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The comparison of maxillary and mandibular dental arch size in male and female Papuan in Surabaya: A cross-sectional study

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Abstract

Aim: The aim of this study was to analyze the differences in the size of maxillary and mandibular dental arch between Papuan males and females. **Materials and Methods:** An analytical cross-sectional study design was carried out in 12 Papuan males and 12 Papuan females aged above 18–25 years in the Surabaya. Rabinovich method was used to measure the maxillary and mandibular dental arches width in the dental cast in transversal (L33, L66, L77) and sagittal direction (L31, L61, L71). The statistical analysis was used to analyze the data normality by Kolmogorov–Smirnov test ($P > 0.05$). In addition, the independent t test was done to determine the differences between groups ($P < 0.01$). **Results:** The average sizes of the maxillary dental arch width in the transversal direction in Papuan males, respectively, L33, L66, and L77 were 35.86, 56.58, and 65.61 mm. The average sizes of the maxillary dental arch in the sagittal direction in men L31, L61, and L71 were 4.04, 35.60, and 46.41 mm. The average widths of the maxillary dental arch in a transversal direction in Papuan female L33, L66, and L77 were 32.45, 53.54, and 63 mm. The average sizes of the maxillary dental arch in the sagittal direction in female L31, L61, and L71 were 3.55, 31.94, and 42.42 mm. There was a significant difference between men and female maxillary dental arch in sagittal and transversal measurement ($P < 0.01$). **Conclusion:** Male Papuan has a bigger maxillary and mandibular dental arch width as compared to female Papuan. Evaluation of Papuan dental arches may help the orthodontist to determine the diagnosis and treatment plan in this population.

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Introduction

Dimensions of dental arches, including dental arches width, length, and shape, are important values for diagnosis, treatment planning, and treatment results about patients seeking orthodontic treatment in all age groups. Different ethnic groups and populations display variable dental arch measurements and characteristics. Thus, it is known that the dental arch dimension continues to change throughout growth and development; however, during adulthood, the change decreases. This explains why many researchers are interested in investigating changes in dental arch dimensions during each stage of growth and development. [1]

In orthodontic treatment, dental arches are the main factor for achieving good occlusion in different environments and widths that are related to the processus alveolaris. Basically, the size and shape of the teeth are determined by the cartilaginous skeleton of the maxilla and mandible in the fetal period then develops. Tooth seeds and jawbones then grow. It is very important to classify and determine the relationship between craniofacial structures and the dimensions of dental arches. [2]

The size of the dental arch has broad implications in orthodontics, especially in diagnosis and treatment plans in affecting available space, aesthetics, and tooth stability. The size of the transversal and sagittal dental arch in one individual is different from others; this is influenced by several factors, namely environment, genetic, race, and sex. [1],[2] Changes in dental arches during growth and development are strongly influenced by growth and development of the processus alveolaris. [3] In general, the dental arch develops at the mixed dentition stage and then tends to be stable until the permanent dentition. The dental arch of the mandible develops from the age of 4–8 years, whereas in the maxilla it takes from the age of 4–13 years and tends to be more stable in adulthood. Several studies have described and classified the size and shape of human dental arches. Differences in the size of the dental archform are related to clinical treatment. Each ethnic group tends to have a different skeletal pattern, so the size and shape of the jaw in an ethnic group are different from other ethnic groups. [4],[5]

Alam et al. [6] in his study showed that ethnic and gender differences affect the size and shape of dental arches. This is very important to be known by the dentist to give the best treatment. Bano and Babu [7] in his research showed that the growth of dental arch width in men is faster than women. In males, the intermolar relationship of the maxillary and mandibular width increases spontaneously at the age of 7 and 18 years. Sinclair also confirmed that the growth of molar width after 12 years was physically different between males and females. The sample that was used in this study is the Papuan population living in Surabaya city. The Papuan population is a tribe that lives on the island of Papua. Papuan is a part of the Australian aboriginal.

The Papuan population includes the Melanesian race, which has the characteristics of curly hair, black skin, and sharp nose. Groups of indigenous tribes in Papua consist of 255 tribes, with different languages. [8] The aim of this study was to analyze the difference in the size of the maxillary and the mandibular dental arch in the male and female Papuan population using the Rabin measurement method, namely the transversal and sagittal measurements.

Materials and Methods

Setting and design

This presented cross-sectional study design was carried out in 12 Papuan males and 12 Papuan females in Papuan Dormitory, Surabaya between September and November 2016. The population of this study was Papuans between 18 and 25 years old.

The samples were Papuan males and females who met the research criteria. The technique used for sample selection is simple random sampling. There were only 24 subjects (12 males and 12 females) who met the inclusion criteria. The inclusion criteria of sample selection were males or females aged between 18 and 25 years old with full permanent dentitions, who had never done any orthodontics treatment with all teeth were in good curvature and lastly never had any tooth extraction history. The dental impression of each subject was done to obtain the dental cast. Rabin method was used to measure the maxillary and mandibular dental arches width in the dental cast in the transversal and sagittal direction.

Study method

The measurement method used was Rabin's method. [9] Vernier calipers was used to measure the length or width of measurement parameters in millimeters [Figure 1]A and [B]. The measurement of maxillary and mandibular dental arch width in transverse direction, as follow: {Figure 1}

a. Distance between cusp of left and right canine teeth (L33).

- b. Distance between the mesiobuccal cusp of the left and right first molars (L66).
- c. The distance between the distobuccal cusp of the left and right second molars (L77).

The measurement of maxillary and mandibular dental arch length in sagittal direction, as follow:

- a. The distance from the median central incisors line perpendicular to the distobuccal cusp line of the left and right second molars (L71).
- b. The distance from the median central incisors line perpendicular to the mesiobuccal cusp line of the left and right first molars (L61).
- c. The distance from the median central incisors line perpendicular to the cusp line of canine and first molar left and right (L31).

Statistical analysis

Data were analyzed using Statistical Package for Social Science (SPSS) software program, version 17.0 (IBM, Illinois). The statistical analysis was used to analyze the data normality by Kolmogrov–Smirnov test ($P > 0.05$). In addition, the independent sample t test comparative analysis was done to determine the differences between men and women in Papuan population ($P < 0.01$).

Results

The average sizes of the maxillary dental arch width in the transversal direction in Papuan males, respectively, L33, L66, L77 were 35.86, 56.58, and 65.61 mm. The average sizes of the maxillary dental arch in the sagittal direction in men L31, L61, and L71 were 4.04, 35.60, and 46.41 mm. Meanwhile, the average width of the maxillary dental arch in transversal direction in Papuan female L33, L66, and L77 were 32.45, 53.54, and 63 mm. The average sizes of the maxillary dental arch in the sagittal direction in women L31, L61, and L71 were 3.55, 31.94, and 42.42 mm. The data of maxillary dental arch men and women measurement were normally distributed ($P > 0.05$). A significant difference was observed between men and female maxillary dental arch in sagittal and transversal measurement ($P < 0.01$) [Table 1].{Table 1}

The average sizes of the mandibular dental arch width in the transversal direction in men for L33, L66, and L77 were 31.79, 54.84, and 61.91 mm, respectively. For the sagittal view, the average sizes of the mandibular dental arch in men for L31, L61, and L71 were 3.48, 29.50, and 41.17 mm, respectively. In comparison, the average sizes of the mandibular dental arch width for the transversal direction in women L33, L66, and L77 were 27.99, 49.21, and 58.87 mm. The average sizes of the mandibular dental arch in the sagittal direction in women L31, L61, and L71 were 3.39, 29.20, and 39.62 mm. The data of mandibular dental arch men and women measurements were normally distributed ($P > 0.05$). A significant difference was observed between men and female mandibular dental arch in L77, L66, and L33 of transversal measurement but only L71 in sagittal measurement ($P < 0.01$) [Table 2].{Table 2}

Discussion

Based on the measurement result of the maxillary and mandibular dental arches length in men and women Papuan populations, it was shown that the mean intercanine, intermolar width, and length of the male dental arch were greater than the female. This study was conducted only 24 samples of Papuan due to cross-sectional and total sampling method carried out in the one location only. Our study result was supported by that of obtained by Azlan et al.'s[10] study in Javanese population, which found that Javanese male maxillary and mandibular intermolar widths were bigger than Javanese females. Mesiodistal width of canine, intercanine width, and Maxillary Canine Impaction (MCI) have been used to determine gender in the past and are supported by many researchers.[1],[11]

Previous study by Papatungan et al.[12] in Mongondow tribes and Alpiyah et al.[13] in Minahasa tribes about dental arch length and width found the difference result when compared to our study. The different ethnicity and race can affect the dental arch length and width measurement value. The average value of L31 in the Papuan population was slightly smaller than the Mongondow and Minahasa tribes, whereas the average values of L61 and L71 were slightly larger. This showed that in the Papuan tribe, the growth of the dental arch in the anterior direction is smaller, but in the posterior direction the growth is larger than the Mongondow and Minahasa tribes.

The results of the maxillary and mandibular dental arch width measurements in the Papuan population also reflect distant different

results. There were significant different results in mandibular and maxillary dental arch in our study compared to Paputungan et al. [12] in the Mongondow tribe and Alpiyah et al.[13] in the Minahasa tribe. The average value of L33, L66 and L77 in the Papuan tribe showed a larger measurement value than Mongondow or Minahasa tribe about 4-8 mm difference. From these results, it can be seen that the size of the dental arch in the anterior or posterior direction in the Papuan tribe is much wider than the Mongondow and Minahasa tribes.[12],[13] The results of the maxillary and mandibular dental arches measurement indicate that the size of the dental arch in the transversal or sagittal direction of the Papuan tribe has a larger location.

Alam et al.[6] stated that different racial groups will show different sizes of arches. Meanwhile, the results of research on ethnic Papuans are also different from the results of research conducted by Hasibuan[14] in the Deutero-Malay race using the same method. The results of the lower jaw length and width measurement of Papuans were found to be higher than the Deutero-Malay race.

The results of the research on the Papuan tribe were in accordance with the previous studies that stated the differences in dental arch size were more likely to be caused by racial factors.[13],[14],[15] Previous study found that male and female group in American Negroid and American Caucasian population have a different size of maxillary dental arch. The maxillary dental arch in American Negroid population tends to be wider and less tapered than American Caucasian population.[16] As known, the Papuan tribes belong to the Negroid race class which has the characteristics of black skin and curly hair, so the study of dental arch size in the Papuan tribe shows that the dental arch size tends to be larger.

The study result of maxillary and mandibular dental arches size in the Papuan tribe also showed that there was a difference in arch size between males and females. This result supports our hypothesis. This study result is in line with previous study that mentions the average maxillary intermolar distance in male is greater than female.[16] This study also supports previous studies that found significant differences in intermolar width between males and females.[17],[18] The increased growth of dental arches in male patient can lead to the difference of maxillary and mandibular dental arches size between male and female. The factors that influence the development of maxillary complex growth are abnormal palatal growth, pressure on the birth process, genetic factors, and environmental factors.[18],[19],[20],[21]

This study distinguishes that the male Papuan has bigger maxillary and mandibular dental arch width compared to female Papuan. The evaluation of Papuan dental arches may help orthodontists to determine the diagnosis and treatment plan in Papuan Population. There were certain variations in the size of maxillary and mandibular dental arches in each individual, so no ideal form can be used as a standard to determine the shape of individual dental arches, but by measuring dental arches in individual of certain races can provide characteristics of the race. The size of the dental arch in an individual can be distinguished based on race because there are prominent differences in races in Indonesia. Determination of maxillary and mandibular dental arches size is important because the measurement results may help orthodontists in their working place where there are many different aboriginals Papuan population to estimate the treatment plan to be performed and the success rate of the treatment.[15],[17]

In this study, we examined only the Papuan population in general; different sub-Papuan ethnic samples could also be studied and compared with larger sample sizes. Nevertheless, the measurements in this study were limited. A modern 3D intraoral scanner can be used to provide a better image for analysis.[22] Finally, further studies could be designed to compare dental arch form between Class I normal occlusion and Class II and Class III malocclusions in Papuan.

Conclusion

Based on research results conducted on the Papuan population, it can be concluded that there were significant differences in maxillary and mandibular dental arch size between male and female Papuan population. Male Papuan has a bigger maxillary and mandibular dental arch width as compared with female Papuan. Evaluation of Papuan dental arches may help the orthodontist to determine the diagnosis and treatment plan in Papuan population. Further study is still needed with better design and a bigger sample size.

Future scope

Further studies could be designed to compare dental arch form between Class I normal occlusion and Class II and Class III malocclusions in Papuan.

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¹Conflicts of interest

There are no conflicts of interest.

Author contributions

⁴OFK, AW, IGAW, and JS contributed to the study conception, data collection, data acquisition and analysis, data interpretation, and manuscript writing. All the authors approved the final version of the manuscript for publication.

¹Ethical policy and institutional review board statement

This study had obtained the ethical clearance from ethical health research committee, Faculty of Dental Medicine, Airlangga University with appointment number: 308/KKEPK.FKG/XII/2016. All the procedures have been performed as per the ethical guidelines laid down by Declaration of Helsinki (1964).

¹Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Data availability statement

Data are available on request from the corresponding author (⁹e-mail: wahju_ardani@fkg.unair.ac.id).

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