Global Dental Arch Dimension Norms and Sexual Disparities: An overview.
Rafiqul Islam¹, Mohammad Khursheed Alam², Fazal Shahid ³, Mohd Fadhli Khamis⁴

Abstract
Background: The aim of the present study was to do an overview of the arch dimension for various populations. Also, to evaluate the various type of measurement methods and sexual disparities. Two reviewers independently performed the selection process and the quality of studies was assessed. Method: Studies published form January 2000 until October 2015 were identified in electronic databases: Pubmed, Scopus, Science direct, Web of Science, Medpilot and Medline using keywords. Criteria used included: observational studies, Arch size measured, Permanent dentition, Arch dimension investigated via plaster and digital dental models, measurement via calipers and computers software’s. Result: The forest plots showed the continuous trend for the greater arch dimension for male in relation to female. The current overview showed the arch dimension and its disparities for various populations. Conclusion: The various methods to assess arch dimension should be carefully considered and well conducted as part of the clinical assessment of orthodontic treatment, since arch dimension could influence the diagnosis and treatment planning of orthodontist.

Keywords: Arch dimension; Arch width; Inter canine width; Interpremolar width; Intermolar width; Arch length.

Material and Methods

Introduction
Malocclusion is a communal quandary in all inhabitants.¹ Although the nature of malocclusion varies in different population, but teeth size and arch length inconsistency are considered to be an important etiological factors.² The arch dimension is of preponderant importance in the various dental specialties such as Orthodontics, Prosthodontics, Forensic Dentistry and Dental Anthropology. Nature has given an ideal balance between the maxillary and mandibular teeth size that should be attained for the ideal occlusion and aesthetics, especially in relation to the finishing phase in orthodontics.³,⁴,⁵ There is obvious population variation in the pattern and magnitude of sexual dimorphism.⁶,⁷,⁸ Teeth in relation to sexual dimorphism have been of prodigious importance to anthropologists and forensic odontologists as well as the focus of many studies for gender assessment.⁹,¹⁰ Conventional caliper was used by researchers to investigate tooth dimension, to identify the sexual disparities through mesiodistal¹¹,⁵,¹²,¹³, buccolingual¹⁰,¹¹,¹²,¹³ and diagonal crown¹⁴ diameters of teeth. Geomorphometrics is the quantitative approach that refers to the morphology of an entity depends on landmarks. This technique resolves numerous problems accompanying with out-of-date methods of measurements.¹⁵ The current overview showed the arch dimension and its disparities for various populations. The various methods to assess arch dimension should be carefully considered and well conducted as part of the clinical assessment of orthodontic treatment, since arch dimension could influence the diagnosis and treatment planning of orthodontist.

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Two reviewers independently performed the selection process and the quality of studies was assessed. Studies published from January 2000 until October 2015 was identified in electronic databases: Table 1 show the Sought electronic databanks sources and Key word words used in data base search. Criteria used included: observational studies, Arch size measured, Permanent dentition, Arch dimension investigated via plaster and digital dental models, measurement via calipers and computers software’s.

### Table 1. Sought electronic databanks sources and Key word words used in data base search

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**Ethical approval:** This study was approved by local Ethics Committee prior the submission for publication.

**Results**

Figure 1,2,3,4,5 and 6125-35 show the arch dimension width for Inter canine, Inter premolar, Inter molar of maxillary and mandibular arch respectively. Arch dimension has greater values for males in relation to females. The Forest plots show the continuous trend of under prediction of female arch width. Figure 7 and 8125-35 show the arch length of maxillary and mandibular arch respectively. Arch length has greater values for males in relation to females. The Forest plots show the continuous trend of under prediction of female arch length.

*Figure 1. Maxillary Intercanine arch width means, standard deviation and Forest plot show the continuous trend of under prediction.*

*Figure 2. Maxillary Inter premolar arch width means, standard deviation and Forest plot show the continuous trend of under prediction.*

*Figure 3. Maxillary Inter molar arch width means, standard deviation and forest plot show the continuous trend of under prediction.*

*Figure 4. Mandibular inter canine arch width means, standard deviation and forest plot show the continuous trend of under prediction.*

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Figure 5. MandibularInter premolar arch width means, standard deviation and forest plot show the continuous trend of under prediction.

Figure 6. MandibularInter molar arch width means, standard deviation and forest plot show the continuous trend of under prediction.

Figure 7. Maxillary arch length means, standard deviation and forest plot show the continuous trend of under prediction.
Discussion

During the mixed dentition, prediction of the mesiodistal dimensions of unerupted permanent teeth is of great importance in diagnosis and treatment planning. Correct assessment of the size of the unerupted tooth allows improved treatment plan to deal with tooth size/arch length discrepancies.\cite{16}

For mixed dentition tooth size and arch dimension analysis direct measurement methods including hand-held calipers, graphs and scale to record dimensions and tooth size on dental casts have been used.\cite{17,18}

Recent development in technology has made it possible that the dental cast can be reproduced in the form of digital dental model.\cite{17,18} These digital model studies provide more accurate and reliable tools for obtaining measurements and carrying out dental analysis.\cite{19,20} Moreover, they have additional benefits, such as accessibility of the images produced, reduction in storage costs and the ability to analyze images by using sophisticated software's.\cite{19,21}

In orthodontic treatment the arch form and shape are usually modified to achieve the treatment goals by the various forms of wires used in the treatment course. The patient’s existing arch form appears to be the best guide for the stability of the arch form after treatment.\cite{1}

The arch size and shape are of scrupulous importance in dentistry. Thus a diversity of diagnostic and analytical indices had been anticipated to help and forecast dental arch development and help out through treatment planning.\cite{22}

For the relieving of crowding and adjustment of arch development, the dental arch expansion is one of the methods to solve the problem by non-extraction orthodontic treatment. After dental arch expansion, to avoid the relapse is most controversial.\cite{23} The researchers put together the indices and techniques using tooth size to calculate the perfect interpemolar and intermolar arch width to get an ideal expansion of arches in order to

![Figure 12. Bar chart showing the gender disparities formandibularInter canine arch width.](image)

![Figure 13. Bar chart showing the gender disparities for mandibularInter premolar arch width.](image)

![Figure 14. Bar chart showing the gender disparities for mandibularInter molar arch width.](image)

![Figure 15. Bar chart showing the gender disparities formaxil- lary arch length.](image)
avoid relapse and to alleviate the crowding.\textsuperscript{24} The current review investigates the arch size of various populations which show the population variation, along with the sexual disparities. As the Figure 9, 10, 11, 12, 13 and 14,\textsuperscript{25-35} show the arch dimension width for Inter canine, Inter premolar, Inter molar of maxillary and mandibular arch respectively. Arch dimension has greater values mean value for males in relation to females.\textsuperscript{1,5, 25-37}\textsuperscript{Figure 15 and 16,}\textsuperscript{1,25-35} show the arch length of maxillary and mandibular arch respectively.\textsuperscript{1,5, 25-37} Arch length has greater values mean value for males in relation to females with the exception of Jordanians. Therefore the before dental arch expansion and growth modification the gender difference need to be had in consideration.

\textbf{Conclusion}

In conclusion, the dental arch dimension has been measured by various hand held and digital models. All the methods showed the sexual disparities in the dental arch dimension. Arch dimension investigated via plaster and digital dental models, measurement via calipers and computers software’s. The current overview showed the arch dimension and its disparities for various populations. Therefore, various methods to assess arch dimension should be carefully considered and well conducted as part of the clinical assessment of orthodontic treatment, since arch dimension could influence the diagnosis and treatment planning of orthodontist.

\textbf{Conflict of interest:} The authors declared no conflict of interest

\textbf{Authors’ contributions:}

Data gathering and idea owner of this study: Rafiqul Islam

Study design: Rafiqul Islam, Mohammad Khursheed Alam

Data gathering: Mohammad Khursheed Alam, Fazal Shahid

Writing and submitting manuscript: Rafiqul Islam, Mohammad Khursheed Alam

Editing and approval of final draft: Fazal Shahid, Mohd Fadhli Khamis

\begin{thebibliography}{99}
\bibitem{3} Bolton WA. Disharmony In Tooth Size And Its Relation To The Analysis And Treatment Of Malocclusion. \textit{Angle Orthod}1958;\textbf{28}(3):113-130.
\bibitem{8} Acharya AB, Mainali S. Sex discrimination potential of buccolingual and mesiodistal tooth dimensions. \textit{J forensic sci}2008;\textbf{53}(4):790-792.
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Dental arch dimension norms an overview


