

MORPHOLOGICAL STUDY OF SUPRATROCHLEAR FORAMEN OF HUMERUS AND ITS CLINICAL IMPLICATIONS

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ABSTRACT

Background: The supratrochlear foramen (STF), alternatively termed septal aperture of humerus is a deficit of the bony septum in the distal end of humerus that separates the coronoid fossa from the olecranon fossa. The study is focused on the STF owing to its significance in the preoperative planning of supracondylar fractures of humerus. The humerus with STF has narrow medullary canal so ante grade route is advised for nailing supracondylar fractures in humerus with STF.

Materials: This study was conducted on 355 dry human humeri belonging to south Indian race. **Results:** The supratrochlear foramen was present in 76 bones (21.4%). The incidence of STF was more on the left side (23.3%) than the right side (19.6%). The transverse and vertical diameters of STF were measured using digital Vernier caliper. The mean transverse diameter on right side was 5.67 ± 1.71 mm and 5.39 ± 1.57 mm on left side. The mean vertical diameter was 3.9 ± 1.32 mm on right side and 3.84 ± 1.20 mm on left side. Various shapes of STF were noted among which oval shape was maximum. The translucent septum was frequently found more on the right side (56.3%).

Conclusions: The STF may be mistakenly interpreted as a cyst or tumors in X rays. Besides its anthropological interest, the knowledge of STF will be helpful for orthopedic surgeons and radiologists.

KEY WORDS: Humerus, Supratrochlear foramen, intramedullary nailing, septal aperture.

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INTRODUCTION

The olecranon and coronoid fossa at the distal end of humerus are usually separated by a thin bony septum lined by synovial membrane in life. In some individuals this bony septum may become perforated to form an opening called supratrochlear foramen (STF) or septal aperture

of humerus [1]. Since it is situated between the two condyles of foramen it is also termed as intercondyloid foramen. It is located above the epiphyseal line and is in the intra-articular part of the olecranon fossa below the line of reflection of the synovial membrane which crosses the middle of the fossa [2]. The STF was

first described by Meckel in 1825 as cited by Kate and Dubey [3]. Hirsh (1927) described that the thin plate of bone between olecranon and coronoid fossa is always present until the age of seven years, after which the bony septum occasionally becomes absorbed to form STF [2]. The incidence of STF varies in different races and review of literature showed increased incidence in Indian population. The bones with STF have shorter medullary canal and width of the medullary canal in the humeri with STF is narrower than in humeri without it [4]. Since there has been an increase in intramedullary fixation of humerus following traumatic injuries and pathological fractures [5], the anatomical knowledge of presence of variations like STF in the distal end of humerus gains importance. The presence of STF may also result in erroneous interpretation of radiographs [6]. Hence the present study focuses on the incidence, morphological features and clinical significance of STF which might be helpful for anthropologists, orthopedic surgeons and radiologists.

MATERIALS AND METHODS

A total of 355 (right side – 188 and left side – 167) dry human humeri of unknown sex belonging to south Indian race from the Department of Anatomy of Government Dharmapuri Medical college, Dharmapuri and Dhanalakshmi Srinivasan medical college and hospital, Perambalur were included in the study. The bones with pathological changes were excluded from the study. The presence of supratrochlear foramen was noted, its shape (oval, round or triangular) was observed. The transverse and vertical diameters of STF were measured using digital Vernier caliper. In bones where STF was not present, the translucency of septum between coronoid and radial fossae was observed by placing the lower end of humerus against X ray lobby.

RESULTS

In the total 355 humeri, 76 bones (21.4%) showed the presence of supratrochlear foramen of which 37 bones (19.6%) was of right side and 39 bones (23.3%) belong to left side. The incidence of supratrochlear foramen was more on the left side than the right side (Table 1).

The mean transverse diameter on right side was 5.67 ± 1.71 mm and 5.39 ± 1.57 mm on left side. The mean vertical diameter was 3.90 ± 1.32 on right side and 3.84 ± 1.20 mm on left side (Table 2). The side differences of the diameters were not statistically significant. The majority of supratrochlear foramina were round in shape (71 bones). The STF was round in 2 bones and triangular in 3 bones (Table 3). The STF was absent in 279 humeri (78.6%) among which 182 humeri (51.26%) showed the translucency of septum. The translucency of septum was observed on 106 right humeri (56.3%) and 76 left humeri (45.5%) (Table 5).

Fig. 1: Supratrochlear foramen of humerus (STF)



AB – Measurement of maximum transverse diameter of STF

CD – Measurement of maximum vertical diameter of STF

Table 1: Presence of supratrochlear foramen (STF) in humerus irrespective of sex and age.

Serial No	Side of humeri	Total No. of Humeri	Presence of STF	Percentage
1	Right	188	37	19.6
2	Left	167	39	23.3

Table 2: Different measurements in supratrochlear foramen.

	Right side		Left side		P value
	Mean (mm)	S.D	Mean (mm)	S.D	
Transverse diameter	5.67	1.71	5.39	1.57	0.47
Vertical diameter	3.9	1.32	3.84	1.2	0.83

S.D – Standard deviation

Table 3: Shape of supratrochlear foramen (STF).

Serial No	Shape of STF	No. of Humeri	Percentage
1	Oval	71	93.42
2	Round	2	2.63
3	Triangular	3	3.94

Table 4: Comparative data of supratrochlear foramen in human races.

RACES	INCIDENCE (%)
Americans(Benfer & Mc kern, 1966)	6.9
Egyptians (Orztuk et al. 2000)	7.9
Ainus (Akabori, 1934)	8.8
Japanese (Akabori,1934)	18.1
North Indians (Singh & Singh, 1972)	27.5
South Indians (Singhal & Rao, 2007)	28
Eastern Indians (Chatterjee, 1968)	27.4
Central Indians (Kate & Dubey, 1970)	32
South Africans (Nodu et al, 2012)	32.5
Present study	21.4

Table 5: Frequency of supratrochlear foramen and translucent septum.

	Right side	Left side	Grand Total
Foramen	37 (19.68%)	39 (23.3%)	76 (21.4%)
Translucent septum	106 (56.3%)	76 (45.5%)	182 (51.26%)
Opaque septum	45 (23.93%)	52 (31.13%)	97 (27.32%)
Total	188	167	355

Table 6: Comparative sidedness of supratrochlear foramen in human races.

POPULATIONS	RIGHT SIDE (%)	LEFT SIDE (%)
Eastern Indians(Chatterjee,1968)	22	35
Japanese (Akabori,1934)	25	27
South Indians (Singhal & Rao,2007)	22	30
Central Indians (Kate & Dubey,1970)	28	35
North Indians (Singh & Singh,1972)	24	31
Present study	19.6	23.3

DISCUSSION

The supratrochlear foramen is a neglected entity in both anatomy and orthopedic textbooks [7]. The knowledge of STF is important not only for its anthropological interest but for its clinical significance. Some authors opine that the presence of STF is an atavistic character because it is frequently found in primates [8]. STF has been reported in animals like dogs, horse, hyena and cattle [9]. Charles Darwin described STF in humans as one of the characteristics linking origin of man's evolution to lower animals [10]. Desmoulins [11] claimed the presence of STF as racial anomaly. The incidence of STF varies in different races (Table 4). In Indian populations the incidence is different in different regions (Table 6). In our study the STF was found in 76 bones (21.4%) which is nearer to the results of

Kumar et al [7], Diwan et al [12], Mahajan et al [13] and Patel et al [14]. But Jadhav et al [15] reported a higher incidence of STF (40.78%) in their study. STF was more common on left side than right side which coincides with the findings of Kaur et al [16].The shapes of the STF observed in our study were oval – 93.4%, round – 2.6%, triangular – 3.9% which is almost similar to those observed by Diwan et al [12]. However Jadhav et al [15] reported a sieve like appearance of STF in 3.22% of bones in their study.

The translucent septum was seen on 56.3% of right side humeri and 45.5 % of left side humeri in the present study which is almost same as the results of Sunday et al[10] (translucent septum on right side – 54.5% and on left humeri – 45.5%). Varlam [17] and Paraskevas [18] have reported the coexistence of STF and supracondylar process in humerus but no such observation was seen in our study.

There is no clear cut idea on the etiology of STF so far. Some authors claimed that the atrophy of the bone after ossification, with the impact of pressure in cases of the extension of the arm in straight – line direction results in the formation of STF [19]. Some researchers assumed that STF occurs as a result of incomplete ossification [10]. According to Glanville [20], genetic and environmental factors such as nutrition and working conditions with extensive impact pressure from the olecranon may modify the thickness of the supratrochlear septum. Recent studies counteract the mechanical pressure hypothesis since large olecranon process is features of males, STF would have been commoner in males. But in most of the studies STF is more common in females than in males (Akabori [21], Mahajan [13], and Paraskevas [4]).

Clinical implications of STF: The presence of STF in humerus may lead to increased local stress and significantly alter the pattern and stability of fractures [22] [23]. It may also interfere with fracture therapy. Supracondylar fracture is the commonest fracture in pediatric age groups and intramedullary nailing has been a procedure of choice for managing supracondylar fracture. Akpinar et al [4] found out that the bones with STF have narrow medullary canal (less than 4 mm) and these bones have extreme anterolateral bowing and or extreme compressed

anterolateral surface at distal part complicating the effective nailing. Nayak et al [6] observed in plain radiographs that the STF was located closer to the medial epicondyle resulting in difficult intramedullary nailing. Paraskevas et al [4] also found out that the distal part of the medullary canal in humeri with STF was narrower and shorter at the entry point of a retrograde nail than in humeri without a STF. Due to the narrowing of distal medullary canal in bones with STF, an ante grade route has been advocated rather than a retrograde nailing route [4]. In adults, stable fixation for complex supracondylar fracture of the humerus is often done with the placement of two plates on the posterior aspect of humeral pillars. In humerus with a wide STF, there will be difficulty in placing the plates to achieve stable reduction [24]. According to De Wilde et al [25], STF is a relatively radiolucent area, commonly described as a “pseudo lesion” in an x-ray of the upper limb and can be mistaken as an osteolytic or cystic lesion. The STF is commoner in ancient primitive people than modern man, hence the presence of STF in humerus can be an invaluable tool to the anthropologists for dating specimens [10].

CONCLUSION

Although anatomists and anthropologists were aware of STF, it remains quite unknown to clinicians, since it is overlooked in most standard textbooks. The knowledge of STF is important for the orthopedic surgeons, because of its significance in the preoperative planning of distal humerus fracture. The radiologists need to be familiar with STF in order to avoid misdiagnosis during interpretation of plain radiographs and computed tomography scans of the distal third of the humerus.

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Conflicts of Interests: None

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