Dental Journal
Majalah Kedokteran Gigi

Dental Journal
(Majalah Kedokteran Gigi)
2018 June; 51(2): 81–85

Research Report

Mandibular morphology of the Mongoloid race in Medan according to age groups

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ABSTRACT

Background: *The mandible constitutes part of the craniofacial bone that plays an important role in determining an individual's facial profile. The mandible grows and develops throughout life from the prenatal phase up to old age when it becomes and edentulous. Changes in the mandible can be measured using radiographs. These establish several parameters of mandibular morphology, including: ramus height, condylion height, body length, condylion angle, symphysis height, symphysis width and symphysis angle.* ***Purpose:*** *This study aimed to determined differences in the mandibular morphology of members of the mongoloid racial group in Medan according to age as measured by cephalometric radiography.* ***Methods:*** *This investigation constituted analytical research using cross-sectional study with a total sample of 150 individuals divided according to age: group 1 (aged 4-12 years), group 2 (aged 13-24 years, group 3 (aged 25-34 years), group 4 (aged 35-60 years) and group of 5 (aged > 60 years). The parameters were computerized by means of a digital cephalometric radiograph, the resulting data being analized with one-way ANOVA and LSD.* ***Results:*** *The mean value of the highest to the lowest ramus height, and symphysis height from the five age groups, sequentially, were in group 3, group 4, group 5, group 2, and group 1. The mean value from the highest to the lowest of body length, condylion height, condylion angle, and symphysis width, sequentially, were in group 3, group 4, group 2, group 5, and group 1. The mean value from the highest to the lowest of symphysis angle, sequentially, were in group 1, group 3, group 4, group 2, and group 5.* ***Conclusion:*** *The mandibular morphology of each age group differs in Mongoloid races in Medan based on lateral cephalometric radiography in which changes are may be affected by the state of teeth and age.*

Keywords: *mandibular morphology; cephalometric radiograph; age group*

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INTRODUCTION

The mandible is a part of the body that can be used in determining race, sex and age of an individual.[1,2] Skeletal anomalies that often occur are not only caused by the condition of the teeth, but also because of mandibular anomalies.[3] In dentistry, especially orthodontics, the mandible is used to determine a person's facial profile. In prosthodontics, particularly in edentulous patients, the determination of vertical dimension is influenced by the maxillary, mandibular, temporomandibular joints and masticatory muscles.[4]

Growth and development that begins at childbirth and continues into old age will produce changes in the mandible. Research on growth and development has been widely conducted, indicating that the most rapid and intense changes occurs during infancy and childhood. Mandibular vertical growth occurs through bone remodelling along with alveolar process development and dental eruption. Posterior borders of the condyle and ramus are very active in mandible growth with new bone deposition and remodelling, while the anterior surface undergoes bone resorption.[5]

The ramus height, condyle height, condyle angle, mandible length (overall length) and condylion angle are all parameters that undergo changes in the shape and the size of the growing and developing mandible.[6–9] After the first year of life, mandibular growth is more selective.[10] According to

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at http://e-journal.unair.ac.id/index.php/MKG
DOI: 10.20473/j.djmkg.v51.i2.p81–85

Enlow and Harris who conducted a study of 25 mandibles in children aged 4-12 years, the lingual and buccal cortex of the condyle neck is formed by the endosteal bone. The size of the gonial angle is reduced (140°) to provide additional space for permanent teeth formation. The coronoid process will experience movement through the periosteal bone incision that occurs continuously. At the age of 5-6 years, growth of the ramus and mandibular bodies is believed to occur mainly in parallel with changes in the midface. The growth of the ramus increases anteroposteriorally, in that vertical growth in the ramus is associated with maxillary growth and maxillary teeth eruption. Liu *et al*.[6] conducted a study of the size of the mandible from the first 6 months until the fifth year of a person's life. The condyle, posterior ramus, inferior ramus, gonion, posterior body and point "B" will change more in the superior and posterior.[6]

In general, edentulism affect both general and oral health which, in turn, will influence quality of life. Several studies conducted on the mandible suggest that there are morphological and anatomical changes between dentate and edentulous individuals.[11,12] Changes in the structure and function of the masticatory muscles in edentulous individuals due to old age, indicate a decrease in activity and muscle density rather than individuals who have lost all their teeth.[9]

This study was conducted to determine differences in the mandibular morphology of Mongoloid individuals in Medan according to age as identified by means of cephalometric radiography. Several parameters of morphology mandibular are ramus height, condylion height, body length, condylion angle, symphysis height, symphysis width and symphysis angle.

MATERIALS AND METHODS

This analytical research was conducted using cross-sectional design and carried out at the Unit of Oral-Maxillofacial Radiology, Faculty of Dentistry, Universitas Sumatera Utara. The research population consisted of members of three successive generations of the Mongoloid race in Medan, divided into groups of 30 individuals.

A sample selection method was applied by purposive sampling method adhering to fulfilled inclusion and exclusion criteria. Inclusion criteria: Group 1 (age 4-12 years): in primary dentition phase: complete primary dentition and never having undergone orthodontic treatment during the mixed dentition period: there is no premature loss of deciduous teeth, no permanent teeth are missing, dentures are not employed and orthodontic treatment has never been applied. Group 2 (age 13-24 years): dentures are not employed, and orthodontic treatment has never been applied. During the mixed dentition period, there is no premature loss of deciduous teeth, and no permanent teeth are missing. During the permanent dentition period, the teeth are complete (28 teeth with the exception of the third molars). Group 3 (age 25-34 years): the teeth are complete (28 teeth with the exception of the third molars) and orthodontic treatment has never been applied. Group 4 (35-60 years): the teeth are complete (28 teeth with the exception of the third molars) and orthodontic treatment has never been applied. Group 5 (aged >60 years): fully edentulous and orthodontic treatment has never been applied.

Exclusion criteria: has suffered from and/or received treatment for systemic diseases, has undergone jaw surgery, odontectomy, has suffered from micrognathia, pathological conditions in the mandible, still possesses deciduous teeth, has experienced deep caries with exposure of the pulp and crown loss, has received treatment of the full crown or space maintainer/space regainer.

After completing the informed consent form, a lateral digital cephalometric radiograph (2D) was taken for each sample using an Instrumentarium Orthopantomograph model QC 200 D 1-4-1, 2012. The parameters were computerized by a digital cephalometric radiograph (Figure. 1). A one-way ANOVA test was performed to analyze the calculated data with $p<0.05$. Ethical clearance was obtained from the Research Ethics Committees of the Faculty of Medicine, Universitas Sumatera Utara No. 345/TGL/KEPK FK USU-RSUP HAM/2017.

RESULTS

The results of the normality test using a one-sample Kolmogorov-Smirnov Test confirmed that the variables are normally distributed with $p>0.05$. Table 1 shows the mean values and significant differences (Multiple Comparison LSD Test result) of all variables (ramus height, symphysis height, body length, condylion height, condylion angle, symphysis width and symphysis angle) in five age groups (p value <0.05). The mean value of ramus height and symphysis height sequentially from the highest to the lowest were in group 3, group 4, group 5, group 2 and group 1. The mean value of body length, condylion height, condylion angle and symphysis width sequentially from the highest to the lowest were in group 3, group 4, group 2, group 5 and group 1. The mean value of the symphysis angle sequentially from the highest to the lowest were in group 1, group 3, group 4, group 2, and group 5.

DISCUSSION

In this study, the average values of the ramus and symphisis height of the five age groups showing the mean value sequentially from the highest to the lowest as follows: group 3, group 4, group 5, group 2 and group 1. There was a significant difference in ramus and symphisis height between group 1 and the other groups. After birth, the mandibular body gradually extends towards the horizontal especially behind the foramen mentale to produce a site for three permanent teeth. Meanwhile, the high vertical

Dental Journal (Majalah Kedokteran Gigi) p-ISSN: 1978-3728; e-ISSN: 2442-9740. Accredited No. 32a/E/KPT/2017.
 Available at http://e-journal.unair.ac.id/index.php/MKG
DOI: 10.20473/j.djmkg.v51.i2.p81–85

Table 1. The mean value of the result of the measurement of mandibular morphological parameters

Mandibular morphological parameters	Groups	Mean ± SD	Post Test LSD				
			Group 1	Group 2	Group 3	Group 4	Group 5
Ramus height (Ar-Go)	1	40.973± 3.599		.000*	.000*	.000*	.000*
	2	48.803±4.020	.000*		.094	.614	.903
	3	51.010±6.828	.000*	.094		.241	.121
	4	49.467±5.728	.000*	.614	.241		.702
	5	48.963±4.512	.000*	.903	.121	.702	
Condylion height (Co-Ar)	1	8.163±1.854		.005*	.000*	.000*	.315
	2	9.420±1.516	.005*		.004*	.260	.065
	3	11.143±2.484	.000*	.004*		.072	.000*
	4	10.103±2.260	.000*	.260	.072		.003*
	5	8.547±1.500	.315	.065	.000*	.003*	
Body length (Go-Gn)	1	67.373±4.078		.000*	.000*	.000*	.000*
	2	75.437±4.467	.000*		.000*	.193	.705
	3	80.037±4.162	.000*	.000*		.008*	.000*
	4	76.940±4.852	.000*	.193	.008*		.094
	5	75.000±4.674	.000*	.705	.000*	.094	
Condylion Angle (Go-Co-Me)	1	33.917±3.006		.000*	.000*	.000*	.050*
	2	37.150±3.116	.000*		.234	.784	.061
	3	38.150±2.949	.000*	.234		.359	.002
	4	37.380±3.698	.000*	.784	.359		.032*
	5	35.570±3.366	.050*	.061	.002	.032*	
Symphysis height	1	12.893±1.638		.000*	.000*	.000*	.000*
	2	17.343±1.899	.000*		.049*	.329	.826
	3	18.337±2.274	.000*	.049*		.316	.079
	4	17.833±2.090	.000*	.329	.316		.449
	5	17.453±1.711	.000*	.826	.079	.449	
Symphysis width	1	12.813±1.513		.011*	.000*	.001*	.153
	2	13.747±1.590	.011*		.001*	.503	.256
	3	15.033±1.393	.000*	.001*		.005*	.000*
	4	13.990±1.266	.001*	.503	.005*		.072
	5	13.333±1.217	.153	.256	.000*	.072	
Symphysis angle	1	86.453±5.052		.192	.944	.261	.000*
	2	84.530±5.960	.192		.217	.856	.000*
	3	86.350±5.558	.944	.217		.291	.000*
	4	84.797±6.291	.261	.856	.291		.000*
	5	75.557±5.468	.000*	.000*	.000*	.000*	

*Multiple Comparison LSD test, the mean diff. (mean differences) is significant at the level of 0.05.

direction of the ramus increases in accordance with the growth of the alveolar bone that will be the site for the dental root and the development of the permanent tooth. High differences in ramus also occur in patients aged between 11 and 69 years. The highest average score was identified in the 20-29 year age group.[13]

The mean value of body length, condylion height, condylion angle and symphysis width from the highest to the lowest is, sequentially, in group 3, group 4, group 2, group 5 and group 1. There was a significant difference in body length, condylion height and condylion angle between group 1 and the other groups, and a significant difference in condylion height and symphysis width between group 1 and all other groups, except group 5. Other studies on the height of the condylion in non edentulous and edentulous groups using panoramic radiography showed that the mean high value of condyles in the non-edentulous group was greater than in the edentulous group.[7]

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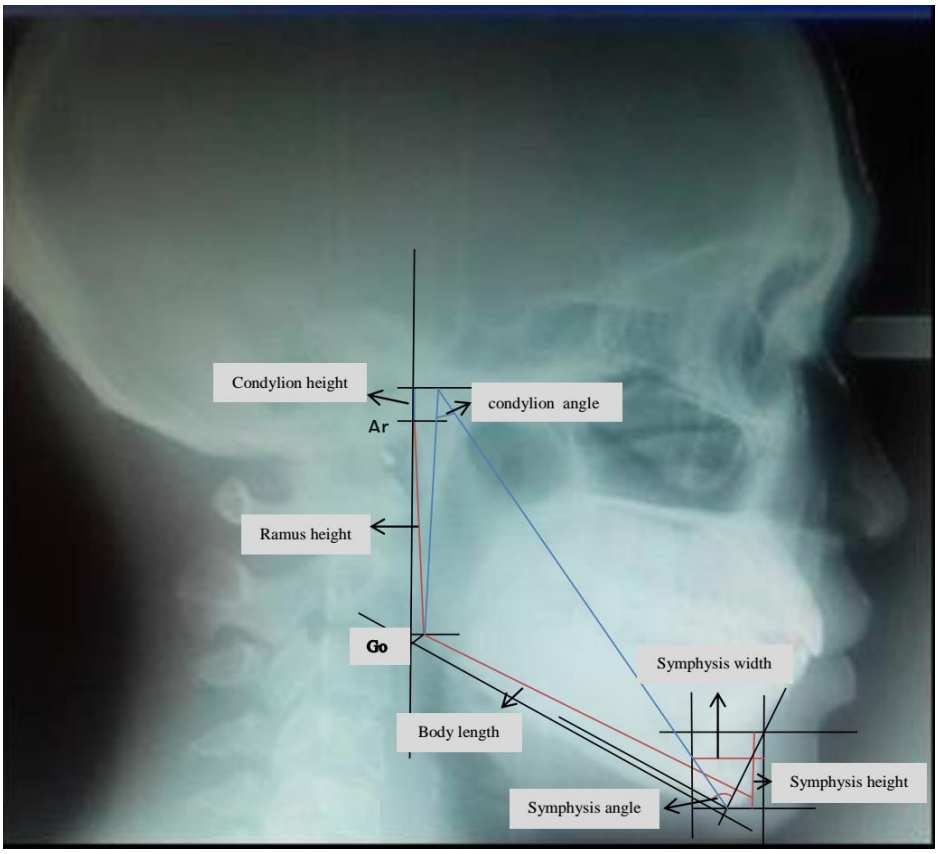

Figure 1. Measurements on lateral cephalometric radiography.

Ramus height: The distance measured from one point Ar to Go.[1] Condylion height: The distance measured from the height of the ramus to the most superior point of the condyle.[7] Body length: The distance measured from Go to Gn.[15] Condylion angle: The angle formed by Go-Co-Me.[6] Symphysis height: The distance from point B to the most inferior point of simphisis[1] Symphysis width: The distance from the most anterior border to the posterior simphisis.[1] Symphysis angle: The posterosuperior angle formed by the line through the point Me and point B in the mandible plane.[1]

The mean value of symphysis angle from the highest to the lowest was sequentially in group 1, group 3, group 4, group 2,and group 5. The mean value of the symphysis angle showed a significant difference between group 5 and the other groups. As teeth in the mandible erupt, they will move upwards and slightly forward. The normal rotation of the mandible causes that section on the anterior portion to grow upward. This rotation changes the pathway of the eruption of the incisor tending to lead it more posteriorly and the molars to further migrate mesially during growth.[14]

In this study, not all parameters showed significant differences in each age group which may be due to the age range used being very wide. Along with tooth eruption in the mandible, the process of growth and development of the mandible also involves remodeling, anterior and inferior displacement (aposition). The endocondrium of the condyle hardens, thereby affecting the growth of the posterior mandible. Apposition and remodeling will cause the mandible to grow larger.[8,15]

Condyle experiences considerable activity as the mandible moves and grows downward and forward. Apposition occurs at the posterior boundary of the ramus and the alveolar process. Resorption occurs along the anterior border of the ramus extending the alveolar border and maintaining the antero-posterior dimension of the ramus. The cephalometric study shows that the body of the mandible maintains a relatively constant angular relationship with the ramus. A slight change in the gonial angle after muscle activity works properly. The mandible's alveolar process grows upward and outward in a widening arc. This allows the dental arch to accommodate a larger permanent tooth.[10] The length of the mandible increase due to the posterior apposition of the ramus and resorption of the anterior ramus. The increase in mandibular height is largely due to growth of the alveolar bone. The chin becomes more prominent as the mandible is elongated and there is only a slight increase of bone in the chin, However, it does not occur again after adolescence.[8,15]

A considerable body of research has been conducted to evaluate mandibular morphology, such as the measurement of ramus and condyle. Post-natal changes in mandibular morphology are thought to be affected by mastication and the age of the patient. Age, systemic factors and tooth loss may alter mandibular morphology.[6,7,11,16,17] Age and changes in the function and structure of the mastication muscles in edentulous patients appear to

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decrease contraction and lower muscle density than in their counterparts who still possess their teeth. Because the masseter and medial pterygoideus muscles exert force in the gonial corner area, the contraction strength of these muscles also affects the mandible's basic shape.[2,9]

The morphology of superficial masseter muscles in the gonial region is wider in dentate subjects than in their edentulous counterparts. Muscle mastication changes in function and structure according to the age of the edentulous subject. In computed tomographic scans, the activity of electromyography and lower muscle density is greater in edentulous subjects than dentulous subjects. The occurrence of masticatory muscle atrophy may be one of the factors that cause changes in the mandible.[8,11,15–17] Another factor likely to induce such changes is the loss of intermaxillary support due to missing teeth, thereby permitting the masseter and medial pterygoid muscles to exert unrestricted tension on the mandible.[15] The conclusion of this study is that group 3 has the highest mean value of mandibular morphology. There is a difference in the mandibular morphology of members of the Mongoloid race resident in Medan according to age identified by cephalometric radiography, in which the morphological differences in the mandible may be affected by the age and condition of the teeth.

ACKNOWLEDGEMENT

This research was conducted with the financial support of the TALENTA grant fund of the Universitas Sumatera Utara No: 325/UN5.2.3.1/PPM/KP-TALENTA USU/2017.

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DOI: 10.20473/j.djmkg.v51.i2.p81–85