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Morphometric evaluation of palate for sexual dimorphism in Kashmiri population

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Abstract

Background: Bones and teeth are parts of human body which are most resistant to decomposition. Owing to the highly mineralized biological composition of these structures, they tend to be indispensable in terms of forensic evidence. Morphometry of skeleton is one of the many methods used for sexual dimorphism in cases of forensic background. Palatal morphometry has been widely implicated for this purpose in various populations. This study was aimed at establishment of sexual dimorphism in Kashmiri population based on palatal morphometric indices.

Methodology: An in vitro study was carried out on maxillary casts of 130 patients (65 males & 65 females). Morphometric landmarks were marked on the cast to measure the parameters of anterior arch length, total arch length and palatal width for both male & female groups.

Results: Students t-test was carried out for comparative analysis. Males were found to have significantly higher values in terms of total arch length & palatal width. However, anterior arch length did not show significant difference among males and females.

Conclusion: The study concluded that palatal morphometric indices can be used as an adjunctive method for establishing sexual dimorphism in Kashmiri population.

Keywords: Sexual dimorphism, Kashmiri population, Palatal, Morphometry

Introduction

In human body, bones and teeth are the most durable parts and may be the only recognizable remains in cases of decomposition, fire scenes or mass fatalities, natural disasters, criminal cases etc. and hence can be used for individual identification in such cases. Proper identification of dead is required both for legal and humanitarian reasons.

Forensic anthropology, a branch of forensic science aims at examining skeletonized or compromised human remains, in the interest of justice to assess age, gender, height and ancestry; to identify injuries; and to estimate the time since death. Examination of these remains may give information that can assist investigators in identifying a victim.

Forensic odontology, is another important offshoot of forensic science which uses dental evidence in interest of justice. It involves examination of development, anatomy, normal variations and special traits in dentition, restorative dental corrections of the teeth, bite mark patterns and lip prints to make a comparative identification of a person. Forensic odontology relies on sound knowledge of teeth and jaws possessed by dentists. The Federation Dentaire Internationale (FDI) defines forensic odontology as that branch of dentistry which, in the interest of justice, deals with the proper handling and examination of dental evidence and with the proper evaluation and presentation of dental findings^[1].

Based on the major fields of activity, Avon classified forensic odontology into civil, criminal and research^[2]. Studying morphometry of jaw bones is an important aspect of forensic anthropology & odontology. Morphological variations have been noted in different sexes and are being used as an aid in establishment of sexual dimorphism as well as individual identification. Sex determination of skeletal remains forms an important part of archaeological and medicolegal examinations. Morphometric evaluation of different bony structures of human body have been carried out, palate being one of them. Maxillary arch dimensions are also believed to be different for males and females because of difference in overall stature of males and females. This variation can be used to identify the sex of an individual in mass disaster

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cases and crime investigations [3]. Apart from this, palatal dimensions can also aid orthodontic and prosthodontic treatments. To the best of our knowledge, studies on palatal morphometry have not been carried out on Kashmiri population. So, current study was done in this context.

Materials and Methods

A cross sectional *in vitro* study was conducted on the maxillary dental casts of patients visiting two registered dental clinics for various other treatment needs. Patients' consents were taken for their casts to be used for the study in interest of social benefit. Ethical clearance was taken from concerned ethical committee. On the basis of conventional sampling method, sample of 130 was found to be suitable, equally distributed among male and female sexes. Maxillary dental casts made up of Plaster of Paris were analyzed for variation in palatal dimensions.

Casts of patients above the age of 18 years, dentulous, having fully erupted permanent dentition with morphologically normal dentition were included in the study.



Fig 1: Armamentarium used

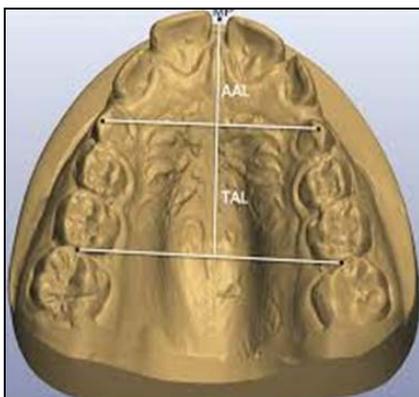


Fig 2: Dental cast showing the parameters

Casts having air bubbles or any damage, crowding, retained deciduous teeth, congenital palatal defects, casts of patients with history of orthodontic or maxillofacial orthopedic treatment, casts of patients with history of surgical treatment in mid facial region, and patients having partially erupted teeth were excluded from the study.

The armamentarium included maxillary dental casts, sharp

graphite pencil, Vernier caliper and metallic scale. Using graphite pencil the landmarks were marked on maxillary casts as, canine tips, mesio lingual cusp tips of first molar, distobuccal cusp tips of second permanent molars on both right and left sides of casts. Incisal point (the point midway between incisal edges of the two central incisors) was also marked. Scale was mainly used to join the landmarks while measurement.

Anterior arch length was measured using vernier caliper and scale as the vertical distance between incisal point and mid-point at inter canine line.

Total arch length was measured as vertical distance between incisal point and the midpoint of line between the distobuccal cusp tips of maxillary second molars.

Palatal width was measured as the linear distance between the mesiolingual cusp tips of right and left first molars.



Fig 3: Landmarks marked



Fig 4: Measurement of palatal width



Fig 5: Measurement of anterior arch length

Results & Observations

Statistical analysis

Independent samples t-test (student t test) was used for determination of statistical evidence among two groups that whether dimorphism based on maxillary arch dimensions, exists in Kashmiri population or not.

Table 1: Group Statistics

	Gender	N	Mean	Std. Deviation
AAL	Female	65	9.66	2.018
	Male	65	9.54	1.786
TAL	Female	65	39.52	2.779
	Male	65	41.00	3.531
P.W	Female	65	35.91	2.703
	Male	65	38.42	1.976

Table 2: Representing the results of t-test.

	t-test for Equality of Means						
	t	df	p-value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
AAL	.368	128	.713	.123	.334	-.538	.784
TAL	2.650	128	.009*	1.477	.557	.374	2.580
P.W	-6.039	128	<.001*	-2.508	.415	-3.329	-1.686

a) Anterior arch length (AAL): In 65 female casts the value of anterior arch length was $9.66\text{mm} \pm 2.01(\text{mean} \pm \text{SD})$, and in 65 male casts the value was $9.54\text{mm} \pm 1.78$. (Table 1). The difference between males and females was statistically insignificant with a p value of 0.713. (table 2) The value was insignificantly higher in females than in males.

b) Total arch length (TAL): The mean value of total arch length in males was $41.00\text{mm} \pm 3.53(\text{mean} \pm \text{SD})$, and in females was $39.52\text{mm} \pm 2.77$. (Table 1) The difference between males and females was found to be statistically significant with $p=0.009$ (Table 2). The value was significantly higher in males than females.

c) Palatal width (PW): The mean value of palatal width in males was found to be $38.42\text{mm} \pm 1.97(\text{mean} \pm \text{SD})$ and in females was $35.91\text{mm} \pm 2.70$.(Table 1) The value in males was significantly higher in males than in females with $p<0.001$.(Table 2)

Discussion

For sexual dimorphism in any population pelvic bone & skull play a very important role. The hormonal and visual differences that make living males and females distinct, also create physiological differences between their skeletons which is most obvious in skull and pelvis [4, 5].

In forensic human identification, sex determination is an important step because not only it does effectively reduce the number of possible matches but also subsequent methods for age and stature estimation are often gender dependent [5, 111]. Upon previous research carried out in this field, the males are believed to have larger dimensions than females and cranial features are more prominent in case of males [7]. Not only the skull as a single unit, but also the different sites of cranium have been researched and found suitable for determination of gender [8]. Bulk of research that has been done on different populations reveals that palatal dimensions exhibit racial difference and sexual dimorphism [9, 10, 11].

In the present study mean value for anterior arch length was found to be higher in females than in males, but the difference was statistically insignificant. A significant difference in mean value of total arch length was noted in males and females with males being on higher side. With regard to mean value of palatal width, statistically significant difference was noted among male & female sexes with males having higher value than females. A study [10] done on Yemeni population showed that the values of all the maxillary parameters were higher for males than in females which is in accordance with

results of our study in terms of palatal width and in contradiction to results of present study in terms of maxillary anterior arch length. The reason for discordance in the results of palatal length may be the smaller sample size in our study and the age limit of 18-25 years of study samples in Yemeni population.

Similar study [11] was conducted in a north Indian population in which 100 subjects were evaluated for sexual dimorphism. It was found that palatal parameters were significantly higher in males compared to females and it concluded that sexual dimorphism could be established on this basis.

Another study was conducted in Jordanian population in which three hundred dental casts were analysed for measurement of different parameters of hard palate and it was found that males are having higher value than females [12].

Most common problems faced in morphometric studies during measurement of metric traits, or observation of nonmetric traits is that these traits are affected by age, trauma or any discrepancy during growth (e.g. malocclusion, retention of deciduous tooth, clefting, and habits). So cases having any such complaints were excluded from the study. In most of the cases for person identification, corroboration of data which is gained through several yet non-specific methods can be used to upgrade the probability of correct identification. Palatal structures are more resilient to traumatic & other natural forces and hence palatal morphometry can be used to supplement the accuracy of gender identification and can be used in Kashmiri population as well.

Conclusion

Skull has been highly implemental when it comes to sex differentiation in forensic studies. Out of numerous landmarks that have been used for this purpose, palate is one of them. Morphometric evaluation of palate in male and female sexes revealed that sexual dimorphism on this basis is possible in Kashmiri population.

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