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THE SUPRATROCHLEAR FORAMEN OF THE HUMERUS: FORMATION AND CLINICAL IMPLICATIONS

Anatomy

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ABSTRACT

Introduction: The supratrochlear foramen (STF) occurs to be a neglected variation in the lower end of the humerus. Generally, this foramen is absent until the age of seven years and later on, it appears in some individuals. The formation of foramen is more on the left side. Various theories have been proposed to signify the formation. Sometimes, this foramen may be misdiagnosed as an osteolytic lesion, as it appears as a translucent area above the trochlea. The prevalence of STF may vary from among the different racial communities.

Aim: To study the prevalence of STF and morphometric measurements in relation to size and distances from the epicondyles.

Material and Methods: The dry adult humeri were collected from the Department of Anatomy, JIPMER, Karaikal. All the bones were identified for the presence of STF and translucent or opaque septum. All the bones were photographed from the same distance with the micrometre scale in it. Morphometric measurements (vertical and transverse diameter) for the STF and the distance of STF from the medial as well as lateral epicondyle were calculated using ImageJ analysis software and presented in tabulated form.

Results: Total 122 bones were included in the study. Out of those 20 bones (14{L}>6{R}) showed the presence of STF. In the present study, the prevalence of STF was 16.3%. After identification, shapes of the STF were noted to categorize them accordingly. The percentage of Round STF is more as compared to oval, reniform or rectangular. The transverse and the vertical diameter on the left side were 6.7±2.3mm and 4.3±1.7 and on the right side, it was 5.3±2.7 and 4.2±3.1mm respectively. The mean distance of the right STF from the medial and lateral epicondyle was 24.1±2.mm and 23.7±2.4mm and for the left side 16.9±5.5mm and 24.3±2.2mm respectively

Conclusion: Knowledge regarding the STF is very much promising for the orthopaedic surgeons while performing intramedullary-nailing for humerus and also for the radiologist as one of the differential diagnosis for some osteolytic lesions in that area. Finally, the prevalence may differ in different communities, hence can be considered as an important indicator of racial differentiation. As the STF is more dominantly found in the lower animals, it may act an evolutionary connecting link between the humans and lower animals.

KEYWORDS

Humerus, Supratrochlear foramen, Anthropology, Surgery

Introduction:-

The supratrochlear foramen (STF) is a relatively common but neglected anatomical variation in the lower end of the humerus in humans. The supratrochlear foramen is a perforation present in the thin plate of bone, which separates the coronoid fossa anteriorly, and olecranon fossa posteriorly at the lower end of the humerus. (1) This thin plate of bone between the olecranon and coronoid fossa is always present until the age of 7 years, thereafter in some individuals, this bony septum undergoes degeneration to form STF.(2) This is also called as an intercondylar foramen or epitrochlear foramen. Meckel first described Supratrochlear foramen in 1825. STF incidence varies from 4.2% to 58% in different racial communities. (3)

STF may have the different shape like oval, round, triangular, sieve-like and irregular. An increase in hyperextension at the elbow was found in association with a bilateral STF in children. The distal portion of the medullary canal in humerus with STF was much narrower and shorter than in humerus without STF.(4) The knowledge regarding STF is beneficial for surgeons during intramedullary fixation. The presence of STF appears radiolucent in X- rays and it may be mistaken as cyst or osteolytic lesions hence knowledge about STF is helpful for radiologists and also helpful to anthropologists to establish relationship between man and lower animals. (5)

Material Methods:

The present study was performed to identify the prevalence of the supratrochlear foramen of the humerus in south Indian population. The dry adult humeri (total: 122) of unknown sex were collected from the Department of Anatomy, JIPMER, Karaikal, Puducherry. The bones were identified for any pathological lesions or any mark of fracture, were discarded from the study. All the photographs were taken from the fixed distance with the micrometer scale. The presence of supratrochlear foramen was identified. Various shapes of the STF were noted and transverse and vertical diameter of the foramen was calculated. Also, the distance of the STF from the medial and lateral epicondyle was measured. Some bones where the foramen was not present, were identified for the presence of translucent or opaque septum by translucency test

All the measurements were done by using the NIH ImageJ analysis software (https://imagej.nih.gov/ij/) and the data was presented in the tabulated manner

Results:

Out of 122 bones studied for the presence of STF, only 20 bones showed the presence of foramen (16.3%). The prevalence of STF was more on the left side (70%) as compared to the right side (30%) (Table 1). In bones where the foramen was absent, there was translucent septum (63.93%) to opaque variety (19.67%) of the septum (Table 2/Figure 1).

The STF was further categorized according to the shape with more prevalence of round (50%), followed by an oval (45%) and reniform to irregular (5%) (Table 3/ Figure 2).

After identification of STF, the mean vertical and the horizontal diameter were measured. The mean vertical and transverse diameter on the right side (4.2±3.1mm and 5.3±2.7mm) and left side (4.3±1.7mm and 6.7±2.3mm) respectively. Differences between the diameters of the right and left side were not statistically significant. (Table 4/ Figure 3)

The mean distance of the STF from the medial epicondyle for the right (24.1±2.2mm) and left side (16.9±5.5mm) and from the lateral epicondyle for the right side (23.7±2.4mm) and left side (24.3±2.2mm) respectively. (Table 5/Figure 3)

Table 1: Prevalence of Supratrochlear foramen

Right side		Left side		Total (122 bones)	
Number	Percentage	Number	Percentage	Number	Percentage
6	30%	14	70%	20	16.3%

Table 2: Frequency of STF and translucent and opaque septum

Variables	Right side		Left side		Total	
	Number	%	Number	%	Number	%
Foramen	06	11.11	14	20.58	20	16.30
Translucent septum	35	64.91	43	63.23	78	63.93
Opaque septum	13	24.07	11	16.17	24	19.67
Total	54	100	68	100	122	100

Table 3: Different shapes of supratrochlear foramen

Variables	Number		Total
	Right	Left	
Round	1	9	10
Oval	4	5	9
Irregular/Reniform shape	1	-	1

Table 4: Showing mean and standard deviation of vertical and transverse diameter of STF

Side	Vertical diameter (mm)	Transverse diameter (mm)
Right	4.2 ± 3.1mm	5.3±2.7
Left	4.3±1.7mm	6.7±2.3

Table 5: Showing mean and standard deviation of distance between medial and lateral margin of STF to medial and lateral epicondyles

Side	Distance between medial margin of STF to medial epicondyle (mm)	Distance between lateral margin of STF to lateral epicondyle (mm)
Right	24.1 ±2.2	23.7± 2.4
Left	16.9 ±5.5	24.3± 2.2

Discussion:

The supratrochlear foramen is defined by its location on the upper aspect of the trochlea, in the lower end of the humerus. The lower end represents the fossae for the articulation of the olecranon and the coronoid process of the ulna and the head of the radius, which were termed as olecranon, coronoid, and the radial fossae. A compact bony septum is present between the olecranon and the coronoid fossa. The septum may range from the opaque variety to translucent one. Sometimes. This septum regresses to form foramen termed as supratrochlear foramen (STF), epitrochlear foramen or supratrochlear aperture. (6)

Most of the times, foramens were meant for the passage of the neurovascular structures but in the present STF, no neurovascular structure will pass through it. Indeed, Roaf et al had reported a case where the median nerve was passing through the STF, causing pain and weakness in the hand. (7)

STF is more common finding and a prominent structure in the lower animals such as cats. In the lower animals, the foramen forms the safe passage for the median nerve and the brachial artery. Darwin considered this foramen as one of the characteristic features that showed the close relationship between humans with lower animals. (8)

Various theories have been proposed in the generation of the STF in the lower end of the humerus. According to some authors, the formation is due to the atrophy of the bone after ossification. (9) Anthropologist suggested rather argued that the incidence of the STF is more in the ancient population as compared to the modern world. The suggested cause in the ancestral population was that they used to perform heavy load work such as agriculture and lifting of heavy tools. The intermittent pressure of the two processes of the ulna may gradually result in the absorption of the septum between them and lead to the formation of the foramen. (10)

Many researchers contradicted the view suggesting that if the mechanical stress was the causative agent in the formation of the foramen, then it would be more common in the right side but after reviewing all the cases and reports, the incidence is more on the left-sided humerus. Thus STF can be considered as a phylogenetic and atavistic feature, since it is suppressed by the stronger and dominant limb and exhibited in the weaker limb. (11)

Another report suggested that the pressure from the olecranon process may acts as a strengthen factor but in the later life due to the insufficient blood flow to the area followed by the degeneration and finally foramen formation. Few studies mentioned that the foramen was not present in the embryonic life, but appears after 7 years of postnatal life due to vascular insufficiency. Some genes such as Homeobox- genes were linked to the formation of STF but yet to be proved. As this foramen is appearing after 7 years of age, these genes have been suggested possibility and their role in postnatal life in the formation of STF. (12)

In the present study, the percentage of STF was found to be 16.3%. Previous studies on the Indian population have the varying incidences from 19.2% to 34.4%. (3)The incidence for the STF varies in different racial communities such as 57% in Libyans, 47% in Africans, 18.1 % in Japanese and the lowest prevalence is found in Greeks (0.304%), hence can be used as an important tool for racial differentiation. (13, 14,15,16) The incidence is more on the left side as compared to the other authors. Various shapes of the STF were identified and the maximum diameters for the STF (vertical and transverse) were calculated. The distance of STF from both epicondyles was measured and calculated. Knowledge of such distances was very much of use while planning for the surgeries related to the fractures of some nailing procedures and sometimes the radiologists to reduce the errors in diagnosing.

Supracondylar fractures account for 17% of all the injuries in the pediatric age group. (2) Initially, conservative management will treat the fracture, but in complicated situations, the only treatment of choice is intramedullary nailing for alignment of the bone. If the STF is present, the medullary diameter in the lower aspect of the humerus was found to be decreased. In those particular cases, antegrade intramedullary nailing fixation should be considered.

The location of STF and it's relatively radiolucent appearance during the radiological procedures could be mistaken for osteolytic or the cystic lesion of the bone. A case of osteochondritis dissecans, a necrotic lesion of bone, involving the supratrochlear septum, has been mentioned in the literature. (15)

Sometimes, the presence of STF may be associated with the other anatomical variation of the lower end of humerus such as supracondylar process or ligament of Struthers, which could cause the compression of the neurovascular structures. (17)

Conclusion:

The STF is very much neglected entity form the clinician's side. The STF forms the important connecting link between the lower animals and humans. The presence of STF can sometimes leads to the change in approach during intramedullary nailing procedures. The STF may be misdiagnosed with the osteolytic lesions, due to its translucent appearance. Knowledge regarding the presence of STF is necessary anthropologist, surgeons and radiologist for the proper diagnosis and for choosing proper modality and approach for the treatment

Figure 1: Presence of Supratrochlear foramen (A) and the translucent septum (B) in the lower end of the humerus

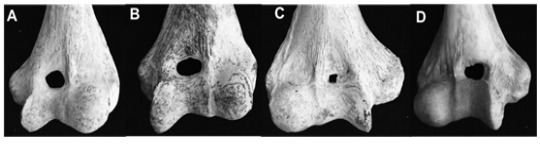

Figure 2: Photograph representing various shapes of the supratrochlear foramen (A-Round, B-Oval, C-Irregular, D-Reniform)

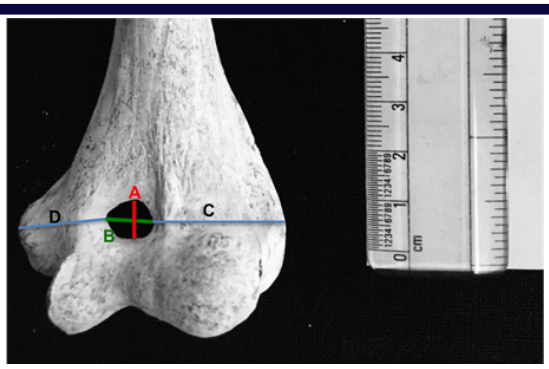

Figure 3: Photograph representing the various measurements in relation to the supratrochlear foramen in the lower end of humerus (A-Vertical Diameter of STF, B-Horizontal diameter of STF, C- Distance between the lateral edge of STF and lateral epicondyle, D-Distance between the medial edge of STF and medial epicondyle)

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