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 prostodontic 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.

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 midpoint 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.

**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.
difference and sexual dimorphism [9, 10, 11].

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a) Anterior arch length (AAL): In 65 female casts the value
of anterior arch length was 9.66mm ± 2.01(mean+SD), and
in 65 male casts the value was 9.54mm ± 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 41.00mm ± 3.53(mean ± SD), and in
females was 39.52mm±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 in females.

c) Palatal width (PW): The mean value of palatal width in
males was found to be 38.42mm±1.97(mean ± SD) and in
females was 35.91mm±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. 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 [112].
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.

References

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