IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 3 Ser.14 (March. 2023), PP 20-27
www.iosrjournals.org

Morphometric Study of Supratrochlear Foramen of Humerus in Rajasthan

Dr. PRATIMA JAISWAL[1], Dr. PRATIK PRATIHAR[2],
Dr. AARUSHI JAIN[3], Dr. ANKUSH ASOPA[4]

[1](Senior Professor, Department of Anatomy, Government Medical College {Kota, Rajasthan}, INDIA)
[2](P.G Resident 3rd year, Department of Anatomy, Government Medical College {Kota, Rajasthan}, INDIA)
[3](Head of Department, Professor, Department of Anatomy, Government Medical College {Kota, Rajasthan}, INDIA)
[4](P.G Resident 3rd year, Department of Anatomy, Government Medical College {Kota, Rajasthan}, INDIA)
\

Abstract:
Background: *Supratrochlear foramen (STF) is an important variation in the lower end of humerus which has been neglected and the knowledge of the presence of Supratrochlear foramen in a humerus may be important for preoperative planning for treatment of supracondylar fractures.*

Materials and Methods:*The present study was carried out on 88 dried human humeri of unknown sex and age from anatomy department of Government medical college Kota Shape and size of the Supratrochlear foramen was recorded. Vertical and transverse diameters were measured by vernier caliper. Translucent and opaque septum was seen with the help of flash light.*
Result: *Supratrochlear foramen was present in (35.95%) of total humeri, more frequently on the left side (38.29%) than on the right side (34.14).Most commonly observed shape was oval(43.75%). In present study the mean transverse diameter of the Supratrochlear foramen was 5.22 mm and 6.27 mm on left and right side while respectively mean vertical diameter of Supratrochlear foramen was 3.85mm and 3.37mm*
Conclusions: *Our study show that Supratrochlear foramen is more common on the left side, with the oval shape being most common. The knowledge of Supratrochlear foramen is very important for preoperative planning of intramedullary Nailing for treatment of supracondylar fractures, especially following traumatic injuries and pathologic fracture presence of Supratrochlear foramen may be important for anthropological, clinical, and academic purpose.*
Keywords: *Humerus, Supratrochlear Foramen (STF), Translucent septum, Oval shape, Intramedullary nailing.*

Date of Submission: 10-03-2023 Date of Acceptance: 22-03-2023

I. INTRODUCTION

The supratrochlear foramen (STF) is a significant and relatively atypical anatomical variation noticed in the distal end of humerus Generally, foramen transmits blood vessels and nerves, in the case of Supratrochlear foramen, no significant structure is transmitted and in the rare case, there may be a probability of entry of the median nerve, which may produce symptoms such as pain and weakness in the hand[1]. A bony septum separates the olecranon and coronoid fossae at the lower end of the humerus, between the two epicondyles. The thickness of the bony septum determines its opacity or translucency[2]. This translucent or opaque septum may have massive perforations, and in severe cases, it may be perforated to form a narrow orifice known as a 'supratrochlear orifice' or 'supratrochlear foramen'[3]. The Supratrochlear foramen has been designated by a variety of names such as intercondylar foramen, olecranon foramen, and epitrochlear foramen[4].

The Supratrochlear foramen observed in a variety of shapes, and their morphometry varies depending on gender and race. The delicate and translucent Supratrochlear septum (STS) is not observed in newborns and appears later in life, persists until the age of seven years, and later, for a variety of reasons, Supratrochlear septum undergoes degeneration or absorption only in some individuals, which may lead to the formation of Supratrochlear foramen[5] and some referred to Supratrochlear foramen as the septal aperture[6].

Researchers have described Supratrochlear foramen in hyenas, dogs and other primates occurred by the overextension posture during tearing of meat of the prey. The Supratrochlear foramen is considered in humans, as one of the characteristics to show the evolutionary aspect of humans from primates[7].Due to high incidence of traumatic injuries and pathological fractures, there has been increased incidence in intramedullary fixation of

humerus[8].Therefore, this study aims to scrutinize the incidence, morphology, and morphometry of supratrochlear foramen among the Rajasthani population and to define the crucial role of Supratrochlear foramen and Supratrochlear septum in treatment of supracondylar fractures of humerus to avoid operative errors.

II. MATERIAL AND METHODS

The present study was anatomy based descriptive type. The prior permission of Institutional Ethics Committee had been taken for this study. The present study was conducted on 88 adult human humeri of unknown sex, collected from the Department of Anatomy,Govt. Medical College Kota (Rajasthan). Out of which 47 were of the left side and 41 were of the right side.All the adult humeri with physical integrity, free of ante-mortal or post-mortal trauma were included. Only bones free from pathological changes were included in the study. Shape of Supratrochlear foramen and its position with respect to trochlear groove were enumerated. As shown in [Fig 1] the width (Transverse diameters =TD) and height (Vertical diameters =VD) of the Supratrochlear foramen, as well as the distances of the medial epicondyle to the medial aspect of the Supratrochlear foramen (MB) and the lateral epicondyle to the lateral border of the Supratrochlear foramen, were measured using digital vernier callipers (LB). The Supratrochlear foramen shape was also photographed. The opacity and translucency of the supratrochlear septum were observed using transmitted light from posterior to anterior in bones where the foramen was not present. All dimensions are given in millimeters. We calculated the minimum, maximum, mean, and standard deviation using these measurements. For statistical analysis, the SPSS 20.0 version was used. Variations on the right and left side was observed and data was compared with other studies.

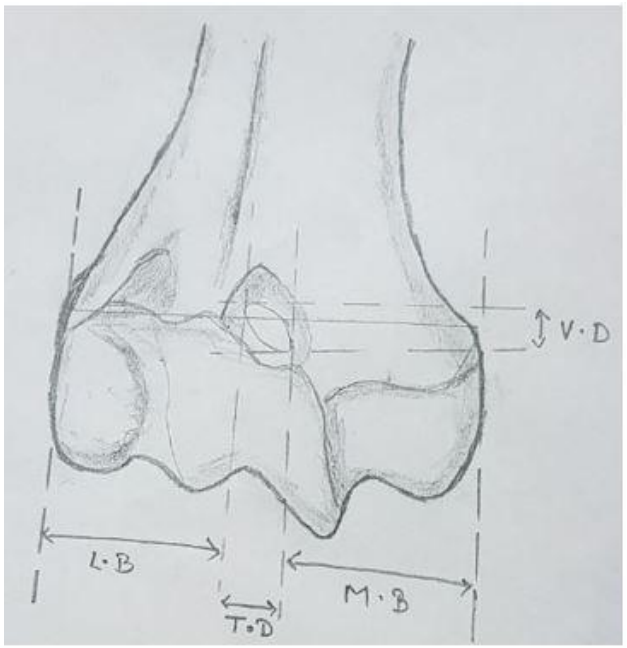

Fig 1: Landmarks for measurements of Distal humerus

III. RESULTS

Out of 88 humeri studied (41 right sided and 47 left sided humeri), 36.36% humeri showed presence of Supratrochlear foramen. The incidence of Supratrochlear foramen was greater on left side (38.29%) compared to right side (34.14%). A clear cut supratrochlear foramen was found in (35.95%) of humeri. Septal apertures were more common on the left humeri than the right ones in 32 bones.

The present study was conducted on human humeri of unknown sex in which we can easily appreciate Supratrochlear foramen. It was oval, round, irregular, and sieve-like in shape [Fig.2]. Supratrochlear foramen was found in 32 bones Out of which in 14 humeri was oval (43.7%), 7 was round (21.87%), 6 was irregular (18.75%), and 5 was sieve (15.62%) like. [Table1].

Over all oval shape Supratrochlear foramen was most common type which was more in right (50%) than left side (38.88%) of humeri, followed by round, irregular and least is sieve type that was more common in left as compared to right humeri. [Table1].

Table 1: Different shape of Supratrochlear foramen present in left & right humeri

FORAMINA	RIGHT HUMERI (N=14)	LEFT HUMERI (N=18)	Total No. of STF (N = 32)
Oval	7 (50%)	7 (38.88%)	14(43.7%)
Round	3 (21.42%)	4 (22.22%)	7(21.87%)
Irregular	2 (14.28%)	4 (22.22%)	6(18.75%)
Sieve	2 (14.28%)	3 (16.66%)	5(15.62%)

In the present study [Table 2], the mean transverse diameter of Supratrochlear foramen was 5.22mm and 6.27mm, on left and right sides while the vertical diameter was 3.85mm and 3.37mm on left and right side respectively, as depicted in [Fig 6, 7]. The p value was not significant in case of both transverse (p = 0.24) and vertical diameter (p = 0.42) .So overall p value > 0.05.

Table 2: Dimensions of Supratrochlear Foramen

DIAMETER	LEFT(N=18)		RIGHT(N=14)		P VALUE
	Range	Mean ± SD	Range	Mean ± SD	
Transverse	9.13-1.44	5.22 ± 2.28	8.35-1.38	6.27 ± 2.68	0.24
Vertical	8.90-2.28	3.85 ± 1.80	5.90-2.09	3.37 ± 1.45	0.42

A greater degree of joint hyper mobility can be the reason of translucency of supratrochlear septum as shown in [Fig 3].Translucency was found in 39.77% humeri in the region of supratrochlear septum when illuminated by a flash light from behind and opaque septum was observed in 23.86% humeri [Table 4].

Table 3: Translucent septum and opaque septum in humeri

	RIGHT HUMERI (N=41)	LEFT HUMERI (N=47)	Total (N=88)
Translucent	17 (41%)	18 (38%)	39.77%
Opaque	10 (24%)	11 (23%)	23.86%
Supratrochlear foramen	14 (34%)	18 (38%)	36.36%

The mean distance from medial epicondyle to medial edge of the Supratrochlear foramen [Fig 4] was 24.4±1.20 mm on the right and 21.15±3.23 mm on the left side. The mean distance from lateral epicondyle to lateral border of the Supratrochlear foramen [Fig 5] was 25.3±3.54 mm on the right and 27.5±1.5 mm on the left side. [Table 5]. There was the significant difference seen between distances from medial border of Supratrochlear foramen to medial epicondyle contrasted with lateral border of Supratrochlear foramen to lateral epicondyle. Thereafter, we found the position of Supratrochlear foramen to be located nearer to the medial epicondyle. The p value were significant both for medial epicondyle (p= 0.0012) and lateral epicondyle (p = 0.0236) as p value $\leq$ 0.05.

Table 4: Distance from Supratrochlear foramen to medial and lateral epicondyle in left and right humeri in mm

	LEFT			RIGHT			P VALUE
	Maximum	Minimum	Mean ± SD	Maximum	Minimum	Mean ± SD	
Medial Epicondyle	26.97	20.11	21.15 ± 3.23	27.2	21.19	24.4±1.20	0.0012
Lateral Epicondyle	28.35	20.43	27.5±1.5	29.07	21.08	25.3±3.54	0.0236

Fig 2: Showing different of STF from left to right oval, round, irregular & sieve

Fig 3: Translucent septum and Opaque

Fig 4: Distance from STF to Medial epicondyle

Fig 5: Distance from STF to Lateral epicondyle

Fig 6: Measurement of Transverse Diameter of STF

Fig 7: Measurement of Vertical Diameter of STF

IV. DISSCUSION

The medial and lateral epicondyles of the humerus are the origins of the flexor and extensor groups of forearm muscles. They have three fossae, the radial, olecranon, and coronoid, and articulate with the radius and ulna to form the elbow joint [9]. The function and formation of supratrochlear foramen is largely obscure. No anatomical structure is known to pass through the Supratrochlear foramen and thus it does fit the definition of foramina, as normally foramina serve as conduits for vessels and nerves, while apertures are merely openings in bones with no structure passing through them[10].

As depicted in Table 5, the shape of Supratrochlear foramen was compared with other studies. Almost all researchers found oval as the most common shape in Supratrochlear foramen and irregular as the least common shape. Nayak et al[11] found highest incidence of Supratrochlear foramen as oval 93% and least was Triangular 1.5%. For other studies conducted by,Krishnamurthy et al[12],Veerappan et al[13],Jadhav et al[14],Divya[15] and Loic Fonkoue[16] observed 66%, 45%, 67.53%, 61.29% and 50% oval as most common while irregular as least common 2%, 5%, 7.79%, 6.45% and 1.9% respectively. In present study, oval was the most common shape 43.75% which is comparable to Veerappan et al[13] but least common type was sieve like which was different from other studies as the most common variant was irregular for other researchers.

Table 5: Comparison of Shapes of Supratrochlear foramen with other studies

Serial no.	Authors	Year	Most common shape	Least common shape
1	Nayak et al[11]	2009	Oval 91.79%	Triangular 1.5%
2	Krishnamurthy et al[12]	2011	Oval 66%	Irregular 2%
3	Veerappan et al[13]	2013	Oval 45%	Irregular 5%
4	Jadhav et al[14]	2015	Oval 67.53%	Irregular 7.79%
5	Divya[15]	2018	Oval 61.29%	Irregular 6.45%
6	Loic Fonkoue[16]	2019	Oval 50%	Irregular 1.9%
7	Present study	2023	Oval 43.75%	Sieve 15.62%

As shown in Table 6, the mean transverse (TD) and vertical diameters (VD) of Supratrochlear foramen was measured and compared with other studies. Almost all authors found that morphometric measurements of Supratrochlear foramen for transverse diameter was more than vertical diameter in both left and right humeri. As Veerappan et al[13] noted transverse diameter in left and right was 7.53±1.28 & 8.30 ± 1.07 while vertical diameter for left and right was 5.35±1.60 & 4.09±1.13 which was highest. For other research conducted by Nayak et al[11], Krishnamurthy et al[12] and Asha[17] found transverse diameter (6.55 ± 2.47, 6.5 ± 2.59&4.88 ± 1.63) for left humeri, while (5.99 ± 1.47, 5.26 ± 2.47 & 5.24 ± 1.76) for right humeri. And vertical diameter (4.85 ±

1.64, 4.7 ± 1.69 & 3.37 ± 1.25) for left humeri, while (3.81 ± 0.97, 4 ± 1.52 & 3.82 ± 1.07) for right humeri. In present study, average transverse diameter of the Supratrochlear foramen was 5.22 ± 2.28 mm and 6.27 ± 2.68 mm, on left and right sides while the vertical diameter was 3.85 ± 1.80 mm and 3.37 ± 1.45 mm on left and right sides respectively.

Table 6: Comparative study of mean transverse (TD) and vertical diameters (VD)

Serial no.	Authors	Year	Diameters	Left (mm)	Right (mm)
1	Nayak et al[11]	2009	Transverse	6.55 ± 2.47	5.99 ± 1.47
			Vertical	4.85 ± 1.64	3.81 ± 0.97
2	Krishnamurthy et al[12]	2011	Transverse	6.5 ± 2.59	5.26 ± 2.47
			Vertical	4.7 ± 1.69	4 ± 1.52
3	Veerappan et al[13]	2013	Transverse	7.53±1.28	8.30 ± 1.07
			Vertical	5.35±1.60	4.09±1.13
4	Asha[17]	2015	Transverse	4.88 ± 1.63	5.24 ± 1.76
			Vertical	3.37 ± 1.25	3.82 ± 1.07
5	Present study	2023	Transverse	5.22 ± 2.28	6.27 ± 2.68
			Vertical	3.85 ± 1.80	3.37 ± 1.45

As depicted in Table 7, studies conducted on different populations around the world for incidence of Supratrochlear foramen had shown a wide variation in the rate of the Supratrochlear foramen occurrence in various human populations. Its incidence varies from close to 0% to almost 60% among different human populations globally. Highest incidence was noted by Hirsh[18] in Arkansas Indians population as 58% while least was observed Papaloucas et al[20] in Greek population as 0.304%. Rest of the researcher's observed values between (4.3% - 47%), Trotter[19] found 12.6% & 4.3% in American population.Glandville[21] study population was Africans and Krishnamurthy et al[12] study population was Australians but results were almost similar 47% and 46.5%. Other studies conducted by Singhal et[22]& Erdogmus et al[23] were 28% & 10.8%.IN present study incidence of Supratrochlear foramen was found in 36.36% which was comparable to the study conducted by Nayak et al[11] (34.4%) and similar to study conducted by Loci Fonkoue et al[16] (36.6%).

Table 7: Comparative data of Supratrochlear foramen in different population

Serial Num.	Authors	Year	Study Population	Incidence (%)
1	Hirsh[18]	1927	Arkansas Indians	58
2	Trotter[19]	1934	American Negroes	12.6
3	Trotter[19]	1934	American white	4.3
4	Glandville[21]	1967	Netherlands	6.1
5	Glandville[21]	1967	Africans	47
6	Singhal et Rao[22]	2007	South Indians	28
7	Nayak et al[11]	2009	Indians	34.4
8	Krishnamurthy et al[12]	2011	Australians	46.5
9	Papaloucas et al[20]	2011	Greeks	0.304
10	Erdogmus et al[23]	2014	Turkish	10.8
11	Loic Fonkoue[16]	2019	Senegalese	36.6
12	Present study	2023	North Indian (Rajasthan)	36.36

V. CONCLUSION

A comprehensive knowledge of the occurrence, shapes, side predisposition of supratrochlear foramen may help in the treatment of supracondylar fractures. We believe that this study will contribute to the literature; anatomical knowledge of Supratrochlear foramen is beneficial for anatomists,for anthropologists, surgeons and radiologists in day to day clinical practice. In addition to its surgical and orthopedic significance, it represents evolutionary factor of the foramen. Supracondylar fractures account for 75% of all injuries in pediatric age group.Supratrochlear foramen is associated with a narrow medullary canal and distal humeral anterior angulation. On x-ray, Supratrochlear foramen present as radiolucent areas simulating an osteolytic lesion, hence knowledge of Supratrochlear foramen prevent misinterpretation of x-rays by medical professionals.

REFERENCES

[1]. Roaf R. Foramen in the humerus is caused by the median nerve. The Journal of Bone and Joint Surgery. 1957; 39B (4): 748–4.
[2]. Mays S: Septal aperture of the humerus in a mediaeval human skeletal population. Am J Phys Anthropology, 2008; 136: 432–40.
[3]. Bhanu PS, Sankar KD: Anatomical note of Supratrochlear foramen of humerus in south costal population of Andhra Pradesh. Narayana Medical Journal, 2012; 1(2): 28–34.

[4]. Meckel JH (1825) cited in Kate, BR, Dubey, and PN. A noteon the septal apertures in the humerus of Central Indians. Eastern Anthropologist. 1970; 33:270-284.
[5]. Morton HS, Crysler WE. Osteochondritis dissecans of the supratrochlear septum. J Bone Joint Surg Am 1945; 27:12-24.
[6]. Hrdlicka A. The humerus: septal apertures. Anthropologie.1932; 10:31-95.
[7]. Benfer .A. Tappen N.C. The occurrence of the septal perforation of the humerus in three non-human primate species. Am.J. Phys.Anthropol.19 8 29:14-28.
[8]. Diwan RK, Rani A, Chopra J et al. Incidence of Supratrochlear foramen of Humerus in North Indian Population. Biomedical Research, 2013; 24(1): 142–45.
[9]. Susan Stranding, Gray's Anatomy: The Anatomical basis of clinical practice, Elsevier, London, UK, 42 the edition.
[10]. Soubhagya R N. Supratrochlear foramen of the Humerus- An anatomico radiological study with clinical implications. Upsala Journal of medical sciences. 2009; 114: 90-94.
[11]. Nayak SR, Das S, Krishnamurthy A, Prabhu LV, Potu BK. Supratrochlear foramen of the humerus: An anatomico-radiological study with clinical implications. Ups J Med Sci. 2009; 114:90-94.
[12]. Krishnamurthy A, Yelicharla AR, Takkalapalli A, Munishamappa V, Bovinndala EB, Chandramohan M. Supratrochlear foramen of humerus - a morphometric study. Int J Biol Med Res. 2011; 2(3):829-31.
[13]. Veerappan V, Ananthi S, Kannan NG, Prabhu K. Anatomical and radiological study of supratrochlear foramen of humerus. World J Pharm Sci. 2013; 2(1):313-20.
[14]. Jadhav SD, Zambare BR. Supratrochlear foramen and its clinical significance. Asian J BiomedPharmaceut Sci; 5: 13-5 (2015).
[15]. Divya Agrawal, G. Sujatha, V. Subhashini Rani et. al. / A Study of Supratrochlear foramen andTheir Clinical Significance in a Teaching hospital of Deccan Plateau Indian Journal of Anatomy, Volume 7 Number 2, March - April 2018; DOI: http://dx.doi.org/10.21088/ija.2 20.0022.7218.8
[16]. Loïc Fonkoue, Jean Marc Ndoye, Zacharie Sando, Jean Joel Bigna, Abdoulaye Ndiaye, Abdarahmane Dia. anatomical study and morphometric predictive factors of the supratrochlear foramen of the humerus in a west african sample. Int J Anat Res 2019; 7(2.1):6443-6449. DOI:10.16965/ijar.2019.138
[17]. Asha Joselet Mathew et al., A Study of the Supratrochlear Foramen of the Humerus: Anatomical and Clinical Perspective, Journal of Clinical and Diagnostic Research. 2016 Feb, Vol-10(2): AC05-AC08; DOI:10.7860/JCDR/2016/17893.7237
[18]. Hirsh IS: The supratrochlear foramen: clinical and anthropological considerations. Am J Surg, 127; 2: 500–5.
[19]. Trotter M: Septal apertures in the humerus of American whites and Negroes American. Am J Phys Anthropol, 1934; 19: 213–27
[20]. Papaloucas, C., Papaloucas, M., Stergioulas, A. 2011. Rare case of humeral septal aperture in Greeks. Trends Med Res, 6: 178-183.
[21]. Glanville EV: Perforation of the coronoid-olecranon septum humero-ulnar relationships in Netherlands and African populations. Am J Phys Anthropol, 1967; 26(1): 85–92.
[22]. Singhal S, Rao V: Supratrochlear foramen of the humerus. Anat Sci Int, 2007; 82: 105–7.
[23]. Senem Erdogmus, Munevver Guler, Serpil Eroglu, Aizami Duran. The Importance of the Supratrochlear Foramen of the Humerus in Humans: An Anatomical Study. Medical science monitor. 2014; 20: 2643-2650.

Dr. PRATIMA JAISWAL, et. al. "Morphometric Study of Supratrochlear Foramen of Humerus In Rajasthan." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 22(3), 2023, pp. 20-27.