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Original Research Article

A morphometric study of supratrochlear foramen of humerus in a medical institute in North-East India

Meiraba Singh Laishram*, Purnabati Soraisam, Jaishree Devi Aribam, Bidyalaxmi Devi Thokchom, Momota Wahengbam

Department of Anatomy, Regional Institute of Medical sciences, Imphal, Manipur, India

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***Correspondence:**
Dr. Meiraba Singh Laishram,
E-mail: laishrammeirabasingh@gmail.com

ABSTRACT

Background: The clinical importance of the supratrochlear foramen (STF) of the humerus, an anatomical variation, has been recognised because of its association with low-impact fractures of the distal end and narrow medullary canal of the humerus. According to the literature, STF prevalence varies between ethnic groups and even between individuals of the same ethnic group. Many studies in India also reflect variations in the prevalence of STF in different regions. However, the study of STF is still a rarity in northeast India, where different indigenous peoples are living.
Methods: A descriptive cross-sectional study of dry humerus bones was conducted a medical institute in Manipur. The presence of STF, its shape, maximum dimensions (transverse and vertical), and distances from the medial and lateral epicondyles were observed.
Results: STF was present in 28.57% of bones, of which 53.85% were observed in the left humerus and 46.15% in the right humerus. STF was found in different shapes, including oval (46.15%), round (19.23%), irregular (19.23%), and triangular (15.38%). The 66.67% of the STF were situated more medially in the right humerus, while 78.57% of the STF were also located more medially in the left humerus.
Conclusions: The study of STF showed a prevalence of 28.57%. The oval-shaped foramen was the most common. The majority of the STF was placed more medially in both the right and left humeri.

Keywords: Humerus, STF, Prevalence, Morphometry, North-east India

INTRODUCTION

The supratrochlear foramen (STF) of the humerus is the opening that results from the perforation of the septum separating the coronoid and olecranon fossae.[1] The septum, also called the supratrochlear septum, is a thin plate of compact bone that is lined by a synovial membrane.[2] STF is also known by various names, such as supratrochlear aperture, septal aperture, intercondylar foramen, epitrochlear foramen, or olecranon foramen.[2,3] The STF in the humerus is not only found in humans but has also been reported in other mammals.[4] STF appears to be more common in females and on the left humerus in human populations, but it can differ greatly between ethnic groups and even between individuals of the same ethnic group.[4,5] STF, if present, usually appears after the age of 7 years.[5,6] Its development in adolescence or, more frequently, in adulthood is due to incomplete ossification, interlamellar space enlargement, and gradual septum absorption.[7]

This anatomical structure is often neglected in many standard textbooks of anatomy and orthopaedics.[5] However, the clinical relevance of STF has been felt by various researchers. It is believed that STF probably acts as a risk factor for atypical fractures in the humerus

following a low-energy impact.[8] This anomaly can be confused with osteolytic and cystic lesions on radiographs.[9-11] Radiologists and orthopaedic surgeons need to be aware of STF for correct X-ray interpretation.[8] Moreover, a narrower medullary canal has also been linked to STF, highlighting the need for identifying STF and assessing the medullary canal when choosing the nailing approach and nail size for the management of a humerus fracture.[3,12] Literature shows that the prevalence of STF varies from 0.3% to almost 60% worldwide.[7] Various shapes of STF are evident.[1,2,13] Various studies in different parts of India also reflect variations in the prevalence and shapes of STF. The prevalence varies from 24.1% to 30% in north Indian studies.[13,14] In south Indian studies the prevalence varies from 16.3% to 32%.[15,16] The prevalence of STF in western Indian studies varies from 35.88% to 40.78%.[17,18] In eastern Indians, the prevalence is reported to be 27.4%.[19] The study of STF is still a rarity in the eastern part of India. Considering this aspect and the clinical importance of STF, the present work was undertaken to describe the prevalence and morphometry of STF for the first time in the state of Manipur, a state in north-east India.

METHODS

A descriptive cross-sectional study of dry humerus bones was conducted in the department of anatomy, regional institute of medical sciences (RIMS), Imphal, Manipur. The study was done during the period from February, 2022 to July, 2022. Ninety-one intact, dried human humerus bones of unknown age, sex, and race were included in the study. The presence of the STF, its shape, maximum dimensions (transverse and vertical), and the distance from the medial and lateral epicondyles were recorded in a predesigned form. The maximum transverse dimension was measured from the most lateral margin of the foramen to its most medial margin. The distance between the most proximal and most distal margins of the foramen was taken as the maximum vertical dimension. The distance from the medial epicondyle was represented by the measurement from the tip of the medial epicondyle to the nearest margin of the STF. Similarly, the distance from the lateral epicondyle was given by the measurement from the tip of the lateral epicondyle to the nearest margin of the STF. All the dimensions were measured with a sliding calliper graduated to a minimum scale of 0.01 mm. The collected data were checked for accuracy and analysed using IBM SPSS version 25. Descriptive statistics like percentage, mean, and standard deviation were used to summarise the result.

RESULTS

Out of 91 dried humerus bones studied, the right humerus constituted 55.55% and the left humerus 46.15%. Twenty-six bones (28.57%) showed the presence of STF, of which 53.85% were observed in the left humerus and 46.15% in the right humerus (Table 1). Different shapes of the STF were noticed. 46.15 percent of the foramina were oval-shaped. Round and irregular shapes made up 19.23% of each, while the triangular shape was observed in 15.38% of the STF (Table 2 and Figure 1).

Figure 1 (A-D): Oval, round, irregular and triangular shapes of supra trochlear foramen of humerus.

Table 1: Prevalence of humerus and STF.

Variables	Number humerus (%)	Number of STF (%)
Right	46 (50.55)	12 (46.15)
Left	45 (49.45)	14 (53.85)
Total	91	26 (28.57)

Table 2: Shape of supratrochlear foramen, (n=26).

Shape	Right humerus	Left humerus	Total (% of total STF)
Oval	7	5	12 (46.15)
Round	2	3	5 (19.23)
Irregular	2	3	5 (19.23)
Triangular	1	3	4 (15.38)

Table 3: Measurement of vertical and transverse dimensions of STF.

STF	Vertical dimension (mm)	Transverse dimension (mm)
Right humeri	4.1±1.88	5.6±2.67
Left humeri	5.4±2.44	6.1±2.61

Note: Values are expressed in mean ± standard deviation (SD).

Table 4: Distances of STF from the medial and lateral epicondyles**.**

STF	Distance of STF from medial epicondyle (mm)	Distance of STF from lateral epicondyle (mm)
Right humerus	24.94±2.86	25.41±2.57
Left humerus	24.24±3.02	25.84±3.71

Values are in mean ± standard deviation. Distance of STF from medial epicondyle=measurement from tip of medial epicondyle to nearest margin of the STF; Distance of STF from lateral epicondyle=measurement from tip of lateral epicondyle to nearest margin of the STF.

Table 5: Ratio of distance of STF from medial epicondyle (DM) to distance from lateral epicondyle (DL).

DM:DL	STF in left humeri, (n=14)		STF in right humeri, (n=12)	
	N	%	N	%
<1	11	78.57	8	66.67
=1	0	0	1	8.33
>1	3	21.43	3	25.00

Note: (<1)-more medial, (=1)-equidistant, (>1)-more lateral.

The maximum vertical and transverse dimensions (mean ± SD) were 4.1±1.88 mm and 5.6± 2.67 mm in the right humerus, and 5.4±2.44 mm and 6.1±2.61 mm in the left humerus, respectively (Table 3). The distance (mean ± SD) of the foramina from the medial and lateral epicondyles measured 24.94±2.86 mm and 25.41±2.57 mm in the right humerus, and 24.24±3.02 mm and 25.84±3.71 mm in the left humerus, respectively (Table 4). In the right humerus, 66.67% of the STF were placed more medially, and 8.33% were equidistant from the epicondyles. In the left humerus, 78.57% of the STF were present more medially (Table 5).

Table 6: Prevalence of STF from some studies in India.

Study	Region/place	Percentages of STF
Diwan et al[13]	North India	24.10
Dang et al[14]	North India	30
Deshmukh et al[15]	South India	16.3
Mallikarjun et al[16]	South India	32
Joshi et al[17]	Western India	35.88
Mayuri et al[18]	Western India	40.78
Chatterjee[19]	Eastern India	27.4
Present study	North-east India	28.57

DISCUSSION

In our study, the prevalence of STF was found to be 28.57%, and studies on STF in the Indian population have reported a varying prevalence from 16.3% to 40.78% (Table 6). The observation is in agreement with the previous study report on eastern Indians.[19] The higher proportion of STF in the left humerus in our study is also consistent with reports from many previous studies in India.[13,15,17,21,22] However, the observation differs from the report of Naik et al., in which the percentage of STF is higher in the right humerus.[10] In a study in South India, almost equal percentages of STF were reported on both humeri.[23] Some study reports from outside India also show STF to be more common in the left humerus.[1-3,7] In a meta-analysis study of the olecranon aperture of the humerus, Pires et al. observed a preponderance of STF in the left humerus.[24]

The STF in the present study exhibited different shapes, which included oval, round, irregular, and triangular. The oval shape was observed in the highest percentage, and the triangular shape was the least common. Similar observations were reported in some studies in India.[5,10,13,25,28] Many studies in different regions also observed the oval shape to be the most common shape.[2,6,7,20,24] However, in a few studies the round shape outnumbered the oval shape.[14,15,26]

The observed means of the maximum vertical dimensions of the STF in the right and left humeri in this study appeared to differ from the observations of other researchers.[5,7,24] This could have been due to differences in measurement points in the STF and different sample size. In our study, we calculated the ratios of the

distances of STF from the medial and lateral epicodyles for both the right and left humeri. The majority of the STF was located nearer to the medial epicondyle, which is in agreement with the observations of some workers.[2,27] STF is a well-known anatomical variation among anatomists and anthropologists. However, the formation of STF has been widely discussed, and so far, researchers have been unable to give any plausible explanation for the formation.[20]

Our study is limited to the samples available only in the department of anatomy of one medical institute in Manipur. Manipur is a state in India inhabited by different ethnic groups. Therefore, the results of this study may not be generalisable to the entirety of the state and its different ethnic groups. More research on STFs and their associations with sex, age, and ancestry will be more interesting.

CONCLUSION

The study of the STF in the north-eastern part of India is still a rarity. The present study sheds light on the prevalence of STF in Manipur, a state in northeast India. Most of the studies of STF in different parts of the world are conducted on dry bones, and the prevalence rates vary in different regions and in different individuals. Acknowledging the variations in the prevalence rate of STF and its association with low-impact fractures of the distal end and narrow medullary canal of the humerus, it will be worth studying a wider population of living individuals using radiologic imaging techniques to enrich clinicians' understanding of STF, especially orthopaedic surgeons.

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