Establishing Esthetic Lateral Cephalometric Values for Thai Adults after Orthodontic Treatment

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Abstract

Lateral cephalometric norms were developed and analyzed to define a pleasing profile and establish a treatment goal for each patient. However, there has been no consensus in Thai orthodontists in how a pleasing profile should be posttreatment. The purpose of this study is to develop the esthetic lateral cephalometric values in Thai adults with pleasing profile after orthodontic treatment and to compare values between males and females. The lateral profile photos from 18-37 year-old individuals who underwent orthodontic treatment were transformed to black silhouette and evaluated by 4 Thai orthodontists. The Likert 5-point scale was used to judge the attractiveness. Two hundred lateral cephalometric radiographs (100 males and 100 females) from the patients who had the pleasing profile were recruited. Thirty-five linear measurement values, 33 angle measurement values and 2 facial height ratios were measured and analyzed. Independent t-test or Mann-Witney U test was used to compare the data between genders. The results showed that the profile attractiveness evaluation on a Likert 5-point scale in males and females was 15.4±1.9 and 15.6±2.1, respectively. For lateral cephalometric analysis, females showed a significant flatter profile, upturned nose tip, upper and lower lips and chin protrusion than males. The upper and lower anterior teeth were more protruded in females. The anterior cranial base, maxillary and mandibular length were significantly larger in males. Our results have demonstrated that distinctive cephalometric goals were needed in order to achieve the pleasing profile in different genders.

***Keywords**: Lateral cephalometric analysis/ Orthodontic treatment/ Silhouette photo*

***Received:** April 25, 2020*
***Revised:** June 27, 2020*
***Accepted:** July 11, 2020*

Introduction

A patient usually seeks orthodontic treatment because of malocclusion and facial esthetic concerns. Cephalometric norms were developed as a tool to help orthodontists explain the definition of a pleasing profile, which is useful for diagnosis and treatment plan on each patient. Many researchers have analyzed these data by using the well-known analysis such as Downs, Steiner and Ricketts.[1-3] The classical cephalometric standards were mainly based on Caucasians population, but it seems that cephalometric standards used for one ethnic group might not be applicable for the others. The cephalometric for Thai norms were reported in many articles. The initial study began in 1975 by Mathurasai and Laosuthiwong, using archial analysis on Thai females. They found that the lateral profiles were almost straight.[4] A larger population was done with students in Bangkok by Suchato and Chaiwat in 1985, which they established the cephalometric standard of Thai adults, but they only emphasized on skeletal and dental measurements and concluded that the skeletal was more protrusive than Caucasians', and the dental pattern was mostly bimaxillary protrusion.[5] Several studies also found the similar results.[6,7] In contrast, in 2004, Visetsiri et al. studied 30 most beautiful Thai females including Thai beauty queens, actresses and models. They found flatter profiles with prominent chins, which were different from the previous reports.[8] This demonstrated that in the 21st century, Thai opinions on what was considered to be an appealing facial profile have changed from the past. To date, Thai perception of facial esthetic still needs to be clarified, and it is orthodontists' responsibility to make sure that the given orthodontic treatment achieves an optimum esthetic result. Therefore, this study aimed to develop the esthetic lateral cephalometric values in Thai adults with pleasing profile after orthodontic treatment and to compare values between males and females.

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Materials and Methods

This study was a retrospective cross-sectional study. The patients recruited underwent orthodontic treatment at Department of Orthodontics, Faculty of Dentistry, Khon Kaen University, Khon Kaen, Thailand from year 2012-2019. These followings were included: no history of facial trauma or severe injury of dentofacial structures, no congenital diseases, syndromes or abnormality of growth involving facial anomalies, and no previous history of cosmetic plastic surgery of face (rhinoplasty, lip surgery or chin correction). 296 lateral facial photographs were obtained in natural head position and edited by Adobe Photoshop CS6 (Adobe Systems Incorporated, San Jose, CA, USA) to create black silhouette images (Figure1). Then, the images were displayed on 14 inches laptop computer with the resolution of 1920x1080 and evaluated by 4 Thai orthodontists using the Microsoft power point 2016 program. Two orthodontists were certified by the American Board of Orthodontics with 5 years of the orthodontic experience, and 2 orthodontists were certified by MOrth RCSEd Diplomate with more than 10 years of the orthodontic experience. All of them were certified by the Fellow of the Royal College of Dental Surgeons of Thailand in Orthodontics. The Likert scale from 1 to 5 was used to judge the attractiveness as follows: 1. very unacceptable, 2. unacceptable, 3. acceptable, 4. very acceptable, and 5. extremely acceptable. In this study, the pleasing profile is the sum of the Likert scale from four orthodontists with the total score of 12 out of 20 or higher. Only 30 black silhouettes were judged per visit (approximately 5 seconds per photo) once a week for each orthodontist to reduce fatigue.[9] An increase or decrease in face attractiveness depends on viewers' perspective. Goldstein and Papageorge found that it takes only 0.15 second, and there is no eye movement to judge a stranger's facial attractiveness.[9] Therefore, the duration orthodontists took to judge the black silhouettes was approximately 5 seconds per photo. Subjects who had attractive facial profile were selected to create the new cephalometric values. Two hundred digital lateral cephalometric radiographs (100 males and 100 females) from the patients with pleasing profile were chosen. All measurements were categorized into 3 groups: 1. Soft tissue, 2. Dental, and 3. Skeletal. The cephalometric landmarks used in this study were shown in Figure 1 and Table 1. The analysis including 35 linear measurements values, 33 angle measurements values and 2 facial height ratio values was developed using Dolphin 3D software 11.9 premium (Dolphin Imaging & Management Solutions, Chatsworth, CA, USA) in Table 2. One orthodontist and a 2nd year orthodontic resident defined the landmarks on 27 inches desktop computer with the resolution of 1920x1080. Thirty-seven hard and soft tissue landmarks were plotted on the cephalometric radiographs and digitized tracings. The analysis was adjusted for the magnification factor by a calibration process, identifying a known distance between two points on the Dolphin ruler. Linear measurements were reported in millimeter (mm) with no magnification, angular measurements in degree (°) and facial height ratio in percentage (%).

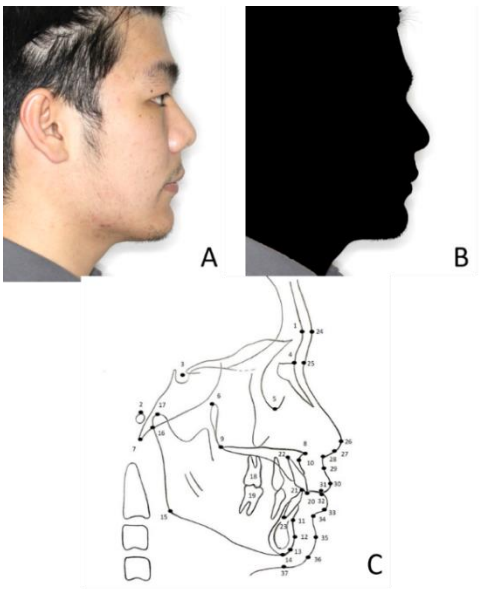

Figure 1 The original lateral profile photo (A), silhouette photo (B), and schematic tracing of lateral cephalogram presents the location of landmarks used in this study (C)

Table 1 Definition of cephalometric landmarks

Points	Definition
Skeletal landmarks	
1. Glabella (Ga)	the most anterior point of the frontal bone
2. Porion (Po)	the most superior point of the external auditory canal
3. Sella (S)	the center of the hypophyseal fossa
4. Nasion (N)	the most anterior point of the frontonasal suture which joins the nasal part of the frontal bone and nasal bone
5. Orbitale (Or)	the most inferior point of the infraorbital rim
6. Pterygomaxillary fissure (Ptm)	the most posterosuperior point of the pterygomaxillary fissure
7. Basion (Ba)	the most anterior point of the foramen magnum
8. ANS	the tip of the anterior nasal spine
9. PNS	the tip of the posterior nasal spine
10. A point	the deepest point of the anterior border of the maxillary alveolar ridge concavity
11. B point	the deepest point of the anterior border of the mandible alveolar ridge concavity
12. Pogonion (Pg)	the most anterior point of the symphysis
13. Gnathion (Gn)	the most anteroinferior aspect of the mandibular symphysis outline between pogonion and menton
14. Menton (Me)	the most inferior point of the symphysis
15. Gonion (Go)	the most convex point along the inferior border of the mandibular ramus
16. Articulare(Ar)	the point of intersection between the basisphenoid and the posterior border of the condylar head
17. Condylar (Co)	the most posterosuperior point on the outline of the mandibular condyle
Dental landmarks	
18. U6	the maxillary first molar
19. L6	the mandibular first molar
20. Incisor superius (Is)	the incisal tip of the most anterior maxillary central incisor
21. Incisor inferius (Ii):	the incisal tip of the most anterior mandibular central incisor
22. Upper incisor apex (Uia)	the root apex of the most anterior maxillary central incisor
23. Lower incisor apex (Lia)	the root apex of the most anterior mandibular central incisor
Soft tissue landmarks	
24. Soft tissue Glabella (G')	the most anterior point of the soft tissue covering the frontal bone
25. Soft tissue Nasion (N')	the most concave point of soft tissue outline at the bridge of the nose
26. Pronasale (Pn)	the most anterior point of the nose (Tip of nose)
27. Columella (Cm)	the most anterior point on the columella of the nose
28. Subnasale (Sn)	the soft tissue point where the curvature of the upper lip connects to the floor of the nose
29. Soft tissue subspinale (SLS)	the most concave point of the upper lip between subnasale and the upper lip point
30. Upper lip (Ls)	the point indicating the mucocutaneous border of the upper lip
31. Stomion superius (Stms)	the most inferior point of the upper lip
32. Stomion inferius (Stmi)	the most superior point of the lower lip
33. Lower lip (Li)	the point indicating the mucocutaneous border of the lower lip
34. Mentolabial sulcus (ILS)	the most concave point of the lower lip between chin and lower lip point
35. Soft tissue pogonion (Pg')	the most anterior point of the soft tissue of the chin
36. Soft tissue gnathion (Gn')	the midpoint of the chin soft tissue outlines between soft tissue pogonion and soft tissue menton
37. Soft tissue menton (Me')	the most inferior point of the soft tissue of the chin from the lowest point of the outline of the mandibular symphysis

Table 2 Definition of measurement line and angle

References line and angle	Definition
1. G'-Sn-Pg'(°)	the angle formed by Ga', Sn and Pg' indicating the facial convexity
2. Nasolabial angle (°)	the angle formed by the line at Sn to the columella and a line from Sn to Ls
3. Upper nasolabial angle(°)	the angle formed by Sn to columella and the true horizontal plane
4. Lower nasolabial angle(°)	the angle formed by the true horizontal plane and a line from Sn to Ls
5. Ls to E-line (mm)	the distance from Ls to the esthetic line (the line extends from the Pn to Pg')
6. Ls to SnV (mm)	the distance from the Ls to a true vertical line passing through the Sn
7. Ls to Sn-Pg' (mm)	the distance from Ls to the Sn-Pg' line
8. Ls to G' V (mm)	the distance from the Ls to a true vertical line passing through the G'
9. Ls to N' V (mm)	the distance from the Ls to a true vertical line passing through the N'
10. H-angle (N'- Pg', upper lip-Pg') (°)	the angular measurement of the H-line (the line drawn tangent to the soft tissue chin and the upper lip) to the N'Pg' line
11. U-lip length (Sn-Stms) (mm)	the distance from Sn to Stms
12. Li to E-line (mm)	the distance from Li to the esthetic line
13. Li to SnV (mm)	the distance from the Li to a true vertical line passing through the Sn
14. Li to Sn-Pg' (mm)	the distance from Li to the Sn-Pg' line
15. Li to G' V (mm)	the distance from the Li to a true vertical line passing through the G'
16. Li to N' V (mm)	the distance from the Li to a true vertical line passing through the N'
17. L-lip length (Stmi-Me') (mm)	the distance from Stmi to Me'
18. Pg-Pg' (mm)	the chin thickness; the distance from Pg to Pg'
19. Pg' to SnV (mm)	the distance from the Pg' to a true vertical line passing through the Sn
20. Pg' to G' V (mm)	the distance from the Pg' to a true vertical line passing through the G'
21. Pg' to N' V (mm)	the distance from the Pg' to a true vertical line passing through the N'
22. Sn to H line (mm)	the distance from the Sn to H-line
23. ILS to H line (mm)	the distance from the ILS to H-line
24. Interlabial gap (Stms-Stmi) (mm)	the distance from Stms to Stmi
25. Mentolabial sulcus depth (mm)	the perpendicular distance from the ILS to the Li-Pg' line
26. Nose projection to SnV (mm)	the distance from the Pn to a true vertical line passing through the Sn
27. U1-SN (°)	the angle formed by the upper incisor axis to the SN line
28. U1-PP (°)	the angle formed by the upper incisor to the palatal plane
29. U1-NA (°)	the angle formed by the upper incisor to the NA line
30. U1-NA (mm)	the distance from the Is to the NA line
31. U1-APg (°)	the angle formed by the upper incisor to the APg line
32. U1-APg (mm)	the distance from the Is to the APg line
33. ADH (mm)	the distance from ANS to the Is perpendicular to the SN line
34. PDH (mm)	the distance from the occlusal plane pass through mesio-buccal cusp of the upper first molar to the inner border of the hard palate
35. IMPA (L1-MP) (°)	the angle formed by the lower mandibular incisor to the plane formed by the lower border of the mandible
36. FMIA (L1-FH) (°)	the angle formed by the Frankfort horizontal plane and mandibular incisor
37. L1-NB (°)	the angle formed by the lower incisor to the NB line
38. L1-NB (mm)	the distance from the Ii to the NB line
39. L1-APg (°)	the angle formed by the lower incisor to the APg line
40. L1-APg (mm)	the distance from the Ii to the APg line
41. U1-L1 (°)	the angle formed by the upper and lower incisors axis
42. SN (mm)	the anterior cranial base length, the distance between sella turcica and nasion
43. SN-FH (°)	the anterior cranial base inclination, the angle between anterior cranial base line and Frankfort horizontal plane
44. NSAr (°)	the saddle angle; the angle between anterior cranial base plane and sella-articulare line
45. NS-Ba (°)	the cranial base angle; the angle between anterior and posterior skull base planes, representing skull base curvature

Table 2 Definition of measurement line and angle (Cont.)

References line and angle	Definition
46. SNA (°)	the angle formed by S, N and A point indicating the sagittal maxillary position
47. SNB (°)	the angle formed by S, N and B point indicating the sagittal mandibular position
48. SNPg (°)	the angle formed by SN plane and NPg indicating the sagittal mandibular position
49. ANB (°)	the skeletal relationship between the maxilla and mandible
50. Wits appraisal (AO-BO) (mm)	the distance from the perpendicular lines from point A and B to the functional occlusal plane
51. FH-NA (°)	the angle formed by the Frankfort horizontal plane to NA line indicating the sagittal maxillary position
52. FH-NPg (°)	the angle formed by the Frankfort horizontal plane to NPg line indicating the sagittal mandibular position
53. A-Nperp (mm)	the distance from point A to N perpendicular to Frankfort horizontal plane
54. Pg-Nperp (mm)	the distance from Pg to N perpendicular to Frankfort horizontal plane
55. Co-A (mm)	the distance from Co to point A indicating the midfacial length
56. Co-Gn (mm)	the distance from Co to Gn indicating the mandibular length
57. N-Go (mm)	the distance from N to Go indicating the facial depth
58. SN-PP (°)	the angle formed by SN plane and palatal plane
59. SN-OP (°)	the angle formed by SN and the functional occlusal plane
60. SN-GoGn (°)	the angle formed by the SN plane and the mandibular plane (GoGn) indicating the facial growth
61. FH-PP (°)	the angle formed by the Frankfort horizontal plane and palatal plane (ANS-PNS)
62. FMA (FH-MP) (Go-Me) (°)	the angle formed by the Frankfort horizontal plane and mandibular plane (GoMe) indicating the vertical mandibular growth
63. PP-MP (Go-Me) (°)	the angle formed by the palatal plane and mandibular plane (GoMe) indicating the deep bite or open bite
64. NSGn (°)	the angle formed by the SN plane and the SGn plane indicating the vertical and anteroposterior mandibular growth
65. LAFH (ANS-Me) (mm)	the distance from ANS to Me indicating the lower anterior facial height
66. UAFH/LAFH Ratio (N-ANS/ANS-Me) (%)	the ratio of the upper anterior facial height (linear distance between point N and ANS project line, measured in N-Me line) and LAFH
67. PFH (S-Go):AFH (N-Gn) (%)	the ratio of the posterior facial height and anterior facial height: the value of S to Go devided by N to Gn length
68. Ar-Go-Gn (°)	the gonial angle formed by the ramal plane and mandibular plane (GoGn) indicating the deep bite or open bite
69. Y-axis (SGn-FH) (°)	the angle formed by Frankfort horizontal plane and S-Gn plane indicating the growth axis
70. Facial axis angle(°) (BaN-PtmGn)	the angle formed by N-Ba and Ptm-Gn line indicating the vertical or horizontal growth

Statistical Analysis

Descriptive analysis was used to determine the quantitative parameters in the study groups. A normal distribution was tested by the Kolmogorov–Smirnov test. The Independent t-test was used to compare the data between male and female groups in normal distribution data and the Mann-Whitney U test in case of nonparametric. The Intraclass Correlation Coefficient was used for reliability testing of measurement outcomes. Twenty subjects were randomly selected and reanalyzed at an interval of at least 2 weeks apart to evaluate the intra- and interrater reliability. All measurements were calculated using IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). This research was approved by the Khon Kaen University Ethics Committee in human research (HE612378)

Results

Two hundred digital lateral cephalometric radiographs (100 males and 100 females) from patients with pleasing profile from post-orthodontic treatment were analyzed in this study. The age was between 18-37 years old (mean±SD;23.7±4.7 years): males aged between 18-37 years old (mean±SD;23.4±4.9 years) and females aged between

18-34.6 years old (mean±SD;23.9±4.4 years). The profile attractiveness evaluation on a Likert scale in males and females were 12-19 (mean±SD;15.4±1.9) and 12-19 (mean±SD;15.6±2.1), respectively. The intra- and interrater reliability were between 0.7 and 0.99 which is considered moderate to substantial reliability.[10] Means and standard deviation of the present cephalometric values were described in Table 3.

Table 3 Esthetic cephalometric values in Thais

Variable	Overall		Comparison between Thai male and female				
			Male		Female		
	Mean	SD	Mean	SD	Mean	SD	p-value
SOFT TISSUE							
Profile angle							
1. G'-Sn-Pg'(°)	171.9	5.2	171	5.4	172.8	5.1	
Median (Min-Max)	171.9 (158.3-186.4)		171.0 (158.3-184.5)		172.5 (161.0-186.4)		0.02**
Nasolabial angle							
2. Nasolabial angle (°)	99.9	7.5	100.3	7.9	99.5	7.2	0.45
3. Upper nasolabial angle(°)	30.0	5.5	27.9	5.9	32.1	5.2	<0.01*
4. Lower nasolabial angle(°)	69.9	6.5	72.4	6.5	67.4	6.6	<0.01*
Upper lip							
5. Ls to E-line (mm)	-1.8	2	-2.2	2.1	-1.5	1.9	0.03*
6. Ls to SnV (mm)	4.7	1.6	4.7	1.7	4.7	1.5	0.99
7. Ls to Sn-Pg' (mm)	5.6	1.5	5.7	1.7	5.5	1.4	0.21
8. Ls to G' V (mm)	9.5	4.9	9.4	5.4	9.6	4.4	0.96
9. Ls to N' V (mm)	13.2	4.2	13.1	4.7	13.4	3.8	0.83
10. H-angle (N'- Pg', upper lip-Pg') (°)	13.8	3.6	13.7	3.8	13.9	3.5	0.73
11. U-lip length (Sn-Stms) (mm)	23.1	2.3	24.7	2.5	21.5	2.1	<0.01*
Lower lip							
12. Li to E-line (mm)	0.5	2.3	0.2	2.4	0.9	2.3	0.04*
13. Li to SnV (mm)	1.4	3.1	0.9	3.3	1.9	2.9	0.03*
14. Li to Sn-Pg' (mm)	3.9	2.0	3.8	2.0	4.1	2.0	0.35
15. Li to G' V (mm)	6.1	5.6	5.2	6.1	7.0	5.2	0.03*
16. Li to N' V (mm)	9.8	4.9	8.9	5.3	10.8	4.5	
Median (Min-Max)	10.7 (-3.9-21.9)		9.3 (-3.9-20.8)		11.5 (-0.5-21.9)		0.01**
17. L-lip length (Stmi-Me') (mm)	44.5	4	47.4	4.5	41.7	3.5	<0.01*
Chin							
18. Pg-Pg' (mm)	11.8	1.7	12.4	1.8	11.3	1.6	<0.01*
19. Pg' to SnV (mm)	-3.8	5.1	-4.3	5.4	-3.4	4.9	0.18
20. Pg' to G' V (mm)	0.7	6.6	-0.3	7.0	1.8	6.3	0.02*
21. Pg' to N' V (mm)	4.5	5.9	3.3	6.1	5.7	5.7	<0.01*
Others							
22. Sn to H line (mm)	7.1	1.9	7.4	2.1	6.9	1.8	0.12
23. ILS to H line (mm)	4.4	1.3	5.0	1.3	3.8	1.4	
Median (Min-Max)	4.5 (-0.1-8.6)		5 (2.3-8.6)		4 (-0.1-6.7)		<0.01**
24. Interlabial gap (Stms-Stmi) (mm)	2.6	1.7	2.7	2	2.6	1.5	0.8
25. Mentolabial sulcus depth (mm)	-5.2	1.0	-5.7	1.2	-4.8	0.9	<0.01*
26. Nose projection to SnV (mm)	13.1	4.3	14.8	4.8	11.5	3.9	<0.01*
DENTAL							
Upper							
27. U1-SN (°)	106.1	7.6	106.3	7.4	106.0	7.8	0.83
28. U1-PP (°)	113.9	7.3	114.2	7.1	113.6	7.6	0.66
29. U1-NA (°)	21.4	7.2	21.6	6.8	21.3	7.7	0.77
30. U1-NA (mm)	3.1	2.5	2.6	2.5	3.6	2.5	<0.01*
31. U1-APg (°)	25.7	5.7	26.0	6.0	25.5	5.5	0.48
32. U1-APg (mm)	4.8	2.3	4.4	2.5	5.3	2.1	0.01*
33. ADH (mm)	28.0	3.1	29.0	3.4	27.0	2.8	<0.01*
34. PDH (mm)	20.0	1.8	21.0	1.9	19.0	1.8	<0.01*

*Independent t-test, **Mann-Whitney U test

Table 3 Esthetic cephalometric values in Thais (Cont.)

Variable	Overall		Comparison between Thai male and female				
			Male		Female		
	Mean	SD	Mean	SD	Mean	SD	p-value
Lower							
35. IMPA (L1-MP) (°)	90.1	8.7	88.8	8.4	91.4	9.1	0.04*
36. FMIA (L1-FH) (°)	64.4	8.4	65.8	8.5	63.0	8.3	
Median (Min-Max)	64 (42.2-83.8)		66.1 (50.7-83.8)		62.6 (42.2-82.2)		0.02**
37. L1-NB (°)	24.3	7.2	23.1	7.1	25.6	7.3	0.01*
38. L1-NB (mm)	4.4	2.4	4.2	2.8	4.7	2.1	0.22
39. L1-APg (°)	22.9	5.8	21.7	6.0	24.2	5.6	
Median (Min-Max)	22.6 (6.7-35.7)		22.1 (6.7-34.8)		22.9 (9.5-35.7)		<0.01**
40. L1-APg (mm)	2.0	2.3	1.5	2.5	2.6	2.1	<0.01*
Upper and lower							
41. U1-L1 (°)	131.2	9.5	132.2	10.1	130.3	8.9	0.16
SKELETAL							
Cranial base							
42. SN (mm)	66.8	3.8	70.2	4.6	63.4	3.1	<0.01*
43. SN-FH (°)	6.9	3.1	7.3	3.2	6.6	3.1	0.11
44. NSAr (°)	122.1	5.1	122.5	5.4	121.8	4.8	0.30
45. NS-Ba (°)	126.9	5.0	126.8	5.3	127.1	4.8	0.65
Antero-posterior analysis							
46. SNA (°)	84.6	3.5	84.6	3.8	84.6	3.3	0.89
47. SNB (°)	81.8	3.8	81.6	4.0	82	3.6	0.51
48. SNPg (°)	82.6	3.9	82.5	4.1	82.7	3.8	0.72
49. ANB (°)	2.8	2.3	3.0	2.3	2.7	2.4	0.40
50. Wits appraisal (AO-BO) (mm)	-1.2	2.8	-0.6	3.1	-1.8	2.6	<0.01*
51. FH-NA (°)	91.6	3.1	91.9	3.1	91.3	3.1	0.15
52. FH-NPg (°)	89.5	3.4	89.8	3.3	89.3	3.5	0.30
53. A-Nperp (mm)	1.6	3.2	2.1	3.4	1.2	3.0	0.06
54. Pg-Nperp (mm)	-0.8	6.7	-0.4	6.9	-1.3	6.5	0.33
55. Co-A (mm)	84.2	5.0	89.2	5.7	79.2	4.4	<0.01*
56. Co-Gn (mm)	121.0	7.5	129.5	8.9	114	6.2	<0.01*
57. N-Go (mm)	114.7	7.4	122.2	8.5	107.3	6.4	
Median (Min-Max)	113.4 (95.7-143)		120.7 (96.1-143)		106 (95.7-136.3)		0.00**
Vertical analysis							
58. SN-PP (°)	7.7	3.1	7.9	3.1	7.6	3.1	0.44
59. SN-OP (°)	14.3	5.3	13.7	5.6	14.9	5.0	0.09
60. SN-GoGn (°)	30.0	6.2	29.9	6.4	30.2	6.0	0.69
61. FH-PP (°)	0.8	2.9	0.6	2.9	1.0	3.0	0.23
62. FMA (FH-MP) (Go-Me) (°)	25.5	5.7	25.4	5.8	25.6	5.7	0.72
63. PP-MP (Go-Me) (°)	25.5	5.9	25.2	5.9	25.9	6.0	0.42
64. NSGn (°)	67.4	3.8	67.9	3.9	66.9	3.8	0.07
65. LAFH (ANS-Me) (mm)	67.5	5.5	72.0	6.1	63.0	5.0	<0.01*
66. UAFH/LAFH Ratio (N-ANS/ANS-Me) (%)	80.2	6.5	80.3	6.1	80.2	6.9	0.90
67. PFH (S-Go):AFH (N-Gn) (%)	66.0	5.1	66.9	5.3	65.2	4.9	0.02*
68. Ar-Go-Gn (°)	120.3	6.2	120.7	6	120	6.4	0.41
Direction of growth							
69. Y-axis (SGn-FH) (°)	60.4	3.4	60.6	3.3	60.3	3.5	0.58
70. Facial axis angle(°) (BaN-PtmGn)	88.0	4.4	87.4	4.5	88.7	4.3	0.07

*Independent t-test, **Mann-Whitney U test

Soft tissue analysis Female facial convexity was flatter than males, but the H-angle was the same. This could be due to the H-angle measurements did not use G' as a reference point. In male group, the G' point was more forward than female group which could affect the lateral facial profile angle. The overall nasolabial angle in males and females was quite equal. Interestingly, upper nasolabial angle in females was larger significantly, but lower nasolabial angle was opposite. This indicated that the nose tip upturned, and upper lip protruded in females more than males. In addition, most of the values also showed that the upper and lower lips in females were significantly protruded than males. Likewise, the chin in females was significantly protruded than males, regardless of a thicker soft tissue chin in males. The upper/lower lip length and mentolabial sulcus depth were significantly larger in males than females (Figure 2).

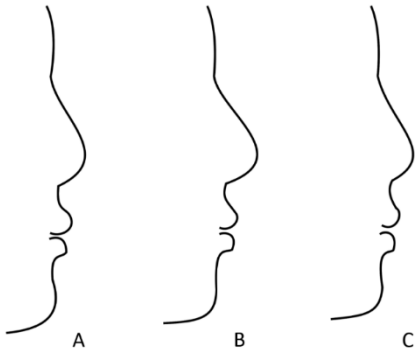

Figure 2 Lateral cephalometric profile in overall (A), male (B) and female (C)

Dental analysis The linear measurements U1-NA, U1-APg and L1-APg, and the angle measurements IMPA, L1-NB and L1-APg were larger in females. This means that the upper anterior teeth were more protruded, and lower teeth were more protruded and proclined in females than males. The ADH and PDH were significantly larger in males.

Skeletal analysis Most of the values between males and females were not statistically different except linear measurements (SN, Co-A, Co-Gn, LAFH, and N-Go) which were significantly greater in males than in females indicating a larger skull in males. Wits appraisal and PFH:AFH ratio were also significantly higher in males suggesting that females had a tendency toward class III openbite skeletal pattern than males.

Discussion

Facial esthetics is one of the most important orthodontic goals. Definition of pleasing profile is decided by beholders. Patients seeking orthodontic treatment tend to prefer improved facial esthetics than average.[11] It is an orthodontist's task to plan and treat soft tissue profile in these patients to meet their expectation. Therefore, the subject selection criteria for this study were focused mainly on soft tissue profiles rather than hard tissues. Many studies had published cephalometric standards, but they are usually valid for some certain ethnic groups and cannot be applied to others. It is recommended for orthodontists to plan the using cephalometric analyses, customized based on the ethnicity of patients. The norms of the lateral cephalometric values for Thai had already been established but outdated, as a result of a change in the facial esthetic perception in the modern society. For instance, Thai norms which were established by Suchato and Chaiwat in 1984[5], showed a more bimaxillary protrusion nature compared to Visetsiri et al. in 2004.[8] This was due to the sample selection of the latter based on the most beautiful Thai females including Miss Universe, Miss Thailand, actresses, fashion models and popular good-looking women. This is different from the study in 1984, which used Thai adult students with normal profile. For this reason, this study was conducted to update the latest trend in facial esthetics, which could be used to establish a proper orthodontic or surgical treatment goal for Thai population.

For the soft tissue analysis, the facial convexity from our female data was flatter than the one reported by Visetsiri et. al. in 2004[8], but both studies preferred prominent chin. The H-angle in the study by Suchato and Chaiwat's[5] was similar to our study but wider than Visetsiri's, indicating a slightly convex profile with protrusive upper lip is still desirable. Interestingly, no previous study in Thailand divided the nasolabial angle into upper and lower angles

which, our results revealed that in females the upper nasolabial angle was more obtuse than males. On the contrary, the lower nasolabial angle was more acute, which suggested that females had more upturned nose and protruded upper lip than males. This contradicted with Visetsiri's finding in that female subjects' upper lip was retruded.[8] From above, we suggested that the overall nasolabial angle that was widely used for diagnosis might not be a good guide to evaluate the facial profile. Horizontal line should be used to divide the angle and measure it separately. By a consideration of the upper and lower lip to E-line, our results showed more retruded lips compared to Dechkunakorn et al. in 1994.[12] This shows that current orthodontists preferred lips to be retracted. Our study found that chin in females was significantly more protruded than in males regardless of thicker soft tissue chin in males. One explanation is that the soft tissue glabella and nasion might be more prominent in males, which could influence the reading to be lower.[13]

The dental analysis showed that the anterior teeth in our study were less proclined and protruded compared to previous researches.[5,8,12] This might contribute to our results of a flatter soft tissue profile observation when comparing to other studies. In a comparison between genders, females had more dental protrusion than males, which was similar to Resnick et. al. who studied Caucasian ethnicity and claimed that the most esthetic maxillary incisor position in females should be more forward than males.[14] Therefore, in treatment planning, the upper anterior teeth in males could be positioned more upright than females, resulting in further retraction of the upper lip.

Similar results were observed between the skeletal analysis from our research relating to previous investigations.[5,13] However, from the female data, Visetsiri et al.[8] showed that the Thai beauties had about 2 degrees less SNA and SNB compared to our female subjects, but our data indicated a flatter soft tissue profile in the female population. This emphasize the importance of soft tissue profile assessment which does not reflect the underlying bony structures. However, the dental and skeletal cephalometric values were necessary in the treatment planning especially in the orthognathic surgery cases. This is the reason that we should present the cephalometric values not only the soft tissue values but also dental and skeletal values.

The limitations of this study are the generalizability of the results because the samples recruitment was included only Thai population, and the rankings of the most and least attractive black silhouettes were depended on a decision made by four certified orthodontists. Previous studies showed that the oral and maxillofacial surgeon, patients and their relatives also had an important impact in facial esthetic treatment planning.[15,16] Therefore, future study should include additional orthodontists, oral surgeons, lay people and multicenter data.

Conclusion

This study had established esthetic lateral cephalometric values for Thai population. When compared to the previous Thai cephalometric studies, the tendency for facial profile was flatter, especially for females. Females also have upturned nose tip and protrusive lips and chin. Thus, the upper and lower anterior teeth in females should be treated with more protrusion than in males to achieve a pleasing profile.

Acknowledgment

The authors would like to thank Dr.Khanoengnit Bootvong for evaluating black silhouette images and also thank to Dr.Thejsit Thanasanwanich for the illustration.

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การสร้างค่าภาพรังสีวัดศีรษะด้านข้างที่สวยงามสำหรับผู้ใหญ่ไทยภายหลังการรักษาทางทันตกรรมจัดฟัน

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บทคัดย่อ

ค่าปกติของกะโหลกศีรษะด้านข้างได้รับการพัฒนาและวิเคราะห์เพื่อกำหนดรูปร่างใบหน้าด้านข้างที่น่าพึงพอใจและสร้างเป้าหมายการรักษาสำหรับผู้ป่วยแต่ละราย อย่างไรก็ตามยังไม่มีการตกลงร่วมกันระหว่างทันตแพทย์จัดฟันไทยว่ารูปร่างใบหน้าด้านข้างที่น่าพึงพอใจควรเป็นอย่างไรภายหลังการรักษา การวิจัยครั้งนี้จึงมีวัตถุประสงค์ เพื่อสร้างค่าภาพรังสีวัดศีรษะด้านข้างที่สวยงามสำหรับผู้ใหญ่ไทยภายหลังการรักษาทางทันตกรรมจัดฟันและเปรียบเทียบค่าระหว่างเพศชายและหญิง ภาพถ่ายรูปร่างใบหน้าด้านข้างจากบุคคลอายุ 18-37 ปี ที่ได้รับการรักษาทางทันตกรรมจัดฟันถูกเปลี่ยนเป็นภาพเงาดำและประเมินความมีเสน่ห์โดยทันตแพทย์จัดฟันไทย 4 คนด้วยมาตราวัดลิเคิร์ท 5 ระดับ ภาพรังสีกะโหลกศีรษะด้านข้างจากผู้ป่วยที่มีรูปร่างใบหน้าด้านข้างที่น่าพึงพอใจจะถูกคัดเข้า 200 ภาพ (เพศชาย 100 ภาพ และเพศหญิง 100 ภาพ) วัดและวิเคราะห์ด้วยการวัดค่าเชิงเส้น 35 ค่า การวัดมุม 33 ค่า และอัตราความสูงของใบหน้า 2 ค่า ข้อมูลระหว่างเพศถูกเปรียบเทียบกันด้วยการทดสอบค่าทีระหว่างกลุ่มหรือสถิติทดสอบแมน-วิทนีย์ยู ผลการศึกษาพบว่า ค่าการประเมินความพึงพอใจของใบหน้าด้านข้างด้วยมาตราวัดลิเคิร์ท 5 ระดับอยู่ที่ 15.4±1.9 ในเพศชาย และ 15.6±2.1 ในเพศหญิง สำหรับการวิเคราะห์ภาพรังสีวัดศีรษะด้านข้างพบว่า เพศหญิงมีลักษณะรูปร่างใบหน้าที่ตรง ปลายจมูกเชิดขึ้น ริมฝีปากบน ล่างและคางยื่นมากกว่าเพศชาย ฟันหน้าบนและล่างมีลักษณะที่ยื่นในเพศหญิงมากกว่า ส่วนความยาวฐานกะโหลกศีรษะส่วนหน้า ขากรรไกรบนและล่างในเพศชายยาวมากกว่าเพศหญิงอย่างมีนัยสำคัญทางสถิติ ผลการวิจัยแสดงให้เห็นว่าลักษณะศีรษะจำเป็นต้องมีลักษณะเฉพาะเพื่อให้ได้รูปร่างใบหน้าที่น่าพอใจในเพศที่แตกต่างกัน

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