

and brightness enhancement and enlargement of images provide an accurate and reproducible method of measuring the chosen points.¹⁸ The limitations of this technique are magnification and geometric distortion, the vertical dimension in contrast to the horizontal dimension is little altered, and this technique is quite sensitive to positioning errors because of relatively narrow image layer.¹⁹ However, in our study, this limitation did not affect our results since all images were uniformly magnified. Kambylalkaset *al.* concluded that the use of the panoramic radiograph for evaluation of total ramal height is reliable and an asymmetry of more than 6% is an indication of a true asymmetry²⁰. Schulze *et al.* found that the most reliable measurements were obtained for linear objects in the horizontal plane and digital measurements are sufficiently accurate for clinical use.²¹

In this study, Discriminant function analysis was used to study the mandibular ramus measurements. Each of the five variables measured on mandibular ramus using orthopantomograph showed statistically significant sex differences between sexes, indicating that ramus expresses strong sexual dimorphism. The mandibular ramus demonstrated greatest univariate sexual dimorphism in terms of minimum ramus breadth, condylar height, followed by projective height of ramus. Overall prediction rate using all five variables was 76% and the accuracy can be increased by repeated iterations. Humphrey *et al.*⁷ emphasized that almost any site of mandibular bone deposition, or resorption, or remodeling for that matter, seems to have a potential for becoming sexually dimorphic. Hence, mandibular condyle and ramus in particular are generally the most sexually dimorphic as they are the sites associated with the greatest morphological changes in size and remodeling during growth.²⁶

Giles measured mandibles of known sex using anthropometric measurements and reported mandibular ramus height, maximum ramus breadth, and minimum ramus breadth as highly significant, with an accuracy of 85% in American Whites and Negroes.²² Steyn and Iscan (1998) achieved an accuracy of 81.5% with five mandibular parameters (i.e. bigonial breadth, total mandibular length, bicondylar breadth, minimum ramus breadth, and gonion-gnathion) in South African Whites, which is comparable with the present study results.²³ Saini *et al.* conducted a study on dry adult mandibles of northern part of India and found that ramus expresses strong sexual dimorphism in this population. The overall prediction rate using five variables was 80.2%. The best parameters were coronoid height, condylar height, and projective height of ramus, and breadth measurements were not very dimorphic in their sample.²

Minimum ramus breadth measurement was found to be the best parameter in the present study, which is consistent with other osteometric studies by Giles (1964) and Vodanovic (2006), where breadth measurements were found to be very dimorphic. This is related to the differences in musculoskeletal development and to the differences related to a different growth trajectory in males and females. Limitations of this study are the inability to reliably assign sex in the sub-adult range and inability to assess the gender in case of edentulous patients.²² It has been established that

socio-environmental factors (e.g. nutrition, food, climate, pathologies, etc.) influence the development, and thus the appearance of bones. Numerous studies have demonstrated that skeletal characteristics differ in each population and have emphasized the need for population-specific osteometric standards for sex determination.^{24,25}

Conclusion :

The present study which has been conducted to evaluate various mandibular indices in digital panoramic radiograph to identify possible interrelationships between indices and sex of the patient analysed the results concluded that coronoid height and the mental index can be used effectively in identification of sex. Whereas maximum and minimum breadth of ramus of the mandible can be used for sex determination only in older age group and for the age determination can be used only for females. Considering the small sample size used in this present study, the study with large proportion of samples may be necessary to confirm the results of our study conclusively.

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