line (mm)	0.07	-0.48	0.62	0.809
Burstone (1967)	U-lip to Sn-Pog′ (mm)	-0.26	-0.72	0.19	0.262
Burstone (1967)	L-lip to Sn-Pog′ (mm)	0.02	-0.48	0.52	0.938
Holdaway (1983)	Basic U-lip thickness (mm)□	-1.20	-1.70	-0.80	<0.001*
Holdaway (1983)	U-lip strain (mm)	-0.16	-0.46	0.14	0.284
Burstone (1967)	U-lip length ($Sn - Stm_s$) (mm)□	-0.90	-1.50	-0.30	0.003*
Burstone (1967)	L-lip length ($Stm_i - Gn'$) (mm)	-0.95	-1.88	-0.02	0.045*
Burstone (1967)	Lip length ratio (L-lip/U-lip)□	0.00	0.00	0.10	0.277
Legan and Burstone (1980)	Interlabial gap (Stm_s - Stmi) (mm)	0.00	-0.18	0.18	0.988
Legan and Burstone (1980)	Maxillary incisor exposure (Stm_s - Is) (mm)	0.06	-0.37	0.49	0.788
Legan and Burstone (1980)	Mandibular prognathism (G - Pog′) (mm)	4.23	2.35	6.12	<0.001*
Holdaway (1983)	Chin thickness (Pog - Pog′) (mm)	0.09	-0.43	0.63	0.710
Legan and Burstone (1980)	Mentolabial sulcus (Si to Li-Pog′) (mm)	-0.59	-0.87	-0.30	<0.001*

* Significance at P<0.05.

□ Data that do not form a normal distribution are presented as median differences, 95%CI of median difference, and P-value using Mann-Whitney U-Test.

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