Pesquisa Brasileira em Odontopediatria e Clínica Integrada 2019, 19:e4419
DOI: http://doi.org/10.4034/PBOCI.2019.191.72
ISSN 1519-0501

ORIGINAL ARTICLE

Vertical Cephalic Index, Dental Arch and Palatal Depth Measurement: A Study in Bataknese Children

Ameta Primasari[1], Ngena Ria[2], Heriandi Sutadi[3]

[1]Department of Oral Biology, Faculty of Dentistry, University of Sumatera Utara, Medan, Indonesia. 0000-0002-4249-4008
[2]Health Polytechnic of Health Department, Medan, Indonesia. 0000-0002-6140-6333
[3]Department of Pediatric Dentistry, Faculty of Dentistry, University of Indonesia, Jakarta, Indonesia. 0000-0002-6718-1083

Author to whom correspondence should be addressed: Ameta Primasari, Department of Oral Biology, Faculty of Dentistry, University of Sumatera Utara, Kampus USU, Jl. Alumni No.2, Padang Bulan, Medan Baru, Kota Medan, Sumatera, Utara 20155, Indonesia. Phone: +62 811245024. E-mail: ametaprima@yahoo.com.

Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 27 September 2018 / Accepted: 11 March 2019 / Published: 09 April 2019

Abstract

Objective: To evaluate the cephalic indices among Bataknese school students. **Material and Methods:** An observational study was performed by measuring 95 Bataknese children aged 3-5 years using a purposive sampling technique. The vertical cephalic index was measured directly in children, while the dental arch and palatal depth were measured on maxillary impressions. Vertical cephalic index data were obtained by measuring the height and length of the child's head directly. Measurement was performed three times by three different people. Cephalic height was measured by a digital calipers by placing each edge of the calipers on the nasion and gnathion. Descriptive statistics were used to calculate the mean and standard deviation. **Results:** The analysis of height and cephalic length showed that the highest values were 9.28 cm and 18.13 cm, while the lowest were 7.43 cm and 13.43 cm, respectively. The means for Maxillary canine arch width and Maxillary molar arch width were 30.66 mm and 46.69 mm, respectively. For the Maxillary canine arch depth, the mean was 12.0 mm, while for the Maxillary molar arch depth was 28.65 mm. The palatal depth was 14.33. **Conclusion:** The majority of Bataknese children have a dolichocephalic head shape with a tapered maxillary dental arch and a narrow one.

Keywords: Anthropometry; Head; Orthodontics; Cephalometry; Odontometry.

Introduction

Anthropometry is the study of human body measurements [1]. Differences in human physical characteristics can be used to identify people based on the measurements and shape of their body parts and skeleton [2]. Race is an important concept and parameter to study humans because each of them are different. Race is a biological concept related to physical characteristics rather than mental traits or social cultures. Physical characteristics that can be used to clarify race include body shape, head shape, facial shape and jaw line, nose shape, skin colour, pupil colour, hair colour and hair shape. Physical traits used to identify a race are assumed not to depend on the environment and are passed down genetically [1]. In Indonesian society, physical characteristics are grouped into Deutro and Proto Malay. Bataknese are included in the Proto Malay [2].

Based on earlier studies, a comprehensive measurement for vertical cephalic index, dental arch and palatal depth has not been found. Here, we measure the head shape and dental arch shape of Bataknese children and the average vertical cephalic index, dental arch and palatal depth of Bataknese children aged 3 to 5 years.

Material and Methods

Study Design and Subject

An observational study was performed by measuring 95 Bataknese children aged 3-5 years using a purposive sampling technique. This study was conducted at Tarutung, North Tapanuli district, Indonesia. At Tarutung, Batak Toba is the dominant ethnicity. The distance from Medan to Tarutung is approximately 294 km. This location is chosen based on the consideration that the subjects' fathers and mothers should be third-generation, pure Bataknese.

Data Collection

The vertical cephalic index was measured directly in children, while the dental arch and palatal depth were measured on maxillary impressions.

Vertical Cephalic Index Data

Vertical cephalic index data were obtained by measuring the height and length of the child's head directly. Measurement was performed three times by three different people. Cephalic height was measured by a digital calipers by placing each edge of the calipers on the nasion and gnathion. The space between both points was recorded. Cephalic length was measured by an arched calipers by placing each edge of the calipers on the glabella and inoin. The space between both points was measured by a ruler, and the length was recorded. The vertical cephalic index is recorded as the ratio between the height of the head from the nasion to the gnathion and the length of the head from the glabella to the inion.

The vertical cephalic index score was obtained using the formula:

$$\text{Vertical Cephalic Index} = \frac{\text{Cephalic Height}}{\text{Cephalic Length}} \times 100$$

- Nasion (n): The point where the median-sagittal field cuts through the suture between the forehead bone (os frontal) and the nasal bone (front-nasalis suture).
- Gnathion (gn): The lowest point on the mandibula cut through by the median-sagittal field.
- Glabella (g): The most frontal point on the forehead bone located between the supraorbital bulge on the median-sagittal field.
- Inion (i): The point on median-sagittal field that cuts through the superior linea nuchae [3].

Dental arch data were obtained by measuring dental impressions obtained for the children. Dental arch width measurement can be performed for two segments: anterior and posterior. Maxillary canine arch width is the length between the primary canines measured from the cuspid point of the left primary canine to that of the right primary canine. Maxillary molar arch width between primary molars measured from the left and right second molar mesio buccal cusp's highest point. Dental arch was measured for both anterior and posterior segments. Maxillary canine arch depth is the distance measured from the contact point between the central incisors perpendicular to a line connecting the distal surface of the right primary canine and the left primary canine. Maxillary molar arch depth was measured as the distance from the contact point between the central incisors perpendicular to the line connecting the distal surface of the right and left primary second molars [4].

Arch length was measured by adding the anterior and posterior segments [5]. The anterior segment was measured from the central incisor contact point to the primary canine contact point, and the posterior segment was measured from the primary canine contact point to the distal surface of the primary second molar. Palatal depth was obtained by measuring the vertical line perpendicular to the raphe palatine midline. The vertical line passes through the palatal surface towards the occlusal surface of a line connecting the primary intermolar mesiolingual cusps [5].

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows Software, version 16 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to calculate the mean and standard deviation.

Ethical Aspects

The study was approved by the Research Ethics Committee of the University of Sumatera Utara.

Results

With regard to sex, 58.9% were boys and 41.1% were girls. As for age, 16.9% were 3 years old, 34.7% were 4 years old and 48.4% were 5 years old. The analysis of height and cephalic length showed that the highest values were 9.28 and 18.13, while the lowest were 7.43 and 13.43, respectively (Table 1).

Table 1. Frequency distribution of the vertical cephalic index mean of Bataknese children.

Variables (cm)	Minimum	Maximum	Mean	Std. Deviation
Cephalic Height	7.43	9.28	8.26	0.35
Cephalic Length	13.43	18.13	16.04	0.66
Vertical Cephalic Index	45.82	61.51	51.59	2.39

The means for Maxillary canine arch width and Maxillary molar arch width were 30.66 mm and 46.69 mm, respectively. For the Maxillary canine arch depth, the mean was 12.0 mm, while for the Maxillary molar arch depth was 28.65 mm. The palatal depth was 14.33 (Table 2).

Table 2. Frequency distribution of the dental arch mean.

Variables	Minimum	Maximum	Mean	Std. Deviation
Maxillary Canine Arch Width	25.61	39.24	30.66	2.21
Maxillary Molar Arch Width	42.81	51.82	46.69	2.13
Maxillary Canine Arch Depth	7.68	16.54	12.00	1.76
Maxillary Molar Arch Depth	23.35	34.94	28.65	2.27
Anterior Segment Arch Length	16.69	40.14	33.71	3.08
Palatal Depth	10.67	18.70	14.33	1.46

Discussion

The samples for this study were Bataknese children aged 3-5 years. This age group was chosen because the dental arch is relatively stable at this age, only minimal changes occur [6], and all the primary teeth have erupted at three years [7,8]. Studies on other ethnic groups have included more boys and children aged 5 years. Indonesia is a multi-ethnic country. Different ethnic groups tend to have different skeletal and dental patterns, although this pattern is usually affected by individual variation.

Anthropometric research on the vertical cephalic index is generally performed in adults and seldom in children. Anthropometric measurement, especially craniofacial measuring, is essential to determine the variety of shapes/ sizes of the head and face [9]. Race, ethnicity, genetics, tradition, nutrition, environment and climatic factors can affect head type [10]. Different head sizes between communities occur because of differences in race, geographic environment and nutrition [10]. This study measured the cephalic height and cephalic length of each sample to obtain a vertical cephalic index.

Based on a previous study on Malay children aged 7-9 years, cephalic height in Malay boys is 9.79 ± 0.87 mm and that for Malay girls is 9.71 ± 0.66 mm; the cephalic length for boys is 17.27 ± 0.76 mm and that for girls is 17.16 ± 0.94 mm; and the vertical cephalic index for boys is 55.52 ± 4.42 mm while that for girls is 56.57 ± 4.16 mm [12]. The results obtained from a study of older children were compared with those obtained in this study, and larger results were obtained.

Head shape needs to be understood because it is connected to facial shape, the palate, and even the dental arch. There are three head shapes: dolichocephalic (long and narrow), mesocephalic (average shape) and brachycephalic (wide and short). It is said that dolichocephalic head shape forms a narrow, long, and protrusive face. This face shape is also called leptoprosopic (narrow). The

anterior cranium fossa, which is long and narrow, will result in a narrow, long and deep maxilla arch and palate. On the other hand, brachycephalic faces are bigger, less protrusive and are termed euryprosopic (wide). Brachycephalic head shapes result in a wide and short anterior cranium fossa and a wide, short, and narrow dental arch and palate [13-15]. Head shape, face type and dental arch shape are correlated [16].

Based on these observations, the results obtained here indicate that the Bataknese are genetically inclined to maxilla dental arches that are tapered. Bataknese have wide face shapes, and this study reveals that the majority of Bataknese people have long faces and tapering dental arches (dolichocephaly). Mean primary dental arch and palatal depth in Bataknese children aged 3-5.

According to the previous study on children aged 3-6 years in Seville, Spain, the mean anterior width arch in these children was 27 ± 2.42 mm and the mean posterior dental arch was 40.05 ± 2.30 mm [17]. Another authors reported that the mean maxillary canine arch width was 27.48 mm and that of the posterior arch was 40.40 ± 2.96 mm [18]. In comparison, this study found greater measurement results: an maxillary canine arch width of 30.66 ± 2.21 mm and a maxillary molar arch width of 46.68 ± 2.13 mm.

Maintaining the dental arch during the primary tooth period is essential to condition the space where the permanent teeth will erupt. Various factors affect the width of the dental arch; an increase in the width involves growth of the alveolar process, and significant clinical changes in the direction and mean jaw arch width and increases in dental arch width are correlated with tooth development. The size and shape of the dental arch can be of help in determining a diagnosis. The depth of the dental arch is greatly affected by orofacial growth and development. The dental arch is a primary factor in obtaining good occlusion within a harmonious arch based on the increase of dental arch width, which is connected to tooth growth involving the alveolar process [15].

Conclusion

The majority of Bataknese children have a dolichocephalic head shape, a tapered maxillary dental arch and a narrow, long and deep palate.

Financial Support: Universitas Sumatera Utara.

Conflict of Interest: The authors declare no conflicts of interest.

References

[1] Harsojo. Pengantar Antropologi. Bandung. Penerbit Binacipta. Cetakan ke lima, 1984. pp. 78-82. [In Indonesian]

[2] Djoena KH, Nasution FH, Trenggono BS. Antropologi Untuk Mahasiswa Kedokteran Gigi. Jakarta: Penerbit Universitas Trisakti. Cetakan Pertama, 2005. pp. 3-80. [In Indonesian]

[3] Rakosi T. An Atlas and Manual of Cephalometric Radiography. London: Wolfe Medical Publications Ltd.; 1982. pp. 34-45.

[4] Moyers RE. Handbook of Orthodontics. 4th. ed. Chicago: Medical Publisher Inc.; 1988. pp. 121-128.

[5] Warren JJ, Bishara SE. Duration of nutritive and non-nutritive sucking behaviors and their effects on the dental arches in primary dentition. Am J Orthod Dentofacial Orthop 2002; 121(4):347-56. https://doi.org/10.1067/mod.2002.121445

[6] Nakata M, Wei SHY. Occlusal Guidance in Pediatric Dentistry. Tokyo-St. Louis: Ishiyaku Euro America Inc.; 1988. pp. 11-20, 60.

[7] Houston WJB. Diagnosis Ortodonti. Edisi III: Jakarta: Penerbit Buku Kedokteran EGC, 1991. pp. 1-46. [In Indonesian]

[8] Mokhtar M. Dasar-Dasar Ortodonti Pertumbuhan dan Perkembangan Kraniodentofasial. Medan: Bina Insani Pustaka, 1998. p. 4-27. [In Indonesian]

[9] Williams P, Dyson M, Dussak JE, Bannister LH, Berry MM, Collins P, Ferguson MWJ. Gray's Anatomy. In. Skeletal System. 38th. ed. London: Elbs with Churchill Livingston; 1995. pp. 607-612.

[10] Rexhepi A, Meka V. Cephalofacial morphological characteristics of Albanian kosova population. Int J Morphol 2008; 26(4):935-40.

[11] Ilayperuma I. Evaluation of cephalic indices: A clue for racial and sex diversity. Int J Morphol 2011; 29(1):112-7.

[12] Agarwal SS, Nehra K, Sharma M, Jayan B, Poonia A, Bhattal H. Association between breastfeeding duration, non-nutritive sucking habits and dental arch dimension in deciduous dentition: A cross-sectional study. Prog Orthod 2014; 15(1):59. https://doi.org/10.1186/s40510-014-0059-4

[13] Salzmann JA. Orthodontics, Principles and Prevention. Philadelphia: JB Lippincott Company, 1957. pp. 127-131, 195-200.

[14] Mokhtar M. Orthodonti. Medan. Fakultas Kedokteran Gigi USU Medan, 1974. p. 37-115. [In Indonesian]

[15] Rahardjo P. Ortodonti Dasar. Surabaya. Edisi 2. Airlangga University Press, 2012. p. 8-67. [In Indonesian]

[16] Tajik I, Mushtaq N, Khan M. Arch forms among different Angle classification. Pak Oral Dent J 2011; 31(1):92-5.

[17] De Nova MJ, Barbéria E, Bartolomé B, Costa F, De Prado de la Torre R. Contribución al estudio de las arcadas dentarias temporales en niños españoles. I. Arcada mandibular. Odontol Pediátr 1995; 4(3):111-9. [In Spanish]

[18] Aznar T, Galan AF, Marin I, Dominguez A. Dental arch diameters and relations to oral habits. Angle Orthod 2006; 76(3):441-5.