



## Mandibular Ramus Notching As a Tool for Sexual Dimorphism

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### ABSTRACT

Sex determination from a single or a part of bone is always difficult in absence of other bones of the same individual. The current study is an attempt to know the sex of an individual from the study of posterior ramus of mandible. The study was done from December, 2014 to August, 2015 in various Medical Colleges of the state of Odisha, India with the use of morbid anatomical specimen of mandibles and simple measuring instruments. The posterior ramus of adult mandibles were studied for presence or absence of any notching and if present its position in relation to occlusal plane. The study resulted, that there was a role of notch position in sex determination. The presence or absence of the notch though was not a consistent finding of all the mandibles. Males had frequent notching at the level of occlusal plane ( $P < 0.01$ ) and females had frequent notching above the occlusal plane ( $P < 0.01$ ). Notch present below the occlusal plane had no relation with sex. Accuracy of sexing mandible from the posterior ramus notch position was 61%, which was more for males (68.57%) as compared to females (43.33%). So the posterior ramus of mandible could be considered for determination of sex of mandible but this should not be the sole criteria and should be correlated with the other standard criteria.

**Key words:** Sex determination, posterior ramus of mandible, notching, accuracy.

### INTRODUCTION

Sex determination by morphology is one of the oldest approaches in medico-legal examinations and it depends upon the available bones and their conditions.[1] Sex determination is usually the first step of the identification process as subsequent methods for age and stature estimations are sex dependant.[2] According to Krogman accuracy of determination of sex from whole skeleton is 100%, pelvis alone 95%, skull alone 90%, pelvis with skull 98% and long bones alone 80%.[3]

If we consider skull for sex determination; mandible may play a vital role, as it is the most dimorphic bone of skull.[1] Mandible is an important tool in the determination of gender with high accuracy.[4] Mandible is the largest, strongest and lowest bone in the face and best preserved part of the body after death along with maxilla and teeth.[5] Sex determination can be more accurately determined after the attainment of puberty. Sexual dimorphism in mandible is seen as the stages of mandibular developments, growth rates, and duration of growth are distinctly different in both sexes. In addition, masticatory forces exerted are different for both sexes, which influence the shape of the mandibular ramus.[1]

There are various studies over the flexure present on the posterior border of ramus and its relationship with the occlusal plane for the determination of sex.[6] These studies highlighted the presence or absence of flexure on the

posterior border of ramus and its position relative to the occlusal plane for sex determination. Reliability of sex determination by studying the flexure of posterior ramus depends upon the sex, age group, presence or absence of molar teeth and forensic or archeological bone.[7] The distinct flexure in the posterior border of ramus at the level of occlusal surface of the molars in adult males is usually not seen in females, if present, it was either above or below the occlusal surface according to the pioneer of such studies by Loth and Henneberg. The authors claimed the prediction accuracy of 90.6-99% in mandibles without loss of molar teeth.[8,9]

The expression of ramus flexure has been suggested to be population specific and thus occurrence of this trait and its sex discriminating ability should be investigated in all parts of the world.[9]

### **Aims and objectives**

- (1) To know the relation between presence and absence of notch in relation to sex.
- (2) To know the position of notch in relation to occlusal plane in determination of sex.
- (3) To know the accuracy of sex determination from posterior ramus of mandible.

### **MATERIALS AND METHODS**

The study was carried between December 2014 to August 2015 in the Department of Anatomy and Forensic Medicine at IMS & SUM Hospital, Bhubaneswar, VIMSAR Medical College, Burla, and Department of Anatomy, SCB Medical College, Cuttack, in the state of Odisha.

The material includes.

1. Intact healthy mandible with ramus.
2. Adult age group of known sex, determined as per standard protocol.

### **Method used**

The sample mandibles so collected were subjected to the present standard parameters for determination of age group (infant / adult / old) and sex.

The adult mandibles were subjected for study of posterior ramus of both sides.

The posterior rami of both sides of mandibles were studied under the following headings.

- Whether the posterior ramus is straight / almost straight / presence of any notch in relation to the occlusal plane.
- If there is notching then position of the notch in relation to the occlusal plane.

LOP – Notch at the level of occlusal plane.

AOP – Notch above the occlusal plane.

BOP – Notch below the occlusal plane.

After collection of the data 'P- value' for the particular test was determined by chi-square test.

### **RESULTS**

**Table I (Posterior Ramus Notching)**

Type	Male	Female	Total
<b>Straight</b>	10	5	15
<b>Notching</b>	60	25	85
<b>Total</b>	70	30	100

**Table II (Position of Notch)**

Notch Position	Male	Female	Total
<b>LOP</b>	48	9	57
<b>AOP</b>	8	13	21
<b>BOP</b>	4	3	7
<b>Total</b>	60	25	85

1. Proforma Used



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**Sexing from Ramus of Mandible**

(A) Age Determination

1	Body	Shallow	Thick	Long
2	Medico-legal Angle	Obtuse		Less Obtuse
3	Position of Mental Foramen	Lower	Midway	Upper
4	Condylold Vs Coronoid	Lower	Projected	Elongated
5	No of Teeth/sockets			
6	Result	Teen	Adult	Old

(B) Sex Determination

1	Size	Large	Thick	Small	Thin
2	Chin Shape	Square	U-Shaped	Rounded	
3	Body Height at Symphysis				
4	Breadth of Ascending Ramus				
5	Gonion				
6	Condyles size				
7	Mental Tubercle	Large	Prominent	Insignificant	Small
8	Sex	Male			Female

(C)Posterior Ramus of Mandible

Right	Almost Straight	Notching	LOP	AOP	BOP
Left	Almost Straight	Notching	LOP	AOP	BOP

(D) Observed by -- .....

Institute and Department of the observed Sample -- .....

## 2. Photographic presentation of the posterior ramus with notch position



(Courtesy-. *Encyclopedia of Forensic Sciences, Vol-1, Page – 255*)

- (1) Though notching was found more frequently compared to the straight one there is no statistical significance of notching and straight ramus compared to the sex by using chi-square test.
- (2) LOP in males and AOP in females are statistically significant at  $P < 0.01$ , whereas BOP has no statistically significant result in relation to sex.
- (3) So the males and females can be categorized by position of notching i.e. LOP or AOP.
- (4) Accuracy of sexing mandible from the posterior ramus notch position is  
 $48 + 13 / 100 \times 100 = 61\%$
- (5) Accuracy of sexing male from LOP is  
 $48 / 70 \times 100 = 68.57\%$
- (6) Accuracy of sexing female from AOP is  
 $13 / 30 \times 100 = 43.33\%$

## DISCUSSION

The most dimorphic part of the skull is the mandible. In adult males, ramus shape is characterized by a distinct angulation of the posterior border of the ramus at the level of the occlusal surface of the molars; this is referred to as 'ramus flexure'. Females, however, are not flexed at this part of the bone – the posterior border maintains the straight juvenile shape, or, in some females, angulation occurs at a higher point at the neck of the condyle. This single trait has demonstrated diagnostic accuracy of 91-99% with confirmation by independent studies.[10]

1. In our study we found there was no relation between presence and absence of notching in relation to sex and are supported by various studies.[6] The ramus being devoid of any muscular attachments it is unlikely to be modified by the chewing habits of a person.

2. Notch position was useful in the determination of sex with 61% accuracy in our study. The accuracy varies from medium to high in other studies i.e., 59-80.4%[7], 76%[12], 78%[13], 82%[9], 83%[11], 90%[6] and 91-99%[8].

But according to another study, ramus is not adequate for sexual dimorphism.[14] Various factors may contribute to the accuracy of sexing like, age at death[15], sex itself[7,11,12,14], presence or absence of molar teeth[8] and forensic or archeological bone.[7] It may also depend on the geographical area.[9]

3. Males were more accurately diagnosed as compared to females using these criteria which are supported by almost all previous studies[6,7,12,14], except one[11], where it is slightly more accurate for females.

4. Application of the ramus flexure as the single most criteria for sex determination in this study is 61% accurate, but it should be used only in fragmented bones or when mandible is the only available bone of an individual.

Study of authors[1,6,8,9], show it may be used as single criteria with high accuracy. Study of many authors[7,11-15], show that it should be used as an additional to the present standard criteria of sex determination from mandible.

### CONCLUSION

Flexure of posterior ramus of mandible is an important tool in the determination of gender with accuracy (61%). It should not be used as the only criteria except in the fragmented bone (parts of mandible with ramus). The ramus flexure is more reliable in the male sex determination (68.57%) than females (43.33%). The study focused only on adult age group. So its accuracy of sex determination in adolescents and old age groups are yet to be studied. Further study on it over larger samples and wide geographical area of this part of the world is required to support these criteria for sex determination.

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**Conflict of interest** – none

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