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A Study On the Incidence of Supra Trochlear Foramen of Humerus in the Population of East Godavari, Andhra Pradesh

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Abstract: *Supra Trochlear Foramen is also termed as Septal aperture of humerus is a deficit of bony septum in the lower end of humerus that seperates the coronoid fossa from the olecranon fossa. Supra Trochlear Foramen (STF) of humerus is a common anatomical variation of the lower end of humerus. Anatomical knowledge of STF is important for discerning normal from various pathological conditions of lower end of humerus in various disciplines of medicine like orthopaedics, radiology and paediatrics etc. The present study was done on a total of 200 dried adult humeri (100 right &100 left) from the bone bank of department of Anatomy, Rangaraya Medical College, Kakinada, East Godavari. The presence of supra trochlear foramen and its various shapes was observed.Out of 200 humeri, supra trochlear foramen is seen in 56 humeri (29 right & 27 left).Incidence of STF is more on right side. Oval shape STF was noticed in most of the humeri.*
Keywords: *Humerus, Supra Trochlear Foramen (STF);*

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I. Introduction

The humerus is an upper arm bone. It has an upper end with head, greater tubercle and lesser tubercle, a shaft and lower end which has anteriorly the coronoid fossa above the trochlea, radial fossa above capitulum and an olecranon fossa present posteriorly. The coronoid and olecranon fossa at the distal end of humerus are usually separated by a thin bony septum lined by synovial membrane in life[1]. The thickness of the bony septum determines its opacity or translucency[2]. In some individuals this bony septum may become perforated to form an opening called supratrochlear foramen (STF) or septal aperture. Since it is situated between the two condyles it is also termed as intercondyloid foramen[1] . It was first described by Meckel in 1825[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[4, 1]. Ossification of the coronoid process is completed about the time when the olecranon ossification centreappears. Perhaps the few years between the appearance of ossification centers of the olecranon process (8-10yrs) and its fusion is crucial for STF formation-Box genes may play a role in STF formation. Genes of the TBX family control the synthesis of T-box proteins that are crucial for the development of the limbs and the heart in utero[2].This concept was furthered by Govonis`s work which postulated that T Box genes effect postnatal development of the limbs[5].Hardlicka observed that the perforation is more frequent in higher primates other than man[6]. Individuals with this anatomic variation may be able to overextend the elbow joint[7].Functionally the overextension resulting from its presence in animals assists in tearing meat off the prey[2]. The bones with STF have shorter medullary canal and width of the medullary canal in the humeri with STF is narrow than in humeri without it[1].In the paediatric age group the supracondylar fracture of humerus is more common[8].This is treated by intramedullary nailing which may be compromised by the presence of this aperture[9].Therefore STF presence is of utmost importance in planning nailing of fractures of the lower end of the humerus[8].During radiological evaluations of the humerus, presence of STF may result in erroneous interpretation as pathological lesions or cysts[9].Generally the shapes of STF are round, oval and triangular[10]. Hence the present study describes incidence and various shapes of the STF among population of East Godavari ,Andhra Pradesh which is quite useful in pre operative planning for orthopaedic surgeons and radiologists in daily practice.

II. Materials And Methods

The current study was done on a total of 200 dried adult human humeri (100 right & 100 left) of unknown age and gender which were obtained from the bone bank of Department of Anatomy, Rangaraya Medical College, Kakinada, East Godavari district. Bones with pathology and damaged ones were discarded. Presence of STF and its various shapes like round, oval, triangular and sieve was observed by visual examination. All observations were recorded in tabular form and results were interpreted.

III. Results

Out of 200 humeri, the Supra Trochlear Foramen was noticed in 56 humeri (28%). The incidence of STF was more on right side (14.5%) compared to left side (13.5%). The STF was further categorized according to its shape with more prevalence of oval (17%) Fig - 3, followed by round (10%) Fig - 2 and sieve (1%) Fig - 4. Triangular shape STF was not seen.

Table 1: Distribution of total number of humeri according to presence of the STF.

	STF Present	**STF Absent**
Right (n=100)	29 (29%)	71 (71%)
Left(n=100)	27 (27%)	73 (73%)
Total (n=200)	56 (28%)	144 (72%)

Table 2: Distribution of humeri with STF according to its shape.

Side	**Total**	**Oval**	**Round**	**Sieve**	**Triangular**
Right	29	17 (58.6%)	11 (37.9%)	1(3.4%)	0
Left	27	17(62.4%)	9 (33.3%)	1 (3.7%)	0

IV. Figures

Figure-1

Figure-2

Figure-3

Figure-4

V. Discussion

Knowledge of variations from regular anatomy is important before interpreting any particular pathological condition. The STF of humerus is one of such common anatomical variation often neglected to mention in most of the text books of anatomy, orthopaedics. In anatomy, foramina are defined as conduits for vessels and nerves, while apertures are merely openings in bones[12]. No anatomical structure is known to pass through the STF and hence does not qualify to be one by definition. Indeed, Roaf et al had reported a case where the median nerve was passing through the STF, causing pain and weakness in the hand[13].

STF is more common finding and prominent structure in the lower animals such as cats. In the lower animals, the foramen forms the safe passage for the median nerve and brachial artery[12]. Darwin considered this foramen in humans, as one of the characteristics to show the evolutionary aspect of humans from primates[2].

Various theories have been proposed by different authors for the formation of STF in the lower end of humerus. According to the mechanical theory, propounded by Glanville the foramen is formed as a result of articulations between the humerus and ulna during extremes of flexion and extension[11] The foramen usually develops during adolescence, or more frequently adulthood due to incomplete ossification, due to intralamellar space enlargement and gradual septum absorption[12]. The genetic theory states that STF is an inherited trait. Frequencies of occurrence in different populations favour this theory[2].

Incidence:-

Incidence of STF varies from 6% to 60% in different races[14]. 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[12]. Studies in Greek population having revealed prevalence as low as 1% and the highest of 52 % have reported in Arkansas Indians. Some of the other populations on which the STF has been studied include American 6.9%, Egyptians 7.9 % and Japanese 18.8%. This wide variation favours the genetic basis of development.

Table No 3: Comparative study of Incidence of STF in Indian Population

S.NO	POPULATION STUDY	INCIDENCE(%)
1.	Central Indians	32%
2.	South Indians	28%
3.	East Indians	27.4%
4.	North Indians	27%
5.	Telangana Population	31.4%
6.	Present study(Costal Andhra)	28%

The studies done on Indian population have shown regional variations. The highest of 32 % was seen in Central Indian population[3] while South Indian population recorded 28% [15] and North Indians and East Indians were 27.4% and 27% respectively (16,17) and 31.4% were seen in Telangana population[18]. In the present study, out of the 200 humeri studied STF was observed in 56 of the 200 accounting for prevalence of 28 % which is supported by Singhal S. Rao et al and comparatively lower than the findings of D. Naga jyothi et al.

Sidedness of STF:-

If mechanical stress is the causative agent, then the STF should be more frequent on the right side. This is due to the fact that the STF is a phylogenetic and atavistic feature found in primates and is suppressed by the stronger limb and exhibited in the weaker limb[19] .The side frequency of STF can be explained on the basis of handedness.

Table No 4: Comparative study of sidedness of STF

S.NO	AUTHOR	YEAR	RIGHT	LEFT
1.	S R Nayak et al	2008	73/132(55.3%)	59/132(44.7%)
2.	RakeshkumarDiwan et al	2012	183/428(42.8%)	245/428(57.2%)
3.	Jaswinderkaur et al	2013	10/22(45.5%)	12/22(54.5%)
4.	JadhavMayuri et al	2013	12/31(38.7%)	19/31(61.3%)
5.	Jing Li et al	2014	9/27(33.4%)	18/27(66.6%)
6.	Arunkumar et al	2015	37/76(48.7%)	39/76(51.3%)
7.	Shivaleela et al	2016	16/38(42.1%)	22/38(57.9%)
8.	Bhumica Dang et al	2016	12/30(40%)	18/30(60%)
9.	AshaJoselet Mathew et al	2016	19/60(31.6%)	41/60(68.3%)
10.	D.NagaJyothi et al	2017	11/34 (32.4%)	23/34(67.6%)
11.	VishwajitRavindraDeshmukh et al	2018	6/20(30%)	14/20(70%)
12.	Present study	2019	29/56(51.8%)	27/56(48.2%)

In the present study, the frequency of STF on right side has been reported which is supported by S R Nayak et al and it is contrary to remaining authors shown in table no 4.

Shape of STF:-

Some authors have suggested that more frequent STF in left bones and in female groups is a result of ligaments and muscle laxity that can lead to greater joint laxity, joint hypermobility, impingement of ulnar processes on the humeral lamina and finally to perforation of the lamina[20].Its presence therefore can be attributed to the functional development of the elbow joint and its variable shapes to the morphometry of the articulating surfaces[2].

Table No 5: Comparative study of various shapes of STF

S.NO	AUTHOR	HUMERI WITHSTF	OVAL	ROUND	TRIANGULAR	SIEVE
1.	S R Nayak et al	132	123(93%)	7(5%)	2(2%)	0(0%)
2.	RakeshkumarDiwan et al	428	353(82.4%)	65(15%)	10(2.5%)	0(0%)
3.	Mallikarjun et al	10	8(80%)	2(20%)	0(0%)	0(0%)
4.	JadhavMayuri et al	31	15(48.4%)	13(42%)	2(6.4%)	1(3.2%)
5.	Jing Li et al	27	19(70.3%)	4(14.8%)	2(7.4%)	0(0%)
6.	Arunkumar et al	76	71(93.4%)	2(2.6%)	3(4%)	0(0%)
7.	Shivaleela et al	38	16(42.1%)	18(47.4%)	0(0%)	0(0%)
8.	Bhumica Dang et al	30	12(40%)	18(60%)	0(0%)	0(0%)
9.	AshaJoselet Mathew et al	60	31(51.6%)	13(21.6%)	3(5%)	5(8.3%)
10.	D.NagaJyothi et al	34	21(61.7%)	8(23.5%)	5(14.7%)	0(0%)
11.	VishwajitRavindraDeshmukh et al	20	9(45%)	10(50%)	0(0%)	0(0%)
12.	Present study	56	34(60.7%)	20(35.7%)	0(0%)	2(3.6%)

In the present study, oval shape of STF (60.7%)was more common followed by round shape (35.7%) and sieve like is (3.6%). These findings were correlated to most of the authors in the table no 5.

VI. Conclusion

The STF of humerus is the very important anatomical variation of lower end of the humerus which is often neglected. For Anthropologists, STF is one of the nonmetrical skeletal traits to play an important role analysis of familial inheritance and population migrations. For orthopaedicians, presence of STF is associated with decreased robustness ,smaller humeral diameter and a narrow medullary canal which predisposes to increased tendency of atypical fractures following low energy impact. Knowledge about this is important for pre operative planning in intra medullary nailing surgeries to prevent secondary fractures. For radiologists, to differentiate psudolesions.

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