ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

Original Article

Morphometric study on supratrochlear foramen of adult human humerus and its clinical correlation.

Running title: Morphometric study of supratrochlear foramen

Rukaiya Jalal[1], Mohd Arif Makdoomi[2], Syed Mubashir Yousuf[3], Javed Ahmed Khan[4],Sajad Hamid[5]

[1]Senior Resident, Department of Anatomy GMC Baramulla

[2,3] Senior Resident, Department of Anatomy GMC Srinagar

[4] Associate Professor, Department of Anatomy GMC Srinagar

[5]Associate Professor, Department of Anatomy SKIMS MCH Srinagar

*Corresponding Author:- Dr. Javed Ahmad Khan; Associate Professor, Department of Anatomy GMC Srinagar

+919596514501

Abstract:

Background: Supratrochlear foramen (STF) if present lies on the lower end of humerus just above its articular surface on the bony septum separating the Olecranon and Coronoid fossae. **Aims**: To check the incidence, shapes and various diameters of STF in 86 adult dry humeri. **Materials and methods**: The present study was conducted on 86 humeri (34 right and 52 left) of unknown sex from Government Medical College, Srinagar. The presence of STF in these humeri was noted, their shapes were also observed and the various diameters were measured with the help of Vernier Caliper. The damaged and broken bones were excluded from the study. **Results**: Out of 86 humeri observed, STF was found in 24 bones i.e. total incidence of 27.90%. Further out of 34 right sided humeri, STF was found in 7 bones, which accounts for 20.59%. Similarly, out of 52 left sided humeri, STF was found in 17 bones which accounts for 32.70%. This shows STF was more common on the left side as compared to that of the right side. The commonest shape noted was oval. Other shapes such as round and irregular were also observed. The transverse and vertical diameters were observed in oval STF, and the mean diameters were measured in round STF using Vernier caliper. In the oval STF, the transverse and vertical diameters on the left side were measured to be 5.84mm (mean) with the range of 3-8mm, S.D= 1.62mm and 4.15mm (mean) with the range of 2-6mm, S.D= 1.37 respectively, while as on the right side, the transverse and vertical diameters were measured to be 4.84mm (mean) with the range of 3-9 mm, S.D= 1.47 and 3.75mm (mean) with range of 2-6mm, S.D= 1.02 respectively. In the round STF, the mean diameter on the left side was observed to be 4.63mm with the range of 3-8mm, S.D of 1.82mm and on the right side the mean diameter was observed to be 4.21mm with the range of 3-8 mm, S.D= 1.47mm. **Conclusion**: The knowledge of STF is important for the Anatomists, Orthopaedicians, Anthropologists and Radiologists. In Supracondylar fracture of humerus, the knowledge of STF is useful for planning the treatment e.g. intramedullary nailing.

Keywords: Humerus, Supratrochlear foramen, Olecranon fossa, Coronoid fossa.

Introduction

Olecranon and Coronoid fossae form an important identifying features of the Humerus. Apart from helping in identification of posterior and anterior surfaces, these fossae also help in the side determination of the Humerus. On close examination it is seen that these fossae are

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

separated by a thin bony laminae[1]. Sometimes this septum is perforated resulting in the formation of supratrochlear foramen. Identified first by Mekel in 1825, STF is known by a variety of terms such as epitrochlear foramen, intercondylar foramen and Olecranon foramen[1,2]. The use of these terminologies is due to the fact that there is lack of substantial knowledge and data which could help in understanding the utility and etymology of the aperture[3]. This foramen is frequently present in predators such as hyenas, dogs as well as in primates[4,5]. Its presence in the animals is attributed to the overextension of the related joint while tearing prey. Genetic imprints is attributed to the development of STF. TBox genes which code for T box proteins are involved in the development of STF.[6] In early life STF is not present, but it develops after the age of 7 years. In children below the age of 7 years, this foramen is covered by a synovial membrane which may later get perforated to give rise to STF[7]. A study conducted by E Akbori in the humeri of Japanese, Ainu and Korean the youngest subject in which the STF was observed was a 9 year old female[8].

The presence of STF is useful from the anthropologists perspective who claims it to an evolutionary link between humans and lower animals[9]. Presence of STF is important for orthopedicians while planning the nailing of fractures of lower humerus[10]. STF occurance is also important from the radiologic perspective as sometimes it can be confused for cystic or osteolytic lesion of distal humerus[11].

Aims: To check the incidence, shapes and various diameters of STF in 86 adult dry humeri.

Materials and methods: The present Cross sectional study was conducted on 86 humeri (34 right and 52 left) of unknown sex. The study was conducted in the department of Anatomy, Government Medical College, Srinagar. The presence of STF in these humeri was noted, their shapes were also observed and the diameters were measured with the help of Vernier Caliper. The damaged and broken bones were excluded from the study.

Instruments used: Vernier Caliper

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

(A) Instruments used (B) Transverse diameter

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

(C) Vertical diameter (D) Oval shape

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

(E) Irregular shape (F) Round shape

Observations: Out of 86 humeri observed, STF was found in 24 bones i.e. total incidence of 27.90%. Further out of 34 right sided humeri, STF was found in 7 bones, which accounts for 20.59%. Similarly, out of 52 left sided humeri, STF was found in 17 bones which accounts for 32.70% (Table 1) . This shows STF was more common on the left side as compared to that of the right side. The commonest shape noted was oval. Other shapes such as round and irregular were also observed. The transverse and vertical diameters were observed in oval STF, and the mean diameters were measured in round STF using Vernier caliper. In the oval STF, the transverse and vertical diameters on the left side were measured to be 5.84mm (mean) with the range of 3-8mm, S.D= 1.62mm and 4.15mm (mean) with the range of 2-6mm, S.D= 1.37 respectively, while as on the right side, the transverse and vertical diameters were measured to be 4.84mm (mean) with the range of 3-9 mm, S.D= 1.47 and 3.75mm (mean) with range of 2-6mm, S.D= 1.02 respectively(Table 2). In the round STF, the mean diameter on the left side was observed to be 4.63mm with the range of 3-8mm, S.D of 1.82mm and on the right side the mean diameter was observed to be 4.21mm with the range of 3-8 mm, S.D= 1.47mm (Table 3).

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

Table 1: Side variation of STF

Side	Number	STF	%age
Right	34	7	20.59
Left	52	17	32.70
Total	86	24	27.90

Table 2: Measurements of Oval shaped STF

Oval	Transverse Mean Diameter	Vertical Mean Diameter
Right	4.84± 1.47mm	3.75± 1.82mm
Left	5.84± 1.62mm	4.15± 1.37mm

Table 3: Measurements of Round shaped STF

Round	Mean Diameter± S.D
Right	4.21± 1.47mm
Left	4.63±1.82mm

Discussion

Openings in the bones can be in the form of foramina or apertures. Foramina allow passage of neurovascular structures but no substantial structure passes through aperture[1]. STF does not fulfill the criteria of foramina as no structure passes through it. The occurrence of STF in some bones can be explained on the basis of genetic and mechanical theories. According to genetic theory STF is inherited as trait, because this can be explained on the basis of its incidence in different population groups [2,3,4].

Glanville[12] postulated the mechanical theory for the development of STF. According to him STF is formed as a result of extreme angular movements between Humerus and Ulna. The increased incidence of STF on the left Humeri as compared to the right can be attributed to

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

the handedness, as the most of the people (95%) are right handed so the bones of right upper limb are more robust[5,6].

The present study was conducted in the department of Anatomy, Government Medical College, Srinagar on 86 Humeri- 34 right and 52 left. Asha Joshlit Mathew[2] in 2016, studied the morphometry of STF in 244 unpaired Humeri and observed that STF was present in 60 Humeri, which accounts for 24.59%. Incidence was more on left side than on right side, 41 out of 60 which accounts for 68.33%. On the right side it was present in 19 out of 60 which accounts for 31.67%. In our study the incidence of STF was also observed to be more on the left side as compared to that of right side. So the above study is consistent with our study. Furthermore as per the study conducted by Asha Joshlet, the STF had variety of shapes like oval, round, Triangular, Reiniform, sieve and rectangular, out of which the oval shape was predominant i.e. 51.6% while the rectangular STF was least common, only in 1 Humerus. While as, in our study we observed Oval, round and irregular shapes of STF. Overall the most frequently observed shape of STF was oval, which is also consistent with the above study. Further on the left side Asha Joshlet found the mean transverse diameter to be 4.9mm and mean vertical diameter to be 3.27mm, while as on the right side the mean transverse diameter was found to be 5.12mm and mean vertical diameter was found to be 3.48mm. Thus the above dimensions which were found more on the right side is not consistent with our study in which we found the mean transverse and vertical diameters were more on left side as compared to that of right side. In case of round shaped STF, Asha Joshlet found mean diameter of 3.23mm on left side and 4.89mm on the right side which is again inconsistent with our study.

Dr Raghavendra[13] while studying STF in 100 humeri- 50 left and 50 right observed the incidence of STF in 28 % of humeri. The incidence was more on the left side i.e. 34% as compared to 22% on the right side. The shape of STF was mostly oval followed by round. Thus the above study was in consistence with our study.

In another study conducted by Jayakumar[14], on 156 Humeri, STF was found to be present in 43 humeri i.e. 27.5%. The pesence of STF was observed to be more common on the left side i.e. 30.9% as compared to the right side i.e. 23.6%. Further the most commonly reported shape was the oval shape in 48.8%. This was in consistence with our study. The mean transverse diameter on right and left side were measured to be 9.5mm and 9.18mm respectively while as mean vertical diameter on right and left side were measured to be 6.7mm and 6.9mm. Also the mean diameters of round shaped STF was measured to be 4.5mm and 6.0mm for right and left sides respectively.

Shivaleela[15] while studying the STF in 142 humeri reported the incidence of STF to be 26.7% with STF to be more common on the left side i.e. 31.43% as compared to 22.22% on the right side which is in consistence with our study. Further the most common shape reported was the round shape in 47.37%, followed by oval shape in 42.11% and irregular shape in 47.89%, which is not consistent with our study in which the most common shape to be observed was oval, followed by round followed by irregular.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 1, 2024

B. Mahitha[16] in their study conducted on 96 humeri observed the incidence of STF in 18.7% bones, with the incidence being more on left side (23.6%) compared to the right side (13.6%). The most common shape reported was the oval shape. Thus the study being consistent with our study. Further the mean transverse diameter was measured to be 4.6mm in the right and 6.2mm on the left side and mean vertical diameter was measured to be 3.4mm on the right side and 4.2mm on the left side.

Conclusion: Supratrochlear foramen is an important anatomical variation at the distal end of humerus but unfortunately, it has not received much attention from the clinicians. The knowledge of STF is important for the Anatomists and Anthropologists. In Supracondylar fracture of humerus, the knowledge of STF is useful for pre operative planning of nailing fractures of distal humerus to orthopaedicians and to the radiologist for differentiating it from cystic or osteolytic lesion.

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