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An Osteometric Study of the Lateral Malleolus of the Lower End of the Fibula

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Tithi Rani Biswas,[1] Tanmoy Kar,[2] Shah Md. Atiqul Haque,[3] Md. Safat Latif,[4] Sabiha Tanzem[5]

Abstract

Background: Humans are unique among primates for their exclusive bipedal locomotion, with body weight entirely supported by the lower limbs. This adaptation has led to several evolutionary modifications that maintain upright posture. The medial malleolus of the tibia and the lateral malleolus of the fibula form a deep socket that stabilizes the talus. During weight-bearing, forces are transmitted from the tibia and fibula to the talus, with the fibula supporting approximately one-sixth of the static load at the tibiofibular joint. ***Objectives:*** This study aimed to measure various morphometric parameters of the lateral malleolus at the distal end of the fibula. ***Methodology:*** This cross-sectional descriptive study was conducted in the Department of Anatomy, Mymensingh Medical College, Bangladesh, from January 2023 to December 2023. A total of 300 dry fibulae (152 right, 148 left) were selected using a purposive sampling technique. Specimens with fractures, deformities, or incomplete ossification were excluded. Data were recorded, tabulated, and statistically analyzed using Microsoft Excel and SPSS software. ***Result:*** The mean (± SD) of height of the lateral malleolus was 25.84 (± 2.76) mm on right side and 25.41 (± 2.96) mm on left side. The mean (± SD) of coronal width of the lateral malleolus was 16.70 (± 1.68) mm on right side and 17.24 (± 1.51) mm on left side. The mean (± SD) of sagittal width of the lateral malleolus was 22.76 (± 2.06) mm on right side and 23.33 (± 1.99) mm on left side. ***Conclusion:*** The standard osteometric measurements of the lateral malleolus of the fibula investigated in this study represent novel findings that may contribute to advancements in both operative management techniques and prosthetic design for lateral malleolar fractures.

Keywords: Osteometry, lateral malleolus, fibula, anatomy

Introduction:

The distal end of the fibula forms the lateral malleolus, which projects distally and posteriorly. Its lateral aspect is subcutaneous, while the posterior aspect features a broad groove with a prominent lateral border. The anterior aspect is rough, rounded, and continuous with the inferior border of the tibia. The medial surface presents a triangular articular facet, vertically convex with its apex directed distally, articulating with the lateral surface of the talus. Posterior to this facet lies a rough malleolar fossa, marked

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Address of correspondence: Tithi Rani Biswas, Assistant Professor, Department of Anatomy, Army Medical College Jashore, Bangladesh. Email: tithi0081@gmail.com

1. Dr. Tithi Rani Biswas, Assistant Professor, Department of Anatomy, Army Medical College Jashore, Bangladesh
2. Dr. Tanmoy Kar, MS Phase B student, Community Ophthalmology Department, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
3. Dr. Shah Md Atiqul Haque, Assistant Professor, Department of Anatomy, Mymensingh Medical College, Bangladesh
4. Dr. Md Safat Latif, Lecturer, Department of Anatomy, Mymensingh Medical College, Bangladesh
5. Dr. Sabiha Tanzem, Lecturer, Department of Anatomy, Mymensingh Medical College, Bangladesh

by vascular foramina.[1] Humans are the only primates with an obligate bipedal gait, transmitting body weight to the ground through the lower limbs. Consequently, several adaptations have evolved to maintain an upright posture. The medial malleolus of the tibia and the lateral malleolus of the fibula form a deep recess that accommodates the talus. Body weight is transmitted from the tibia and fibula to the talus, with approximately one-sixth of the static load borne by the fibula at the tibiofibular joint. The lateral malleolus contributes to a stable socket-like structure, ensuring proper talar alignment.[2] Accurate morphometric assessment of the distal fibula is essential for managing isolated lateral malleolar fractures or bimalleolar fractures. Complete anatomical reduction of the lateral malleolus during treatment is critical to preventing long-term complications such as degenerative arthritis.[3]

Materials and methods

This study was conducted on 300 fully ossified dry human fibulae collected from the Department of Anatomy at Mymensingh Medical College (MMC), Mymensingh, Bangladesh, as well as from 1st and 2nd-year MBBS students. Among the 300 fibulae, 152 were right-sided, and 148 were left-sided. The study was carried out from January 2023 to December 2023 as a cross-sectional descriptive study. A non-random purposive sampling technique was used for sample selection. Ethical clearance was obtained from the Institutional Review Board (IRB) of MMC (Memo No. MMC/IRB/2023/575; Date: 24/06/2023).

Only fully ossified dry human fibulae were included in this study. Fractured fibulae, as well as those with tumors, deformities, or other abnormalities, were excluded. Three different parameters were measured in this study:

1. Maximum Height of the Lateral Malleolus: The fixed jaw of the slide calipers was placed on the upper margin of the facet for the talus, and the sliding jaw was adjusted to the tip of the lateral malleolus. The maximum height between these two points was measured and recorded in millimeters (mm).
2. Maximum Coronal Width of the Lateral Malleolus: The fixed jaw of the slide calipers was placed on the widest part of the lateral surface of the lateral malleolus, and the sliding jaw was positioned on the medial surface. The distance between these two points was measured using digital slide calipers and recorded in millimeters (mm).
3. Maximum Sagittal Width of the Lateral Malleolus

Figure 1 : Photograph showing procedure of measurement of height of lateral malleolus & measured by slide calipers

Figure 2 : Photograph showing procedure of measurement of coronal width of lateral malleolus & measured by slide calipers

Figure 3: Photograph showing procedure of measurement of sagittal width of lateral malleolus & measured by slide calipers

Result:

The height of the lateral malleolus in 152 right fibulae ranged from 18.26 mm to 34.43 mm, with >86% of measurements falling between 22.50 mm and 30.00 mm. Among 148 left fibulae, the height ranged from 14.56 mm to 37.77 mm, with >83% of cases measuring between 22.50 mm and 27.50 mm.

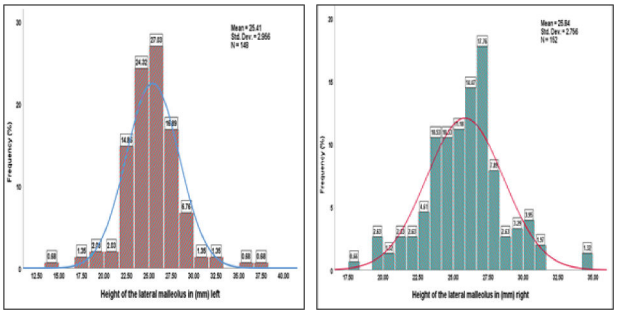

Figure 4: Histogram showing the frequency distribution of height of the lateral malleolus of both sided fibula

The coronal width of the lateral malleolus in 152 right fibulae ranged from 12.38 mm to 20.91 mm, with >82% of measurements falling between 15.00 mm and 19.00 mm. Among 148 left fibulae, the coronal width ranged from 13.54 mm to 20.76 mm, with >84% of cases measuring between 15.00 mm and 19.00 mm. .

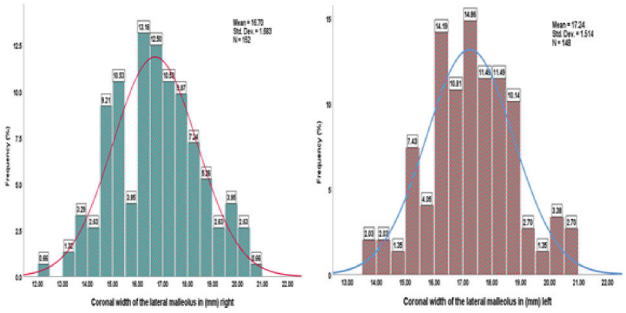

Figure 5: Histogram showing the frequency distribution of coronal width of lateral malleolus of both sided fibula

The sagittal width of the lateral malleolus in 152 right fibulae ranged from 16.42 mm to 27.79 mm, with >85% of measurements falling between 20.00 mm and 25.00 mm. Among 148 left fibulae, the sagittal width ranged from 18.44 mm to 28.87 mm, with >83% of cases measuring between 21.00 mm and 26.00 mm.

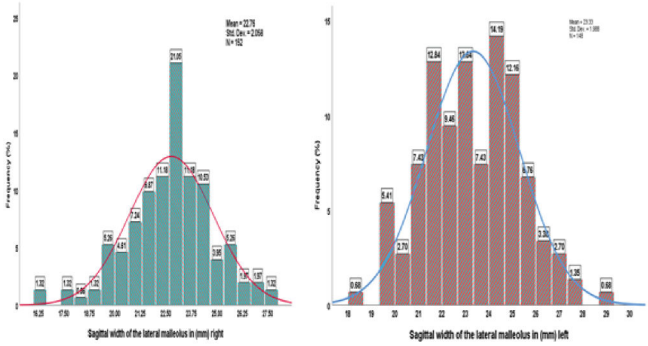

Figure 6: Histogram showing the frequency distribution of sagittal width of lateral malleolus of both sided fibula

Discussion

In the present study, the mean (±SD) height of the lateral malleolus measured 25.84±2.76 mm on the right side and 25.41±2.96 mm on the left side. These values were higher than those reported by Raza et al. (23.7±2.2 mm on right; 19.25±1.528 mm on left)[4] and Shishirkumar et al. (18.93±2.093 mm on right; 19.25±1.528 mm on left).[5] For coronal width measurements, our study found means of 16.70±1.68 mm (right) and 17.24±1.51 mm (left). These results were comparable to Raza et al. (18.0±2.3 mm on right; 16.9±1.6 mm on left).[4] Regarding sagittal width, we recorded means of 22.76±2.06 mm (right) and 23.33±1.99 mm (left). These findings were similar to Raza et al. (23.5±1.5 mm on right; 22.9±1.2 mm on left)[4] but higher than Shishirkumar et al. (20.07±1.9 mm on right; 19.94±1.181 mm on left).[5]

Conclusion

This study yields novel osteometric data on the lateral malleolus, precisely quantifying its contour, length, and width—addressing gaps in existing literature through a robust sample (N=300) that surpasses prior studies in both

scope and detail. These findings hold direct clinical value for improving pre-contoured plating systems by enabling anatomically accurate curvature designs, optimized screw trajectories, and region-specific thickness variations, thereby reducing intraoperative plate bending and improving fit. Furthermore, the dimensional parameters establish objective benchmarks for assessing fracture reduction quality and detecting malunions, while correlations between contralateral limbs suggest potential for mirroring technology in unilateral fracture repair. By bridging anatomical precision with orthopedic engineering, this work lays the foundation for next-generation implants that may decrease operative time, minimize implant-related complications, and reduce revision rates—ultimately advancing personalized fracture fixation through evidence-based design.

Reference

1. Drake et al. Gray's Anatomy for Students. 4th edn, Elsevier, London. (2020);531, 542, 623, 634.

2. Bhadkariya A, et al. Study of Lower End of Fibula and Its Clinical Significance. Annals of International Medical and Dental Research. (2021);7:420-426.

3. Lingamdenne PE. Evaluation of osteometric parameters of fibula and talar facet morphometry in Telangana region. (2019); 2118-2394.

4. Raza HKT, et al. Anthropometry of Lateral Malleolus. International Journal of Recent Scientific Research. (2015);6:4821-4826.

5. Shishirkumar et al. Morphometric Study of the Articular Surfaces of Bones Forming the Tibio-fibular Mortise in South Indian Population. Journal of Evidence Based Medicine and Healthcare. (2014);1:190-197.