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Original Research Article

Importance of fibular incisura measurements in ankle reconstructive surgeries

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Abstract

Fibular incisura found on the lateral surface of the distal end of the tibia articulates with the fibula, forming distal tibiofibular syndesmosis. Fibular incisura is also called the incisural notch, peroneal groove or syndesmotic notch of the tibia. The present study was done on 34 dry adult tibia bones to analyze the morphometric characteristics of the fibular incisura in dry tibia. Of the total tibia studied, 88.2% (30) bones presented a deeply concave and rest 11.8% (4) presented a shallow concave fibular notch. The study of fibular incisura measurements helps the orthopaedic surgeons in ankle reconstructive surgeries (open reduction and internal fixation of the fracture dislocation of the ankle mortise) and these measurements may play a pivot role in ankle joint replacement.

Keywords: Ankle reconstructive surgery; Fibular incisura; Fibular notch; Incisural notch

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1. Introduction

Fibular incisura found on the lateral surface of the distal end of the tibia articulates with the fibula, forming distal tibiofibular syndesmosis. Fibular incisura is also called the fibular notch, incisural notch, peroneal groove or syndesmotic notch of the tibia.[1, 2, 4, 5, 6] The fibular notch is triangular, its anterior and posterior edges project and converge proximally to the interosseous border of the tibia. The floor of the notch is roughened proximally by a substantial interosseous ligament but is smooth distally and sometimes covered by articular cartilage. The anterior and posterior tibiofibular ligaments are attached to the corresponding edges of the notch.[1] 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, thus forming a syndesmosis type of the fibrous joint. The ligaments of the syndesmosis keep the fibula closely approximated in the fibular notch, thus forming an articulation.[1-4]

The anatomical relationship between the tibia and the fibula at the level of the ankle is of prime importance for the proper function of the distal tibiofibular joint and thus for the structural and functional integrity of the ankle mortise. This integrity may be disrupted in case of ankle

fractures and dislocations. Hence, the morphometric data of fibular incisura are also important in order to perform surgical reconstructions after dislocation fractures. The purpose of this study was to determine the anatomical characteristics of the fibular incisura of the tibia and obtain the morphometric data comparing on right and left sides for pre & postoperative assessment of ankle sprains and fractures.

2. Materials and methods

The present study was done on 34 dry adult tibia bones (right=16, left=18) collected from the Department of Anatomy, A.J. Institute of Medical Sciences, Mangalore, Karnataka, India. Sex of the bones was not considered. Damaged and abnormal bones were excluded from the study. Vernier caliper and goniometer were used for the linear and angular measurements respectively. All data including mean, minimum, maximum and standard deviation values were recorded and calculated using SPSS 11.0 software for various parameters. The obtained morphometric data was then subjected to Karl Pearson correlation test to find for any significant correlation among the different parameters on the same side and for comparison between right and left sides. The confidence level for significance was $p<0.05$.

3. Results

Of the total tibia studied, 88.2% (30) bones presented a deeply concave (≥4 mm) and rest 11.8% (4) presented a shallow concave (<4 mm) fibular notch. It was found that as the depth of the fibular notch decreases, the angle between the anterior and posterior facets increases. Hence, shallow concave fibular incisura is a predisposing factor in displacement of fibula, associated with fracture dislocations. There was a statistically significant strong positive correlation between: width of the tibia and width of the fibular incisura; width of the tibia and depth of the fibular incisura; lengths of the anterior and posterior facets. The respective p values are given in Tables V, VI and VII. The angle between anterior and posterior facets was approximately 130 on both sides. The angle between anterior surface of the tibia and intertubercular line varied between 64^{o} and 94^{o}(80.41± 8.56). There was no significant difference between right and left side. There was no correlation between this angle and angle of the anterior and posterior tubercles and depth of the fibular incisura. The minimum, maximum, mean and standard deviation values of right and left sides are given in Tables 2 and 3 respectively.

The following parameters were measured at the level of 1cm from tibial plafond (Table 1, Fig 1):

Table 1

Parameter
Width of the tibia (between the medial and lateral borders of the tibia)
Width of the fibular incisura (between the anterior and posterior tubercles)
Depth of the fibular incisura (from the deepest point of the fibular incisura to a line between the tips of the anterior and posterior tubercles)
Length of the anterior facet (from the tip of the anterior tubercle and the deepest point of the fibular incisura)
Length of the posterior facet (from the tip of the posterior tubercle and the deepest point of the fibular incisura)
Angle between the anterior and posterior facet
Angle between the anterior surface of the tibia and intertubercular line which was drawn tangent to the tip of the both tubercles

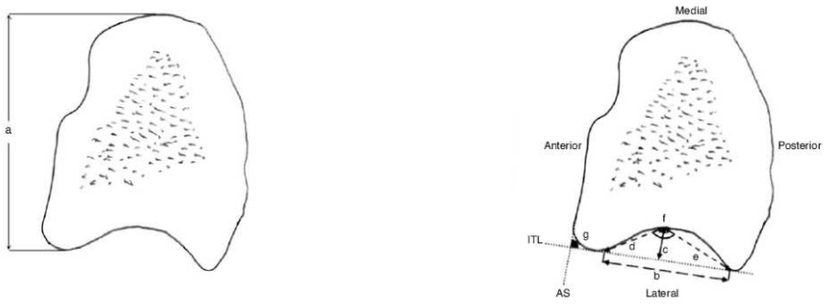

Fig. 1: The measurement points at 1 cm proximal from the tibial plafond (a: Width of the tibia; b: Width of the incisura fibularis; c: Depth of the incisura fibularis; d: Length of the anterior facet; e: Length of the posterior facet; f: Angle between the anterior and posterior facets; g: Angle between the anterior surface of the tibia and intertubercular line; ITL: Intertubercular line; AS: Anterior surface of tibia)

Table 2: Right sided measurements at 1 cm proximal level from the tibial plafond (n= 16)

Measurement points	Min-Max. (mm)	Mean±SD
Width of the tibia	33.0-46.0	41.86 ±3.28
Width of the fibular incisura	21.2-27.5	23.50±1.72
Depth of the fibular incisura	3.5-8.9	6.22±1.46
Length of the anterior facet	7.4-15.6	11.59±1.88
Length of the posterior facet	10.0-20.0	14.79±2.57
Angle between anterior and posterior facet	116-138	128.88±7.65
Angle of anterior surface of tibia & intertubercular line	64-88	74.81±7.33

Table 3: Left sided measurements at 1 cm proximal level from the tibial plafond (n= 18)

Measurement points	Min-Max. (mm)	Mean±SD
Width of the tibia	31.6-44.4	38.97±3.77
Width of the fibular incisura	19.7-26.4	23.11±1.90
Depth of the fibular incisura	3.2-9.1	6.14±1.71
Length of the anterior facet	8.1-13.5	11.03±1.60
Length of the posterior facet	12.0-18.2	14.63±2.23
Angle between anterior and posterior facet	122-158	131.06±8.098
Angle of anterior surface of tibia & intertubercular line	74-94	85.39±6.270

4. Discussion

An intact tibiofibular syndesmosis joint is important in maintaining normal functioning of the ankle mortise. The function of the syndesmosis is to maintain the normal articulation of the ankle joint by determining the precise relationship between the distal tibia and

The mean and standard deviation values of all the seven parameters for 34 bones are given in Table 4.

Table 4: Measurements at 1 cm proximal level from the tibial plafond (n= 34)

Measurement points	Mean±SD
Width of the tibia	4.03±0.37
Width of the fibular incisura	2.32±0.18
Depth of the fibular incisura	0.61±0.15
Length of the anterior facet	1.12±0.17
Length of the posterior facet	1.47±0.23
Angle between anterior and posterior facet	130.02±7.85
Angle of anterior surface of tibia & intertubercular line	80.41±8.56

Table 5: Correlation between width of the tibia and width of the fibular incisura (n=34)

Parameter	Mean±SD	p
Width of the tibia	4.03±0.37	0.035*
Width of the fibular incisura	2.32±0.18	0.035*

*: $p<0.05$ Statistically significant difference.

Table 6: Correlation between width of the tibia and depth of the fibular incisura (n=34)

Parameter	Mean±SD	p
Width of the tibia	4.03±0.37	0.040*
Depth of the fibular incisura	0.61±0.15	0.040*

*: $p<0.05$ Statistically significant difference.

Table 7: Correlation between lengths of the anterior and posterior facets on the right side (n=16)

Parameter	Mean±SD	p
Length of anterior facet	11.59±1.88	0.043*
Length of posterior facet	14.79±2.57	0.043*

*: $p<0.05$ Statistically significant difference.

the fibula.[2,3,6,7] The anatomical knowledge of the tibiofibular syndesmosis is essential for the preoperative and postoperative assessment of ankle sprains and ankle fractures. This syndesmosis may be injured in ankle sprains and fractures with or without dislocation. The fibula could be displaced posteriorly from the tibia in severe injuries.[2,6,8-13] Thus, it is clear that the relationship of fibular incisura and the fibula is of prime importance in maintaining the structural and functional integrity of ankle mortise. The anatomy of the tibiofibular syndesmosis and the fibular incisura has been described by CT and MRI previously.[5,6,12-14] But there are very few

anatomical studies in the literature regarding the morphometric measurements of fibular incisura on dry human bones.

In our study, the mean value of the angle between the anterior and posterior facets was found to be 130°, while it was 139° and 126° in the studies done by Yildirim et al. and Taser et al. respectively.[12,13] In the present study, it was found that 88.2% (30) bones presented a deeply concave (≥4 mm) and rest 11.8% (4) presented a shallow concave (<4 mm) fibular notch. In a study performed by Ebraheim et al., 60% cases presented a deeply concave and 40% shallow concave fibular notch.[3] While Taser et al., in his study found 35% deeply concave and 65% shallow concave fibular notch.[12]

There is a relationship between the position of the fibula and recurrent ankle instability. Ankle mortise with a more posteriorly positioned fibula has less structural stability and is more susceptible to sprains.[15] The position of the tibial tubercles, which depends on their dimensions and angle between them, denotes the location and position of the fibula within the fibular incisura. In our study, it was found that as the depth of the fibular notch decreases, the angle between the anterior and posterior facets increases. Hence, shallow concave fibular incisura is a predisposing factor in displacement of fibula, associated with fracture dislocations.

In our study, we found that the angle between the anterior surface of the tibia and intertubercular line varied between 64° and 94°. This angle shows that the position of the fibula depends on the tibia. This angular measurement could be important for the interpretation of the mortise radiograph.

5. Conclusion

To conclude, this data may help to define the anatomic variability and morphometric characteristics in fibular incisura of the distal end of the tibia. Syndesmotic injury may be difficult to appreciate by radiographic criteria because of variations in the amount of rotation, the wide anatomic variability in the depth of the fibular incisura. These measurements may also help to interpret plain radiographs, CT and MRI of the ankle mortise that are done as a routine OPD procedure. It may also help orthopaedic surgeons to use the appropriate dimensioned implants in ankle reconstructive surgeries as well as in case of ankle joint replacement.

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