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**Original Research Article**

# MORPHOMETRIC STUDY OFTHE HUMAN FIBULAR INCISURA

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## ABSTRACT

**Introduction:** The aim of this study was to determine the anatomy of the Fibular Incisura (FI) of the tibia and the distal end of the fibula which form together the TibiofibularSyndesmosis (TS) joint and also to obtain the morphometric data in both genders.

**Materials and Methods:** Present study has been performed on 50 dry adult tibia of known sex (25 males and 25 females) at Bone Bank,Department of Anatomy, GMCH Aurangabad, MH, India. Measurements were taken directly from the bone using a digital pair of vernier calipers. Means and frequencies were determined in both male and female and compared using unpaired t-test with the help of SPSS software. Data were presented in tabulated format.

**Results:** The mean value of height of fibular incisura measured in mm were 31.87, 29.32 in male and female, the mean of depth of FI in male and female were 3.25,3.00 while width were 23.94,20.91 mm in male and female respectively. The length of anterior tubercle was 11.63,9.11mm and length of posterior tubercle was 16.37,11.65 mm in males and females respectively.The parameters height, depth, width of FI and length of anterior tubercle showedstatistical significant difference (p value 0.0001) when compared in male and female while the parameter length of posterior tubercle did not shown statistical significant difference when compared in both sexes.

**Conclusion:** The morphometric data gathered in this study is very helpful to easily interpret and explain plain radiographs, CT, MRI. It could also be important to perform surgical reconstruction surgeries of distal limb.

**KEY WORDS:** Fibular incisura, Tibiofibular Syndesmosis, Morphometry, Tibia, Fibula.

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## INTRODUCTION

The lower ends of the fibula and tibia form an anatomical and functional unit. The distal tibiofibular joint takes on a shape between the medial convex surface on the distal end of the fibula and the lateral concave surface of the fibular incisura of the tibia and formssyndesmosis type of the fibrous joint. The ligaments of the syndesmosis keep the fibula closely approximated in the fibular notch, thus forming an articulation [1-3].The interosseous border of the tibia splits to form anterior and posterior

ridges that project into anterior and posterior tubercles.These ridges and tubercles enclose the fibular incisura (FI).The articulation of FI and lower end of fibula along with associated ligaments forms syndesmosis that constitutes the 'mortise' which articulates with the 'tenon', the talus, at the talocrural joint. In this regard, the FI and the distal fibula form an anatomical unit whose stability depends largely on the FI's morphometry [4]. Morphometric analysis of tibia find clinical application in imaging diagnosis of fractures of the ankle joint [5].The data collected in this study is explainsthe morphometry of the human FI. It also guide in the interpretation of diagnostic images of the ankle joint.

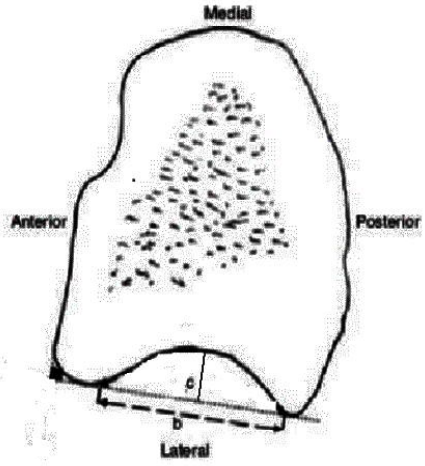
## MATERIALS AND METHODS

We studied total of 50 tibiae of known sex (25 male and 25 female) obtained from the Department of Anatomy, Government Medical College, Aurangabad, Maharashtra, India in 2015. The inclusion criteria for tibia under study was complete epiphyseal fusion so that it belongs to adult. The exclusion criteria was any sign of previous fracture in life over distal end of tibia.A pair of digital verniercallipers with accuracy 0.01 mm were used for measurement of parameters of distal end of tibia. Statistical analysis was done with the help of SPSS software. As this study was cross sectional observational study unpaired t test was used to compare various parameters for determination of significance in sexual dimorphism. The p value of <0.05 was considered statistically significant at 95% confidence interval.

**The dimensions measured included:** Width of the fibular incisura is the distance between anterior and posteriortubercles 1 cm proximal to the tibial plafond; depth of the FI taken as the distance from thedeepest point of the FI to a line between tipsof the anterior and posterior tubercles. Length of anterior (Chaput's) tubercle is the distance from the deepest point of the FI tothe tip of the anterior tubercle; the length of posterior (Volkmann's) tubercle isthe distance from the deepest point of theFI to the tip of the posterior tubercle;height of the FI is taken as the vertical distancebetween the tibial plafond and the pointwhere the interosseous border splits intoanterior and posterior edges.

**Fig. 1:** a : Height of FI


**Fig. 2**: b-Width of FI, c- Depth of FI




The mean, range, standard deviation of height, depth and width of the FI as well as length of the anterior and posterior tubercle in 50 tibiae of both sexes (25 male and 25 female) are presented in table1. The parameters height, depth and width of the FI also the length of anterior tubercle shows significant statistical difference when compared in both sexes ($p < 0.0001$). However The sex difference in length of anterior tubercle was not statistically significant (*p* value 0.0145).

**Table 1:** Descriptive measurements and sex differences in dimensions of the distal tibia.

| Parameter | Sex | Range | Mean (mm) | Std. Dev | P value |
|---|---|---|---|---|---|
| Height of the fibular incisura | Male | 29.06-35.63 | 31.87 | 2.01 | 0.0001 |
| | Female | 27.22-31.46 | 29.32 | 1.5 | |
| Depth of the fibular incisura | Male | 2.83-3.82 | 3.25 | 0.32 | 0.0049 |
| | Female | 2.27-3.29 | 3 | 0.25 | |
| Width of the fibular incisura | Male | 22.44-25.67 | 23.94 | 1.02 | 0.0001 |
| | Female | 19.17-22.98 | 20.91 | 1.14 | |
| Length of the anterior tubercle | Male | 10.22-12.84 | 11.63 | 0.79 | 0.0001 |
| | Female | 8.08-10.34 | 9.11 | 0.69 | |
| Length of the posterior tubercle | Male | 14.28-17.74 | 16.37 | 0.99 | 0.0145 |
| | Female | 14.03-17.73 | 11.65 | 1.06 | |

## DISCUSSION

Normal ankle function is maintained by intact TibiofibularSyndesmosis (TS) joint. The syndesmosis is very helpful to maintain the normal articulation of the ankle joint by determining the precise relationship between the distal tibia and the fibula [6,7].The preoperative and postopera-tive assessment of ankle sprains and ankle fractures will become very convenient with the precise knowledge of TS joint. Ankle sprains and fractures may lead to TS joint injury with or without dislocation. The fibula may be displaced posteriorly from the tibia in severe injuries [8-11].The fibulaperforms primerole in maintaining the integrity of ankle mortise i.e.the relationship of the distal tibia, especially the FI [10,11].This is the morphomet-ric study of the FI of the tibia. There are less number of morphometric studies in the literature concerning this area on dry human bones. The anatomy of the TS joint and the FI has been described previously by CT and MRI [8,10,11].

Mavi et al [8]studied FI on MRI. They used recurrent sprained ankle patients as subjects and determined that in the study group the anterior and posterior tubercles were lengthier, the depth of FI was deeper and fibula was more anterior in study cases. The depth of the FI in men was greater than those of the women in both groups. Yýldýrým et al[11] studied fibular incisura using MRI and concluded that in women syndesmotic injury may be observed more commanly than men because of anatomic differences.

The height of the FI in the current study was found to be 31.87 mm and 29.32 mm in males and females respectively which is similar findings to that of research done by Misiani Musa et al, Mandela Pamela et al,Kulkarni et al while study of FI on Turkish people by Taser et al., 2009 found that the mean of height of FI was39.14±2.75 mm. This disparity could be due to populational variations between the present study and Turkish individuals. A lower bifurca-tion of the interosseoustibial ridge suggests shorter FIwhile the depth of the FI increases proximo-distally, a lower division of the interosseoustibial ridge results in a shallower FI [12,13].Males and females showed significant statistical difference for height of FI in present study which could be explained by the shorter tibiae among female subjects. Previous research done byworkers Ebraheimetal,Taser et al reached to the similar observations.

In the present study depth of FI was 3.25 mm and 3 mm in males and females respectively. This value is comparable to that obtained in previous studies by Kin et al, Taser et al,Misiani Musa et al, Mandela Pamela et al,Yildrim et al. The mean depth obtained in the current study was however less than a mean depth of 5.07±0.76mm obtained by Sora et al in a plastination study, this difference is might bedue different methodology employed.Male had deeper incisuraeas compared to females. Comparison of the depth of then FI among sexes in the current study demonstrated a statistically significant difference in the depth of the FI in contrast to the findings by Taser et al who found no statistically significant difference in the depth of the FI among males and females. This could be due to populational differences in osteometric dimensions due to differences in body habitus.Shallow FI have been implicated in the pathomechanics of displacement of the fibula associated with fracture dislocation that results in instability of the TS joint and the ankle joint [12].

The width of FI in present study was 23.94 mm and 20.91 mm in males and females respectively. These results are very similar to the research done by Taser et al,Misiani Musa et al, Mandela Pamela et al,Yildrim et al.The width of the FIis representative of the size of the TS joint.Since a wider FI indicates a greater separation of the anterior and posterior incisural tubercles. This translates to a shallower incisurathat predisposes an individual to instability of the TS joint [14].

In the present study the mean length of anterior tubercle in males and females was 11.63 mm and 9.11mm respectively. While mean length of posterior tubercle was 16.37 mm, 11.65mm in males and females respectively. The statistical difference was significant for anterior tubercle but it does not show significance for posterior tubercle in males and females. Research done by Taser et al, Misiani Musa et al, Mandela Pamela et al,Yildrim et al got similar mean value

of both anterior and posterior tubercles as that of present study but they did not found significant statistical difference in males and females for these two parameters. In contrast to this, in present study we found significant difference for length of anterior tubercle this might be due to geographical and populationalvariations.Dimensions of the tibial tubercles can be used to infer the location of the fibula in the FI [15].There is a relationship between the position of the fibula and recurrent ankle instability. Syndesmoses with a more posteriorly positioned fibula showsless structural stability and therefore more susceptible to sprains [16].

## CONCLUSION

The morphometric variability and sexual dimorphism of the parameters of FI useful to interpret radiographs, CT, MRI of TS joint and talocrural joint. This study also useful for orthopedic surgeons for placement of implants of appropriate dimensions in ankle reconstruction surgeries.

**Conflicts of Interests: None**

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