

Original Research Paper

Comparison of Inter-Canine and Inter-Molar Width as an Aid in Gender Determination: A Preliminary Study

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Abstract

The dentition use in gender determination has been explored and advocated owing to its strength and resistance to various insults. Our aim was to determine and evaluate the usefulness of inter-molar arch width in gender determination. Our objective was to compare these distances in determination of gender and to validate its use as a forensic tool. Fifty subjects were selected and impressions were made for both the arches with alginate. Study models were prepared and used for analysis.

Inter-canine and inter-molar width in maxillary arch for male and female were 35.22 ± 1.54 and 33.49 ± 1.49 ; and 48.74 ± 1.89 and 45.44 ± 1.92 respectively. Inter-canine and inter-molar width in mandibular arch for male and female were 25.58 ± 1.37 and 25.29 ± 1.50 ; and 42.45 ± 2.00 and 39.53 ± 1.87 respectively. Thus, these measurements were significantly higher in males. On using the Receiver Operating Characteristic (ROC) curve to deduce values with high specificity maxillary inter-molar arch width gave high specificity of 92% to detect gender correctly, with best sensitivity i.e. 64%. Therefore, we conclude that inter-molar arch width is useful in determining the gender of dental remains accurately, of individuals with missing canine teeth.

Key Words: Maxillary arch, Mandibular arch, Inter-canine arch width, Inter-molar arch width, Gender determination

Introduction:

Gender determination of skeletal remains is a part of archaeological and many medico-legal examinations. The method of the identification may vary, but the ultimate goal is to determine the gender of the remains correctly. [1, 2] The identification of remains gains utmost importance in cases of mass fatality like in earthquakes, tsunami, cyclones and flood etc., where the bodies are damaged beyond recognition. In situations, where only fragments of skeletal remains are found for e.g. fragment of the jaws, in such situations only the odontometric features will help in recognition of the individual from the remains, particularly the teeth in the fragment. [3]

Because no two mouths are alike and dentition is as individual as fingerprints, it can be used for human identification. The dentition's use in gender determination has been explored and advocated owing to its strength and resistance to various insults.

As teeth are the hardest and chemically the most stable tissue in the body, they are an excellent material in living and non-living populations for Forensic investigations. [1]

Hence, tooth size standards based on odontometric investigations can be used in determining the age and particularly the gender. [2] With such tooth size standards, whenever it is possible to predict the gender, identification is simplified because then only missing persons of one gender needs to be considered. [2]

In this sense identification of gender takes precedence over age. Sexual dimorphism refers to those differences in size, stature and appearance between male and female that can be applied for individual identification.

Canines, in particular, have the greatest degree of sexual dimorphism, rendering them highly valuable in identification. Mesio-distal width of canine, [3, 4] inter-canine width [2] and mandibular canine index (MCI) [5] have been proved highly valuable in gender identification. Recently, there has been an increased interest in using molars as an aid in gender

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determination. [1] Since, first permanent molars are the first permanent teeth to erupt in the respective arches [6] and also have less chance of being impacted; therefore, an attempt has been made to compare the accuracy of inter-molar arch width between the first permanent molars to inter-canine arch width in gender determination and to validate it as an accurate entity for gender determination in cases where canines are missing.

Aims and Objectives:

- To determine the inter-canine and inter-molar arch width in the maxillary and mandibular arches.
- To evaluate the usefulness of inter-molar arch width in gender determination.
- To compare the inter-molar arch width to inter-canine arch width in determination of gender and to validate its use as a Forensic tool.

Materials and Methods:

Fifty subjects consisting of 25 males and 25 females, with age ranging between 18 to 25 years as per inclusion criteria were selected for our study. The patient was evaluated clinically. (Fig. 1) Patients with normal overjet and overbite, with absent spacing in the anterior teeth and with normal molar and canine relationship were included in the study.

Patients with presence of partially erupted teeth, with deleterious oral habits and having teeth with severe attrition were excluded from the study. [1] Once a patient was selected, a written consent was obtained from the patient after explaining the procedure and the purpose of the study. After that the patient was comfortably seated on the dental chair and height adjustment done before wearing gloves.

Maxillary and mandibular impressions were made with alginate using universal precautions for infection control. [7] Study models were prepared in dental stone and used for analysis. (Fig. 2)

On study model following measurements were made for all subjects using Vernier caliper. The measurements taken included: **Maxillary inter-canine** (Fig. 3) and **inter-molar** (Fig. 4) **arch width**; and **mandibular inter-canine** (Fig. 5) and **inter-molar** (Fig. 6) **arch width**. The inter-canine arch width was calculated from the cusp tip of canine on one side to the cusp tip of the canine on the opposite side, [3, 4] while the inter-molar arch width was calculated from the central fossa of first permanent molar on either sides.

Results:

In this Study arithmetic means were calculated for inter-canine and inter-molar arch

width in maxillary and mandibular arches for males and females. Student 't' test was used to compare the means of the inter-canine and inter-molar width in maxillary and mandibular arches for males and females.

All the comparison of means done was significant with 'p' value < 0.05. Inter-canine width in maxillary arch for male and female were 35.22 ± 1.54 and 33.49 ± 1.49 respectively with 't' value of 4.01. (Table 1)

Inter-molar width in maxillary arch for male and female were 48.74 ± 1.89 and 45.44 ± 1.92 respectively with 't' value of 6.09. (Table 1)

Inter-canine width in mandibular arch for male and female were 25.58 ± 1.37 and 25.29 ± 1.50 respectively with 't' value of 0.70. (Table 2) Inter-molar width in mandibular arch for male and female were 42.45 ± 2.00 and 39.53 ± 1.87 respectively with 't' value of 5.30. (Table 2)

Receiver Operating Characteristic (ROC) curve was used to deduce sensitivity and specificity of the measurements to determine gender correctly. (Graph 1)

On using the curve to deduce balanced sensitivity and specificity mandibular inter-molar arch width gave 92% sensitivity with satisfactory specificity of 76%; and on using the curve to deduce values with high specificity maxillary inter-molar arch width gave high specificity of 92% with best sensitivity i.e. 64%. (Table 3)

Discussion:

With an increase in the number of natural, as well as man-made calamities like earthquakes, floods, wars, riots etc. the need to correctly identify the remains of dead individuals have increased. Individual identification depends on different parameters like age, gender and race. Gender determination is one of the important steps employed in the identification of an individual. Correctly, determined gender limits the number of missing persons to just one half of the population. [2]

In Forensic cases, it is common to recover partial remains like fragmented skull, jaws and other bones of the body. The teeth being one of the strongest human tissues are known to resist a variety of ante-mortem and post-mortem insults and are one of the most commonly recovered remains.

Mesio-distal width of canine, [3, 4] inter-canine width [2] and mandibular canine index (MCI) [5] have been used to determine gender in the past and is supported by many researchers. But recent research by Acharya et al [8, 9], Boaz et al [10] have found that these measurements do not reflect the gender difference accurately.

Also these measurements are not useful in individuals with missing canines. In such cases, width of molars or inter-molar arch width may be used in gender determination. [1]

Hence, in our study inter-molar arch width was used to determine the gender and the results were compared with inter-canine arch width to assess a better method to determine gender correctly.

In our study, the mean inter-canine width in maxilla; and the mean inter-molar width in both maxilla and mandible were significantly higher in males than females.

This observation is in agreement with the study done by other authors [11-13] wherein they stated that boys have wider teeth; and larger upper and lower inter-molar width than girls. This may be because the dental arch width reflects the size of the basal bone and since males in general are larger than females; same would reflect itself in the basal bone of the jaws and the dental arches.

There was no significant difference between the mean mandibular inter-canine width between male and female, in our study. This observation is in agreement with other studies. [12, 14] Since crowding tends to decrease the anterior dental arch width and crowding is more common in mandibular anteriors, this could be the reason for the above mentioned finding.

But this observation is in disagreement with the study done by Hussein et al, [11] as they found the mandibular inter-canine width to be greater in males.

On comparing the means the maxillary inter-canine and mandibular inter-molar arch width were found to have high't' values, and were found to be quite useful in determining the gender. This was due to significant difference in the arch width between males and females.

But in our study, the maxillary inter-molar width was found to have the highest't' value, which was due to most significant difference in the values of mandibular inter-molar arch width in males as compared to females, making it the most useful measurement to determine gender correctly.

The sensitivity to determine gender correctly was high for mandibular inter-molar arch width i.e. 92% with a satisfactory specificity of 76%. But in Forensic and medico-legal examinations high specificity is required, to eliminate inaccurate identification and to prevent prosecution of innocent individuals.

In our study; maxillary inter-molar arch width was found to have the highest specificity of 92% in determining the gender correctly along with a satisfactory sensitivity of 64%, which was

again due to most significant difference in the values of mandibular inter-molar arch width in males as compared to females.

Thus, the maxillary inter-molar width had both high specificity and high't' value and this measurement may be used to determine gender correctly.

Conclusion:

Although the odontometric measurements based on canines are quite popular and have been substantiated from time to time for determining gender, these are rendered invaluable where canines are absent.

In such cases, where molars are present these teeth may be used to determine gender. On the basis of the results of our study, we may conclude that inter-molar arch width may be useful in determining the gender of dental remains accurately, of individuals with missing canine teeth and also it may be more accurate in gender determination than inter-canine arch width, with maxillary inter-molar arch width being more specific.

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Fig. 1: Armamentarium Used For Clinical Evaluation



Fig. 2: Armamentarium for Preparing Dental Models



Fig. 3: Maxillary Inter-Canine Arch Width



Fig. 4: Maxillary Inter-Molar Arch Width



Fig. 5: Mandibular Inter-Canine Arch Width

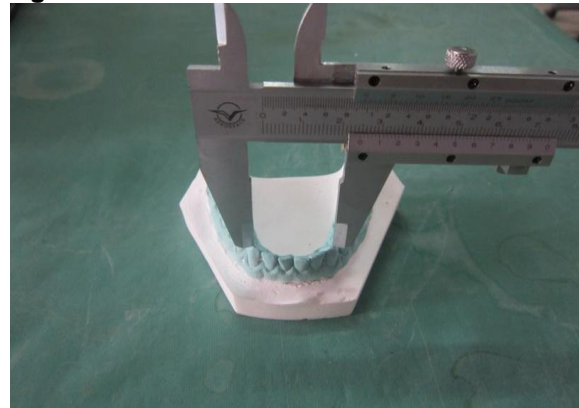


Fig. 6: Mandibular Inter-Molar Arch Width



Graph 1: Receiver Operating Characteristic Curve

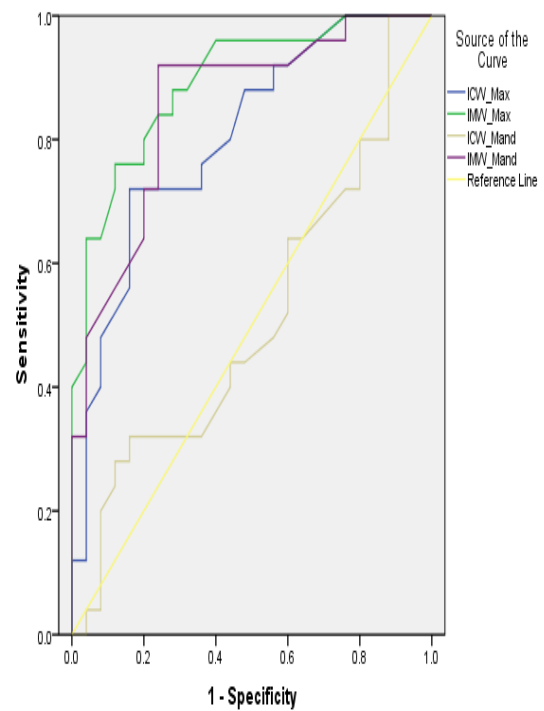


Table 1
Statistical Significance of Different Parameters of Maxilla

Parameters	Sex	Mean	±S.D	't' value	'p' value	Significance
Inter Canine Width	M	35.22	1.54	4.01	0.00	Significant
	F	33.49	1.49			
Inter Molar Width	M	48.74	1.89	6.09	0.00	Significant
	F	45.44	1.92			

Table 2
Statistical Significance of Different Parameters of Mandible

Parameters	Sex	Mean	±S.D	't' value	'p' value	Significance
Inter Canine Width	M	25.58	1.37	0.70	0.48	Significant
	F	25.29	1.50			
Inter Molar Width	M	42.45	2.00	5.30	0.00	Significant
	F	39.53	1.87			

Table 3
Sensitivity and Specificity

Arch	Parameter	Balanced		High Specificity	
		Sensitivity	Specificity	Sensitivity	Specificity
Maxillary	Inter Canine Width	72%	84%	48%	92%
	Inter Molar Width	80%	80%	64%	92%
Mandibular	Inter Canine Width	44%	52%	20%	92%
	Inter Molar Width	92%	76%	56%	88%

My Autopsy Case

I know, you are speechless, but I am sure now.

Your wounds are horrible, but pain is no more.

Your maggots don't dare to scare,

They are but to tell me, what has happened, where.

Your rajma rice, no more feels like butterfly in my stomach,

They are, but to let me feel the fun, you had much before, you are gone.

Your tongue out puffy face doesn't tease me anymore.

But it really makes me, take you up, as a challenge for sure.

Your severed limb with rigor, do'nt try to grab me anymore.

But it seems to me, as if it is asking a help for.

Your stillness doesn't burrow in my ears any more.

But it helps me concentrate on my own.

Your story of being scorned off, upsets me no more.

But the silent cry desperately makes me, open the door.

Off course, you are not able to speak now.

But, your voice would not be unheard any more.

Someone may say, you are of no use any more.

But here, with due regard, I acknowledge,

That day by day, my autopsy case teaches me more and more.

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