



A Study Of The Supratrochlear Foramen Of The Humerus

Dr. Alka Nagar¹, Dr. Arti², Dr. Hema Nagpal^{3*}

Abstract

Backgrounds: The supratrochlear foramen (STF) of the humerus is the opening that results from the perforation of the thin bony septum separating the coronoid and olecranon fossae. Various names, such as supratrochlear aperture, septal aperture, intercondylar foramen, epitrochlear foramen, or olecranon foramen, also know it. It is situated 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.

Material and methods: A total of 200 (right side – 110 and left side – 90) dry human humeri of unknown sex. The presence of STF and its prevalence were studied. Shapes were visualized and classified. In the oval STF, transverse and vertical diameters were measured. The mean and standard deviation were calculated and compared with other recent studies. In the round STF, the diameter was noted. In the triangular STF, the maximum vertical and transverse lengths were considered. In the reniform STF, vertical length at the hilar point and maximum transverse length was measured.

Results: A total of 200 (110 right-sided and 90 left-sided) adult human dried humeri were studied for the presence or absence of Supratrochlear foramen. Out of 200 humeri studied, STF was present in 30 (15%) humeri. Supratrochlear foramen was present on the right side in 20 (10%) humeri. On the left side Supratrochlear foramen were present in 10 (5%). Most of foramen were oval shaped that is 15 (39.6%) on left side and 3 (9.1%) on right side while few of the foramen were round, heart, kidney and circular shaped.

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 orthopedic surgeons, because of its significance in the preoperative planning of distal humerus fractures.

388

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INTRODUCTION

The supratrochlear foramen (STF) of the humerus is the opening that results from the perforation of the thin bony septum separating the coronoid and olecranon fossae¹. Various names, such as supratrochlear aperture, septal aperture, intercondylar foramen, epitrochlear foramen, or olecranon foramen^{2,3} also know it. It is situated 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 fossa⁴.

The STF was first described by Meckel in 1825 as cited by Kate and Dubey⁵. In 1927, Hirsh

described that the thin plate of bone between the olecranon and coronoid fossa is always present until the age of seven years, after which the bony septum occasionally becomes absorbed to form the STF⁶. The septal apertures have been observed not only in humans but also in hyenas, dogs, and other primates also^{7,8}.

There are various factors that are responsible for the formation of this foramen. According to Glanville's mechanical theory, supratrochlear foramen can result from repetitive injury between the ulna and humerus during flexion and extension⁹. Another factor that may play a significant role in supratrochlear foramen

*Corresponding Author: Dr. Hema Nagpal

Address: ¹Associated Professor, Anatomy Department, GSVM Medical College, Kanpur, UP

²Assistant Professor, Anatomy Department, GSVM Medical College, Kanpur, UP

³Assistant Professor, Department Of Anatomy, Autonomous State Medical College, Etah, UP,
Email: Hemanagpal30@Gmail.Com

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formation is T-Box (TBX) genes which are important in the developmental process of limb and heart in utero¹⁰. This concept was furthered by Govonis work which postulated that T box genes effect postnatal development of the limbs¹¹.

Based on orthopaedic surgical experience, it has been noted that STF is associated with a narrow intramedullary cavity³. In the paediatric age group the supracondylar fracture is of common occurrence¹². This is treated by intramedullary nailing which may be compromised by the presence of this aperture. Hence the present study describes the incidence, morphological features, and clinical importance of STF which may be beneficial to anthropologists, anatomist, orthopaedic surgeons and radiologists.

MATERIAL AND METHOD

Study Population: A total of 200 (right side – 110 and left side – 90) dry human humeri of unknown sex from the Department of Anatomy of Ganesh Shankar Vidyarthi Memorial Medical College over a period between September 2022 to December 2022 were included in the study.

Methodology: The presence of STF and its prevalence were studied. Shapes were visualized and classified. In the oval STF, transverse and vertical diameters were measured. The mean and standard deviation were calculated and compared with other recent studies. In the round STF, the diameter was noted. In the triangular STF, the maximum vertical and transverse lengths were considered. In the reniform STF, vertical length at the hilar point and maximum transverse length was measured. The distance from the

nearest margin of the STF to the tip of medial, lateral epicondyles and the lower trochlear margin were measured with digital vernier calipers, and averages were calculated. All measurements were tabulated in millimetre.

Statistical analysis

The qualitative data were expressed in proportion and percentages and the quantitative data were expressed as mean and standard deviations. The difference in proportion was analyzed by using the chi-square test. Test significance levels were determined as 95% (P< 0.05).

RESULTS

A total of 200 (110 right-sided and 90 left-sided) adult human dried humeri were studied for the presence or absence of Supratrochlear foramen. Out of 200 humeri studied, STF was present in 30 (15%) humeri. On the right side, Supratrochlear foramen was present in 20 (10%) humeri. On the left side Supratrochlear foramen were present in 10 (5%).

Most of foramen were oval shaped that is 15 (39.6) on left side and 3 (9.1%) on right side while few of the foramen were round, heart, kidney and circular shaped.

We found that difference between measurements of vertical and transverse diameter of right and left sided foramina was not statistically significant (p>0.05)

We also observed that the difference between measurements of the distance of foramen from medial epicondyle and lateral epicondyle and the midpoint of trochlea on the right and left sides were not statistically significant (p>0.05).

Table 1 Shapes of Supratrochlear foramina.

Shape	Right (n=30)	Left (n=10)
Oval	11 (34%)	3 (30%)
Round	8 (27%)	1 (10%)
Heart	5 (16%)	2 (20%)
Kidney	4 (14%)	3 (30%)
Circular	2 (7%)	1 (10%)

Table 2: Type of Septum.

Type of septum	Right (n=110)	Left (n=90)
Translucent	45 (41.2%)	35 (28.9%)
Opaque	39 (35.7%)	21 (17.3%)
Total	84 (77.1%)	56 (46.2%)



Table 3: Diameters of Supratrochlear foramina

Variable	Right side		Left side		P value
	Mean	SD	Mean	SD	
Vertical diameter of Supratrochlear foramina	3.82	1.21	3.61	1.31	0.2
Transverse diameter of Supratrochlear foramina	5.52	1.82	5.85	1.48	0.4

Table 4: Distance of foramen from medial epicondyle and lateral epicondyle and midpoint of trochlea.

Distance	Right side		Left side		P value
	Mean	SD	Mean	SD	
Distance of foramen from medial epicondyle	2.38	0.28	2.53	0.56	0.8
Distance of foramen from lateral epicondyle	2.39	0.17	2.60	0.98	0.5
Distance of foramen from midpoint of trochlea	1.44	0.18	1.40	0.89	0.7

Discussion

The supratrochlear foramen is a neglected entity in both anatomy and orthopedic textbooks¹³. The knowledge of STF is important not only for its anthropological interest but for its clinical significance. The incidence of STF varies in different races. The global statistics show that STF has an incidence ranged from 4.2% to 58%¹⁴. The genetic theory states that STF is an inherited trait¹. Frequencies of occurrence in different populations favour this theory. Studies in Greek population having revealed prevalence as low as 1% and the highest of 52 % have reported in Arkansas Indians². Some of the other populations on which the STF has been studied include American 6.9%, Egyptians 7.9 % and Japanese 18.8%^{15,8,16}.

In this study we found that Out of total 230 humeri studied STF were present in 40 (20%) humeri which is in accordance with Joshi M et al who reported 35.88% however there are various studies in India who reported 32%, 28%, 27.5%, and 27.4% in Central Indians, South Indians, North Indians, and Eastern Indians, respectively^{5,17-19}. This wide variation favours the genetic basis of development of STF.

The frequency of STF on left side has been reported by many researchers^{8,9,18,20}. However study done by Nayak et al showed a greater prevalence on the right side¹². In a study in South India, almost equal percentages of STF were reported on both humeri¹⁷. Its left side frequency can be explained on the basis of handedness. It is more common on the non-dominant left hand as the dominant right limb has more robust bones^{4,21}.

In this study we found that most of the foramen were oval shaped that is 11(34) on left side and 3(30%) on right side followed by round shaped 2% on left side, kidney-shaped and circular shaped were 4.1% respectively however 0.8% were heart shaped on left side and 1.8% on right side. Our findings are similar with Joshi M et al¹⁴, Laishram M S et al²², Arun Kumar KR et al²³. However, in a few studies the round shape foramen outnumbered the oval shape²⁴⁻²⁶. Study conducted by Jadhav et al²⁷ reported a sieve like appearance of STF in 3.22% of bones in their study.

In this study 46.3% humeri on left sides were having septum while 77.1% humeri on right sides were having septum. Most of septum 57.14% on left side (28.9%) and right side of humeri (41.2%) were having translucent septum while 42.85% were opaque. Septal aperture may be unilateral or bilateral. If unilateral it is more common on the left side, if it is bilateral, a larger aperture will be seen on the left side bone^{4,21}. Our findings are in accordance with Singhal and Rao et al¹⁷ who reported translucent septum was seen in 66% of the bones, in 51.51% of right and in 48.48% of the left. Only nine bones had opaque septae (6%). In another study conducted by Sunday et al²⁸ reported translucent septum on right side 54.5% and on left humeri 45.5%.

From previous studies, the size of the foramen was commonly measured by the vertical and transverse diameter, but this could be a cause of confounding bias according to the varied sizes of the humeri. In present study, the mean transverse diameter of the STF was 5.85 mm and 5.52 mm, on left and right sides



respectively while the vertical diameter was 3.61 mm and 3.82 mm on left and right sides respectively. This result was consistent with a study by Mathew et al²⁹. The results obtained in the present study were compared with that of other authors like Nayak et al¹² and Krishnamurthy et al³⁰. In present study, difference between measurements of vertical and transverse diameter of right and left sided foramina and difference between measurements of distance of foramen from medial epicondyle and lateral epicondyle and midpoint of trochle on right and left sides were not statistically significant ($p>0.05$).

Clinical significance of STF:

The presence of STF in humerus may lead to increased local stress and significantly alter the pattern and stability of fractures²³. 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.

So knowledge of its presence helps decide the surgical course of action. STF appears relatively radiolucent and may commonly be confused with osteolytic or cystic lesion^[22]. STF shows wide racial differences and hence can be used as a parameter in racial identification. Its link as an evolutionary trait can be used for dating specimens by the anthropologist^{17,28}.

CONCLUSION

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

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