Dental Journal
Majalah Kedokteran Gigi

Dental Journal
(Majalah Kedokteran Gigi)
2022 December; 55(4): 200–203

Original article

Gender differences in cephalometric angular measurements between boys and girls

Helsa Alyayuan, Johan Arief Budiman
Department of Orthodontics, Faculty of Dentistry, Universitas Trisakti, Jakarta, Indonesia

ABSTRACT

Background: *Gender determination is an important aspect of human biologic profile identification. The human skull is part of the body that has many gender indicators. Lateral cephalogram is used for human skull analysis because of its morphological biologic details, including gender.* ***Purpose:*** *The objective of this study was to determine the difference of angular measurements, those are sella-nasion-point A (SNA), sella-nasion-point B (SNB), point A-nasion-point B (ANB), gonial, mandibular plane, glabella-metopion and sella-nasion (GM-SN), glabella-metopion and Frankfort horizontal plane (GM-FHP), and glabella-metopion and basion-nasion (GM-BaN) angles measurement's results between boys and girls aged 8-12 years.* ***Methods:*** *This study was an observational analytic on cephalometric radiographs in children aged 8-12 years from July-December 2018 using 54 samples from the Faculty of Dentistry Universitas Trisakti's Oral and Dental Hospital Radiology Installation. Landmarks determination and angular measurement were digitized. The data were analyzed to a univariate test followed by a statistical test using the independent t-test.* ***Results:*** *The independent t-test showed there are no differences between boys' and girls' angular measurement results ($p > 0.05$).* ***Conclusion:*** *There are no differences in the angular measurements results between boys and girls aged 8-12 years.*

Keywords: *angular measurement; gender; lateral cephalogram*

Correspondence: Johan Arief Budiman, Department of Orthodontics, Faculty of Dentistry, Universitas Trisakti. Jl. Kyai Tapa No. 260, Jakarta, 11440, Indonesia. Email: johanarief@trisakti.ac.id

INTRODUCTION

Gender determination is the most important aspect of medico-legal cases and anthropological research. Identification techniques such as facial reconstruction will be difficult to perform if gender determination is not carried out correctly.[1] Therefore, separating and assessing gender manifestations is an integral part of identifying human skeletons. In forensic and physical anthropology, elements of the human skeleton play an important role in gender determination. The human skull has many excellent indicators of gender although the pelvis is considered a gender indicator for craniofacial growth.[2]

Lateral cephalometrics are one of the tools used for the human skull analysis because it can provide information on anatomical points in one radiography and show morphological details for evaluation including various anatomical points and morphological details for gender determination.[3,4] Lateral cephalometrics are becoming popular in orthodontics and are used for craniofacial assessment which assists in the determination of diagnosis and treatment planning.[5] In determining the gender of an incomplete skull, the lateral cephalometric has an important role because it can provide details of skull morphology and thus aid in identifying the characteristics of the skull.[1]

Since Broadbent and Hofrath's introduction in 1931, the cephalometric has become an important tool in assisting diagnosis in orthodontic treatment planning cases. Its main advantage is that it can provide facial and tooth relationships measurements, identification and classification of bone and tooth disorders, and assessment of facial growth.[6] Lateral cefalometrics were used in many growth studies before being recognized for their role in determining the diagnosis.[7] One analysis that has an important role in diagnostics the orthodontic routine is an angular measurement.[8] Angular measurements on the face have more informative than linear measurements. Faces vary in size from person to person and it is difficult to assign specific directions to

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 158/E/KPT/2021.
 Available at https://e-journal.unair.ac.id/MKG/index
DOI: 10.20473/j.djmkg.v55.i4.p200–203

linear measurements.[7] Angular measurement of faces can provide information about the variability in facial profiles concerning biological profiles including gender.[9]

One of the angles that can be measured from the cephalogram is the gonial angle. Several studies have shown that the gonial angle is a parameter with acceptable accuracy and precision for determining gender. However, in several studies found that there was no significant difference in the measurement of the gonial angle between men and women with a mean of 122.17° for men and 124.99° for women.[10] Apart from the gonial angle, several other angles, sella-nasion-point A (SNA), sella-nasion-point B (SNB), point A-nasion-point B (ANB), and the mandibular plane angle are also used in several studies such as research conducted by Mathur et al.[1] The results of this study indicate that there is a difference in the gonial angle (124.766° in women and 119.96° in men) and the mandibular plane angle (28.133° in women and 24.533° in men) with women being greater than men. Other measurements show that there is no significant difference between men and women, namely SNA with a mean of 81.316° for men and 80.4° for women, SNB with a mean of 77.35° for men and 77° for women, and ANB with 3.9° in men and 3.6° in women. Although, in general, the skeleton does not manifest gender characteristics until puberty, in establishing the gender identity from a defleshed skull, lateral cephalometrics and posteroanterior view radiographs assume a predominant role, as they can provide architectural and morphological details of the skull, thereby revealing additional characteristics and multiple points for comparison. Various researchers have claimed that the gender identification by skull radiographs is a reliable method with up to 80–100% accuracy.[1]

In a study conducted on the Kuruba caste in India. the angle of the intersection of the glabella-metopion (GM) and sella-nasion (SN) lines obtained an average angle measurement of 96.5° in men and 92.7° in women.[2] While in the measurement of the intersection angle of the glabella-metopion (GM) and Frankfort Horizontal Plane (FHP) lines, it was found an average of 77.8° in men and 75.8° in women. Then, at the intersection angle of the glabella-metopion (GM) and basion-nasion (BaN) lines, it was obtained an average of 104.6° in men and 102.2° in women.[2] Therefore, the objective of this research was to find out the differences in cephalometric angular measurements, SNA, SNB, ANB, gonial, mandibular plane, GM-SN, GM-FHP, and GM-BaN angles between boys and girls aged 8-12 years at our Oral and Dental Hospital.

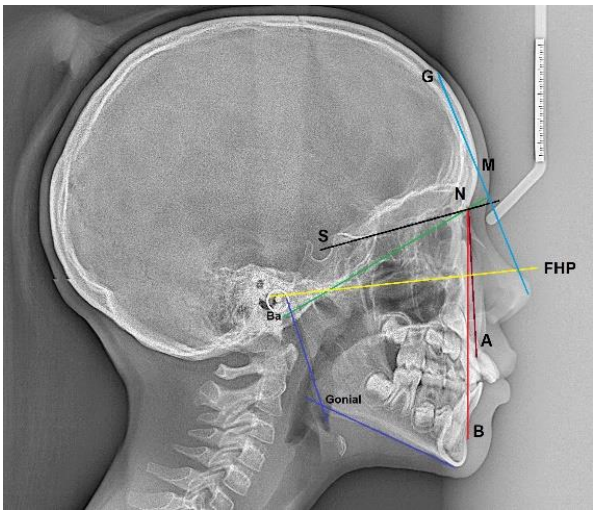

Figure 1. Landmarks and lines for angular measurements.

MATERIALS AND METHODS

This is an observational analytic study on the lateral cephalometrics of patients. The population in this study were all lateral cephalometrics which were produced from the Veraviewepocs 2D panoramic machine (Morita®-Japan) for patients aged 8-12 years at our Oral and Dental Hospital. which was conducted at the Radiology Installation of our Oral and Dental Hospital from July-December 2018. The population in this study were all lateral cephalometrics which were produced from the Veraviewepocs 2D panoramic machine (Morita®-Japan) at our Oral and Dental Hospital. The sample size was determined using the Lemeshow formula. Based on the formula, the minimum number of samples is 26. The taken samples are 27 for each gender. The total lateral cephalometrics samples were digitized using I-Dixel 2.0 software (Morita®, Japan) on a PC HP® I7 (8700) GTX1060 with an HP® 23f monitor with 1920 x 1080 resolution.

The anatomical reference point was determined on the lateral cephalometrics. Those were SNA, SNB, ANB, gonial, mandibular plane, GM-SN, GM-FHP, and GM-BaN angles. A line was drawn (Figure 1), then the angles in the study were measured. Anatomical landmark determination, tracing, and angular measurements were carried out twice at different time intervals to avoid fatigue. All measurement results are analyzed and tabulated according to the name and angular measurement and gender. The data were analyzed using Shapiro-Wilk Normality Test, the Cronbach's alpha reliability test and a univariate test using the independent t-test ($p<0.05$).

RESULTS

The study was conducted on 54 samples of lateral cephalometrics of children aged 8-12 years old. Information was obtained by collecting the lateral cephalometrics angular measurements and gender. The sample distribution can be seen in Table 1. Landmarks determination and angular measurement (SNA, SNB, ANB, gonial, mandibular plane, GM-SN, GM-FHP, and GM-BaN angles) were carried out twice at different times to minimize errors. The two assessment results are carried out by a normality test to find out whether the data are distributed normally. From the normality test, it can be seen that the two assessment

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 158/E/KPT/2021.
 Available at https://e-journal.unair.ac.id/MKG/index
DOI: 10.20473/j.djmkg.v55.i4.p200–203

results are normally distributed (p>0.05). The normality test can be seen in Table 2

Then an internal reliability test was carried out on both assessments using the Cronbach's alpha method to determine the consistency of the assessment for each angular measurement according to gender. The reliability test can be seen in Table 3. Furthermore, the homogeneity test was carried out on the two assessments. The results of the homogeneity test showed that in the first measurement there was one angle where the assessment was not homogeneous, the glabella-metopion (GM) and sella-nasion (SN) lines (p<0.05) while in the second assessment all angular measurements showed homogeneous results (p>0.05). The homogeneity test can be seen in Table 4.

Table 1. Sample distribution

Gender	Age					Total
	8	9	10	11	12	
Boys	0	8	9	5	5	27
Girls	0	9	10	7	1	27
Total	0	17	19	12	6	54

Table 2. Shapiro-Wilk normality test on 1st and 2nd assessment

Angular measurement	Gender	Degree of freedom	p*	
			1	2
SNA	Boys	27	0.387	0.685
	Girls	27	0.559	0.839
SNB	Boys	27	0.880	0.938
	Girls	27	0.167	0.299
ANB	Boys	27	0.607	0.123
	Girls	27	0.376	0.880
Gonial	Boys	27	0.861	0.623
	Girls	27	0.161	0.996
Mandibular plane	Boys	27	0.863	0.148
	Girls	27	0.951	0.66
GM-SN	Boys	27	0.121	0.697
	Girls	27	0.71	0.662
GM-FHP	Boys	27	0.237	0.760
	Girls	27	0.65	0.613
GM-BaN	Boys	27	0.179	0.394
	Girls	27	0.088	0.737

*p=0.05

Table 3. Reliability test on 1st and 2nd assessment

Assessment	Gender	Cronbach's alpha*
1	Boys	0.445
	Girls	0.502
2	Boys	0.512
	Girls	0.704

*p=0.05

Table 4. Homogeneity test on 1st and 2nd assessment

Angular Measurement	p*	
	1	2
SNA	0.768	0.279
SNB	0.741	0.938
ANB	0.806	0.248
Gonial	0.985	0.554
Mandibular plane	0.844	0.113
GM-SN	0.022	0.66
GM-FHP	0.078	0.326
GM-BaN	0.060	0.284

*p=0.05

The test results showed that the first assessment data was not homogeneous at the GM-SN angle (p=0.022), whereas, in the second assessment, all of the angular measurements showed homogeneous data (p>0.05). From the results of the three univariate tests carried out, only the second measurement result data can be continued for a different test with an independent t-test to determine whether there is a difference in the results of angular measurement between genders.

DISCUSSION

Digital analysis is slowly replacing the manual method because it uses less time, can modify the size and contrast as needed, and solves the problem of film damage over time, which reduces the information on a radiograph.[11,12] The landmarks determination followed by angular measurement was carried out twice at different times to minimize errors. After the second assessment, the normality test was carried out to determine whether the data were normally distributed. The normality test used the Shapiro-Wilk method because of the small number of samples for each man and woman (27 samples). The test results showed that in the 1st and 2nd data assessment, all angular measurements for each gender were normally distributed (p>0.05).[13] After that, the internal reliability test, using the Cronbach's alpha method, was assessed on the two-assessment data. The result showed that both assessments are statistically reliable for each gender, with no significant difference (p>0.05).

Gender determination of an unknown human skeleton is important information needed in the development of the identification of a human biological profile.[14] The skull is the second-best accurate skeleton after the pelvis in gender determination because it consists of hard tissue so that the skull is the most widely available part for forensic examination.[15] Lateral cephalometrics is one of the tools used in identifying gender. The lateral cephalometrics shows morphological details of the skull architecture on a radiograph.[16]

In previous research conducted by Mathur et al.[1] among young adults in Nashik, India, there was no significant difference in the measurement results of SNA (p = 0.369), SNB (p = 0.71), and ANB (p = 0.6) measurement results. the men are bigger than the women. Meanwhile, in the gonial and mandibular plane angles, there were significant differences (p <0.05) with women being greater than men.[1] Another study concluded that the gonial angle of the digital lateral cephalometrics has the same result.[17] According to previous study, in cases where an intact skull is not found, gender can be predicted by analyzing the mandible because it is the most dimorphic skull bone.[1] One that can be analyzed on the mandibular is the gonial angle. Several studies in South Africa, Europe, America, and Egypt prove that the gonial angle is gender dimorphic.[1,17]

The results of this research conducted whose race was unknown showed similarities at the SNA (p = 0.563),

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 158/E/KPT/2021.
 Available at https://e-journal.unair.ac.id/MKG/index
DOI: 10.20473/j.djmkg.v55.i4.p200–203

SNB (p = 0.651), and ANB (p = 0.797). There was a significant difference between the mean of the lateral cephalometrics angular measurement between genders. The gonial and mandibular planes showed different results. In the average measurement of the gonial angle, showed that there is no significant difference (p = 0.789), and the mean measurement of women is greater than that of men. While, the results of the mandibular plane angle measurement showed very different results, because the mean measurement of men was greater than that of women with no significant difference (p = 0.272).

Previous research conducted on a population of children and adolescents of the Kurubas caste in India showed a significant difference (p <0.05) between the results of the angular measurement between gender.[2] The angular intersection of the glabella-metopion (GM) and sella nasion (SN) lines, glabella-metopion (GM), and Frankfort Horizontal Plane (FHP), as well as glabella-metopion (GM) and basion-nasion (BaN), have the average measurement of men being greater than the women. Meanwhile, the other research showed that the measurement results of women's angular measurement were greater than men's at the three angles of GM-SN, GM-FHP, and GM-BaN with significant differences (p< 0.05).[15]

The results of this study were in line with research on the Kurubas caste in India, the GM-SN angle (p = 0.484) and GM-FHP (p = 0.637), with the average measurement result for men, is greater than that for women, but statistically insignificant.[2] However, the GM-BaN angle (p = 0.582) showed different results, with women greater than men with no statistically significant difference.

The differences in the results of previous studies with this study are due to differences in various races.[1] Gender differentiation in one human group may not be the same in another group. Factors such as genetics, environmental conditions, socioeconomic status, daily diet, and physical activity allow for differences among populations.[1,2] Those factors are not the part of this study.

This research can be concluded that there is no difference in the angular measurement of SNA, SNB ANB, gonial, mandibular plane, GM-SN, GM-FHP, and GM-BaN between boys and girls in children aged 8-12 years old. This study can be developed with more specific techniques and methods to assess gender differentiation on angular lateral cephalometrics measurements.

REFERENCES

1. Mathur RU, Mahajan AM, Dandekar RC, Patil RB. Determination of sex using discriminant function analysis in young adults of Nashik: a lateral cephalometric study. J Adv Med Dent Sci. 2014; 21–5.
2. Devang Divakar D, John J, Al Kheraif AA, Mavinapalla S, Ramakrishnaiah R, Vellappally S, Hashem MI, Dalati MHN, Durgesh BH, Safadi RA, Anil S. Sex determination using discriminant function analysis in Indigenous (Kurubas) children and adolescents of Coorg, Karnataka, India: A lateral cephalometric study. Saudi J Biol Sci. 2016; 23(6): 782–8.
3. Datta A, Chandrappa Siddappa S, Karibasappa Gowda V, Revapla Channabasappa S, Babu Banagere Shivalingappa S, Dey D. A study of sex determination from human mandible using various morphometrical parameters. Indian J Forensic Community Med. 2015; 2(3): 158–66.
4. Farhidnia N, Soltani S, Aghakhani K, Salehi S, Khloosy L, Chehreii S, Fallah F, Memarian A. The value of lateral cephalometric variables measured by cephalogram in sex determining among Iranians. Glob J Health Sci. 2016; 9(6): 214.
5. Qamruddin I, Alam MK, Shahid F, Tanveer S, Mukhtiar M, Asim Z. Assessment of gender dimorphism on sagittal cephalometry in Pakistani population. J Coll Physicians Surg Pak. 2016; 26(5): 390–3.
6. Mehta P, Sagarkar RM, Mathew S. Photographic assessment of cephalometric measurements in skeletal class II cases: A comparative study. J Clin Diagn Res. 2017; 11(6): ZC60–4.
7. Premkumar S. Textbook of craniofacial growth. Jaypee Brothers Medical Publishers (P) Ltd.; 2011. p. 396.
8. Heil A, Lazo Gonzalez E, Hilgenfeld T, Kickingereder P, Bendszus M, Heiland S, Ozga A-K, Sommer A, Lux CJ, Zingler S. Lateral cephalometric analysis for treatment planning in orthodontics based on MRI compared with radiographs: A feasibility study in children and adolescents. Kleinschnitz C, editor. PLoS One. 2017; 12(3): e0174524.
9. Adamu LH, Ojo SA, Danborno B, Adebisi SS, Taura MG. Sex determination using facial linear dimensions and angles among Hausa population of Kano State, Nigeria. Egypt J Forensic Sci. 2016; 6(4): 459–67.
10. Leversha J, McKeough G, Myrteza A, Skjellrup-Wakefiled H, Welsh J, Sholapurkar A. Age and gender correlation of gonial angle, ramus height and bigonial width in dentate subjects in a dental school in Far North Queensland. J Clin Exp Dent. 2016; 8(1): e49-54.
11. Kamath M, Arun A. Comparison of cephalometric readings between manual tracing and digital software tracing: A pilot study. Int J Orthod Rehabil. 2016; 7(4): 135–8.
12. Navarro R de L, Oltramari-Navarro PVP, Fernandes TMF, Oliveira GF de, Conti AC de CF, Almeida MR de, Almeida RR de. Comparison of manual, digital and lateral CBCT cephalometric analyses. J Appl Oral Sci. 2013; 21(2): 167–76.
13. Ghasemi A, Zahediasl S. Normality tests for statistical analysis: a guide for non-statisticians. Int J Endocrinol Metab. 2012; 10(2): 486–9.
14. Thomas RM, Parks CL, Richard AH. Accuracy rates of ancestry estimation by forensic anthropologists using identified forensic cases. J Forensic Sci. 2017; 62(4): 971–4.
15. Badam RK, Manjunath M, Rani M. Determination of sex by discriminant function analysis of lateral radiographic cephalometry. Kailasam S, editor. J Indian Acad Oral Med Radiol. 2011; 23(3): 179–83.
16. Binnal A, Yashoda Devi B. Identification of sex using lateral cephalogram: role of cephalofacial parameters. J Indian Acad Oral Med Radiol. 2012; 24: 280–3.
17. Belaldavar C, Acharya AB, Angadi P. Sex estimation in Indians by digital analysis of the gonial angle on lateral cephalographs. J Forensic Odontostomatol. 2019; 37(2): 45–50.

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 158/E/KPT/2021.

DOI: 10.20473/j.djmkg.v55.i4.p200–203