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Anatomy

MORPHOLOGICAL STUDY AND PREVALENCE OF THE SUPRATROCHLEAR FORAMEN OF THE HUMERUS IN THE GWALIOR REGION POPULATION

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ABSTRACT The supratrochlear foramen (STF) of the humerus is an anatomical variation of considerable clinical significance because of its association with low-impact distal humeral fractures and a narrowed medullary canal. Previous studies have demonstrated variations in the prevalence of STF among different ethnic populations as well as within the same ethnic groups. Regional differences in STF occurrence have also been reported across various parts of India. However, limited data are available regarding its prevalence and morphological characteristics in the Gwalior region, despite the presence of diverse indigenous populations.The present study was conducted on dry humeri obtained from the Department of Anatomy, G.R. Medical College, Gwalior, Madhya Pradesh. A total of 67 dried humeri were examined, comprising 31 right-sided and 36 left-sided bones. The supratrochlear foramen was observed in 20 specimens, yielding an overall prevalence of 29.79%. The prevalence was marginally higher on the left side (30.55%) than on the right side (29.03%). Morphological assessment revealed various shapes of STF, including round, oval, triangular, and irregular forms.The findings contribute to the existing knowledge of regional anatomical variations in STF and may be useful for anatomists, anthropologists, radiologists, and orthopedic surgeons, particularly during radiological interpretation and procedures such as intramedullary nailing.

KEYWORDS : Humerus, Supratrochlear Foramen (STF), Morphometry; Intramedullary Nailing, Anatomical Variation.

INTRODUCTION

The supratrochlear foramen (STF) is a relatively common yet often overlooked anatomical variation found at the distal end of the human humerus. It is characterized by a perforation in the thin bony septum that separates the coronoid fossa anteriorly from the olecranon fossa posteriorly.[1] Owing to its location between the medial and lateral condyles of the humerus, it is also referred to as the intercondylar or septal foramen. Anatomically, the STF is situated above the epiphyseal line within the intra-articular region of the olecranon fossa and lies below the reflection of the synovial membrane crossing the middle of the fossa.[2]

The STF was first described by Meckel in 1825, as cited by Kate and Dubey.[3] Hirsh (1927) reported that the bony septum separating the olecranon and coronoid fossae is consistently present until approximately seven years of age. Thereafter, resorption of this septum may occur, resulting in the formation of the supratrochlear foramen.[2] Although the exact mechanism underlying its development remains uncertain, the STF has attracted considerable interest because of its anthropological, anatomical, and clinical significance.

The prevalence of STF varies widely among different ethnic and racial populations, with several studies reporting a relatively higher incidence among Indian populations. The occurrence of STF has also been shown to exhibit regional variations within India. Such differences may reflect genetic, developmental, and environmental influences on skeletal morphology.

From a clinical perspective, the presence of STF is associated with a narrower and shorter medullary canal of the humerus compared with bones lacking the foramen.[4] This anatomical variation assumes particular importance in orthopedic practice, as intramedullary fixation techniques are increasingly employed in the management of traumatic and pathological fractures of the humerus.[5] A narrow medullary canal may influence the selection of implants and surgical approaches during intramedullary nailing procedures. Furthermore, the radiolucent appearance of the STF on radiographs may be misinterpreted as an osteolytic lesion, cystic defect, or other pathological condition, thereby leading to diagnostic errors.[6]

Morphologically, the STF exhibits considerable variation in shape and may appear as oval, round, triangular, sieve-like, or irregular. Previous studies have also reported an association between bilateral STF and increased elbow hyperextension in children.[16] Given its anatomical variability and clinical relevance, detailed knowledge of the incidence and morphological characteristics of STF is essential for anatomists, anthropologists, radiologists, and orthopedic surgeons.

Therefore, the present study was undertaken to determine the prevalence, morphological variations, and clinical significance of the supratrochlear foramen in dry human humeri from the Gwalior region. The findings are expected to contribute to the existing anatomical database and provide useful information for clinical and surgical practice.

MATERIALS AND METHODS

The present osteological study was conducted on 67 dried adult human humeri obtained from the Departments of Anatomy and Forensic Medicine & Toxicology, G.R. Medical College, Gwalior, Madhya Pradesh. The study sample comprised 31 right-sided and 36 left-sided humeri. Only bones with intact anatomical features and without any apparent pathological changes or deformities were included in the study.

Each humerus was carefully examined for the presence of the supratrochlear foramen and associated morphometric parameters. Prior to measurement, the bones were labeled and side determined. For standardization, each humerus was placed on a flat surface covered with graph paper, with the posterior aspect of the shaft resting on the board. Morphometric measurements were obtained using a digital Vernier caliper with an accuracy of 0.01 mm. All measurements were recorded following a standardized protocol. To minimize measurement errors and ensure reliability, the observations were independently repeated by different investigators. The repeated measurements were compared to assess both intra-observer and inter-observer reliability.

The collected data were recorded systematically and analyzed to determine the prevalence and morphological characteristics of the supratrochlear foramen.

RESULTS

Side	Sample size	Prevalence of STF	Percentage
Right	31	09	29.03
left	36	11	30.55
Total	67	20	29.79

A total of 67 dried human humeri were examined in the present study, comprising 31 right-sided and 36 left-sided bones. The supratrochlear

foramen (STF) was observed in 20 specimens, yielding an overall prevalence of 29.79%.

Side-wise analysis revealed the presence of STF in 9 of the 31 right humeri (29.03%) and 11 of the 36 left humeri (30.55%). Thus, a slightly higher prevalence was observed on the left side compared to the right side.

Morphological examination demonstrated variations in the shape of the supratrochlear foramen. The observed forms included round, oval, triangular, and irregular types. The distribution of these morphological variants is presented in the corresponding tables and figures.

Shape	Right humerus (9)	left humerus (11)	Total (20)
Oval	3	4	7
Round	1	4	5
Irregular	4	2	6
Triangle	1	1	2

Figure 1. Supratrochlear foramen in a left humerus.

Figure 2. Supratrochlear foramen in a right humerus.

DISCUSSION

In our study, the prevalence of STF was found to be 29.79 %, and studies on STF in the Indian population have reported a varying prevalence from 16.3% to 40.78%.

Comparison of STF of present study with other Indian and foreign studies.

S.NO.	Authers	Year	Geographical area	Prevalence of STF (%)
01	Benfer & Mc kern[12]	1966	Americans	6.9
02	Orztuk et al [13]	2000	Egyptians	7.9
03	Akabori1[4]	1934	Japanese	18.1
04	Ndou et al [16]	2012	South Africans	32.5
05	Diwan et al[7]	2013	Luchnow, Uttar Pradesh	24.10
06	Deshmukh et al[8]	2018	Karaikal, Puducherry.	16.3
07	Mayuri et al[9]	2013	Mumbai, Maharashtra.	40.78
08	Meiraba Singh Laishram et al[10]	2023	North-east Manipur	28.57
09	Arunkumar K R[11]	2015	Tamil Nadu	21.4
10	Present study	2026	Gwalior Madhya Pradesh	29.79

The present study revealed a prevalence of 29.79% for the supratrochlear foramen (STF) in dry human humeri from the Gwalior region. This prevalence is higher than that reported in American, Egyptian, Japanese, and several Indian populations, but lower than the findings reported from Mumbai. The results are comparable to studies conducted in North-East Manipur and South African populations, indicating regional and ethnic variations in the occurrence of STF.

The relatively high prevalence observed in the present study suggests that STF is a common anatomical variation in the Gwalior population. Clinically, its presence is associated with a narrower medullary canal, which may influence intramedullary fixation procedures and radiological interpretation. Therefore, awareness of STF and its morphological variations is important for anatomists, radiologists, and orthopedic surgeons.

CONCLUSION

The present study revealed a prevalence of 29.79% of the supratrochlear foramen (STF) in dry human humeri from the Gwalior region, indicating that STF is a relatively common anatomical variation in this population. The observed prevalence is comparable to that reported in other Indian and international studies, highlighting regional and ethnic differences in its occurrence.

Knowledge of STF is of clinical importance due to its association with a narrow medullary canal and its potential impact on orthopedic procedures, particularly intramedullary fixation. Furthermore, awareness of this anatomical variation can aid radiologists in avoiding misinterpretation of STF as a pathological radiolucent lesion. The findings of the present study contribute to the existing anatomical database and may be useful in clinical and surgical practice.

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