



Research Article

ARCH LENGTH AND ARCH WIDTH: A TOOL IN GENDER DETERMINATION

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ABSTRACT

Introduction: Forensic science have played a key role in human identification. One of the important method of assessing gender is arch length and arch width, palatal rugae pattern and measurement of facial height. Knowledge of dental arch widths in a population plays a key role in orthodontics, Prosthodontics and Oral Surgery.

Aim: The aim of this study was to investigate the maxillary arch width and length in 200 medical and dental students of Davangere.

Materials and Methods: A total of 200 students, 100 males and 100 females, in the age group of 17-23 years were included in the study. The arch length and arch width measurements were performed on maxillary casts using digital Vernier Caliper of 0.01 calibrations. Two-sample t-test and Chi-Square tests were used for comparison of means and relationship between the attributes.

Results: The arch width were significantly greater in males with p value of $P < 0.001$ which is highly significant in our study. The arch length were greater in males than those of the females at all dimensions, which were found to be statistically significant.

Conclusion: The maxillary arch length and arch width can be used as a method in differentiating gender between human population.

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INTRODUCTION

Forensic science have played a key role in human identification¹. Gender determination is one of the important aspects of human identification as it helps in building the biological profile of unidentified human remains. One of the important method of assessing gender is anthropometry of face and intraoral regions. It includes measurement of arch length and arch width, palatal rugae pattern and measurement of facial height^{1,2}. The palate is one of the key anatomical structures in determining the type of skeletal pattern due to its morphology and position³. Knowledge of dental arch widths in a population plays a key role in orthodontics, Prosthodontics and Oral Surgery⁴.

Knowledge of standard dimensions which concerns the dental arch in human population are very useful to clinicians in different fields of dentistry and they are of great interest to anthropologists in studying the dental arch growth and development in relation to different environmental, genetic and physical factors for different population^{5,6}. The size and shape of the maxillary and mandibular arches have considerable implications in orthodontic diagnosis and treatment planning

affecting the space available, dental esthetics, and stability of the dentition^{5,7}. Dental arch length varies with different races and gender. Many of the studies have been reported to determine gender using arch length and arch width¹. This study was carried out to determine the sexual dimorphism using arch width and arch length of the permanent dentition in male and female patient.

Aims and Objectives

The aim of this study was to investigate the maxillary arch width and length in 200 medical and dental students of Davangere.

MATERIALS AND METHODS

This cross sectional study was conducted at the Department of Oral Medicine and Radiology, Bapuji Dental College and Hospital, Davangere. Ethical clearance was obtained from the institutional ethical committee. Total of 200 students, 100 males and 100 females, in the age group of 17-23 years were included in the study. A written informed consent was obtained from the students participating in the study.

Inclusion Criteria

All the students with full complement of normal shaped permanent teeth (excluding third molars) with no heavy

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fillings, congenital missing teeth, retained deciduous, and supernumerary teeth with no previous orthodontic, orthopedic, facial surgical treatments and no history of bad oral habits such as thumb sucking or mouth breathing were included in the study.

Exclusion Criteria

All those students Subjects not willing to participate, who are undergoing orthodontic treatment, inflammation and trauma were excluded in our study.

Maxillary impression was taken with alginate, and cast were prepared with dental stone. The study casts was numbered for easy identification. All the measurements were taken by a two observer to prevent inter-observer difference. The measurements were performed on maxillary casts using digital Vernier Caliper of 0.01 calibrations.

Parameters measured for arch width included⁴

1. **Intercanine width** - measured from cusp tip to cusp tip
2. **Interpremolar width** - measured from the buccal tips of contralateral first premolars.
3. **Intermolar width** - This was measured as the distance between the mesio-buccal cusp tips of the first permanent molars

The dimensions of dental arch length were measured by using Lavelle *et al*^{1,8}, between the most mesial aspect of anterior teeth and the most distal aspect of posterior teeth. The dimensions measured were 11-13 and 11-16, 21-23 and 21-26.

Measurements used in arch length are as follows

1. **Incisal-Canine distance:** the distance from mesial aspect of central incisor to the cusp tip of the canine (I-C).
2. **Incisal - Molar distance:** the distance from the mesial aspect of central incisor to the distobuccal cusp tip of the first permanent molar (I-M).

The data thus obtained was recorded in a printed proforma.

Statistical Analysis

Two-sample t-test and Chi-Square tests were used for comparison of means and relationship between the attributes. A significance level of 5% was considered as critical value.

RESULTS

A total of 200 subjects were included in the study, which had equal distribution of males and females. Table 1 depicts the mean values of arch width of subjects. The mean intercanine width in males was 35.12mm and females was 33.93mm which showed significantly greater arch width in males. The interpremolar width in males was 42.52mm and females was 40.74mm which showed significantly greater arch width in males. The intermolar width in males was 53.16mm and females was 50.38mm which showed significantly greater arch width in males. Overall increase in arch width was greater in males than in females.

The mean maxillary intercanine, interpremolar and intermolar widths were 35.12mm, 42.52mm, 53.16mm respectively in males and 33.93mm, 40.74mm, 50.38mm respectively in females. All findings were significantly greater in males with p value of $P < 0.001$ which is highly significant in our study.

Table 2 depicts the mean values of arch length of subjects. It was found that the mean arch length from 11-13 in males were 22.69 and females were 22.11 with $P < 0.05$ which is significant. The mean arch length from 21-23 in males were 38.34 and females were 37.31 with $P < 0.001$ which is highly significant. The mean arch length from 11-16 in males were 22.71 and females were 22.04 with $P = 0.001$ which is highly significant. The mean arch length from 21-26 in males were 38.43 and females were 37.27 with $P < 0.001$ which is highly significant. The males had higher arch length than those of the females at all dimensions, which were found to be statistically significant.

DISCUSSION

Study on dental arch width in a population plays a key role in orthodontics⁹. Dental arch length varies with different races and gender¹. Various landmarks have been described and discussed by different investigators, but universal agreement on how it should be determined has not been reached^{9,10}. Information regarding maxillary arch dimensions in human population is important to clinicians in Orthodontics, Prosthodontics and Oral Surgery¹⁰.

Arch width measurements

The dental arch width is important in orthodontics treatment planning as it affects the space available, dental esthetic and stability of the dentition^{4,9}. The mean inter-canine, inter-premolar, inter-molar width was greater in males compared to females with $p < 0.001$ which is highly significant in our study, which is similar with the study conducted by Aluko IA in Nigerian population⁴.

In the present study the inter first molar arch width is greater in males than in females which is in agreement with the results obtained from the study conducted in North Indian Punjab population and Agnohotri G & Gulati MS in North Indian population^{9,11}.

The inter canine and inter molar distance was greater in males than females in our study, which is in agreement with study conducted on Yemeni population and Iraqi population^{5,12}. In our study the intercanine width and intermolar width showed greater sexual dimorphism with highly significant results, which was in disagreement with the study conducted by H A Mohammad *et al* on Malay ethnic group¹³ and also with study conducted by Siti Adibah Othman *et al* on Malaysian population¹⁴.

Arch length measurement

The arch length of the males were greater than females with significant statistical results in our study, which were similar with the findings of Shrestha & Bhattarai¹⁵, Barrett *et al*¹⁶, Bishara *et al*¹⁷, Huang *et al*¹⁸ & Amandeep Chopra *et al*¹.

In our study the arch length of the males were greater than females from 11-16, 21-26 with highly significant results, which is in agreement with the findings of Iraqi and Egyptian population⁵.

CONCLUSION

The results of our study have shown significant sexual dimorphism in all dimensions measured. The arch width and arch length were found to be significantly greater in males compared to females. This sexual dimorphism can be of

immense medicolegal significance as it can be used for gender discrimination. However the information regarding maxillary arch dimension in human population is important to clinicians in orthodontics, prosthodontics and oral surgeon. Further research work with advanced statistical methods is required to validate its use in forensic application.

Table 1 t test of significance for the difference between the mean arch width of males and females

Arch width	Gender	N	Mean	Standard deviation	t-value	P - value
Inter-canine	Male	100	35.129	2.084	3.891	P<0.001(HS)
	Female	100	33.931	2.265		
Inter – Premolar	Male	100	42.527	2.399	5.181	P<0.001(HS)
	Female	100	40.745	2.466		
Inter-Molar	Male	100	53.162	2.552	7.370	P<0.001(HS)
	Female	100	50.386	2.766		

HS-Highly Significant

Table 2 t test of significance for the difference between the mean arch lengths of males and females

Arch length	Gender	N	Mean	Standard deviation	t-value	P - value
11-13	Male	100	22.693	1.476	2.80	P<0.05 (S)
	Female	100	22.112	1.453		
11-16	Male	100	22.715	1.494	3.25	P=0.001(HS)
	Female	100	22.040	1.434		
21-23	Male	100	38.348	2.274	3.93	P<0.001(HS)
	Female	100	37.317	2.151		
21-26	Male	100	38.439	2.323	3.75	P<0.001(HS)
	Female	100	37.279	2.042		

S-Significant, HS-Highly Significant

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