European Journal of Therapeutics

DOI: 10.5152/EurJTher.2019.18026

Original Research

An Anatomic Study of the Supratrochlear Foramen of the Humerus and Review of the Literature

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ABSTRACT

Objective: The coronoid fossa and the olecranon fossa located on the distal end of the humerus are separated by a thin bone septum. This septum may be translucent or opaque. In some cases, this septum may become perforated, and it is called supratrochlear foramen. The aim of the present study was to describe the morphology of the supratrochlear foramen of the humerus.

Methods: This study was conducted on 108 dry humeri (right (R): 56, left (L): 52) belonging to adults whose age, gender, and racial properties are unknown. They were examined to determine the presence of the supratrochlear foramen. The shapes of the supratrochlear foramen were determined, and their diameters were measured.

Results: The supratrochlear foramen was observed in 11 cases on the right side and 11 cases on the left side. On the right side, 5 foramens were detected to be round-shaped, 3 oval-shaped, and 3 kidney-shaped, whereas on the left side, 6 foramens were detected to be oval-shaped and 5 round-shaped. Of the 86 dry humeri with no supratrochlear foramen, 57 (R: 30, L: 27) had a translucent septum, and 29 (R: 15, L: 14) had an opaque septum.

Conclusion: It is apparent that the supratrochlear foramen has been evaluated on bones generally in the literature, and there are differences in incidence rates. Owing to the clinical significance of this formation, it is thought that studying on a wider population of living individuals using radiologic imaging methods will contribute to the literature. In addition, although there are different terms used to express this formation in the literature, it is thought that adopting the name, which is commonly used as supratrochlear foramen, is most appropriate.

Keywords: Humerus, intercondylar foramen, septal aperture, supratrochlear aperture, supratrochlear foramen, terminology

INTRODUCTION

The coronoid fossa and the olecranon fossa located on the distal end of the humerus are separated by a thin bone septum (lamina) (1, 2). This septum is lined by the synovial membrane. The septum may be translucent or opaque. This septum may become perforated in some cases (1, 3). The perforated septum has many alternate names, such as supratrochlear foramen, septal aperture, supratrochlear aperture, intercondylar foramen, epitrochlear foramen, or olecranon foramen. Although supratrochlear foramen is the most commonly used term in the literature, there is no definite name that is accepted for this condition. De Wilde et al. (4) stated that this anatomic variation may be able to overextend the elbow joint. Erdogmus et al. (5) reported that the supratrochlear foramen has been neglected in the orthopedics and standard anatomy books.

The aim of the present study was to describe the morphology and morphometry of the supratrochlear foramen of the humerus and to compare with the literature in detail.

METHODS

This study was conducted in the laboratory of the department of anatomy, Gaziantep University School of Medicine. This study was performed in a manner to confirm with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. A total of 108 dry humeri (right (R): 56 and left (L): 52) belonging to adults whose age, gender, and racial properties are unknown. They were examined to determine the presence of the supratrochlear foramen. The shapes of the supratrochlear foramen were determined, and their diameters were measured. The distance between the medial edge of the supratrochlear foramen and the outer border of the medial epicondyle, as well as the distance between the lateral edge of the supratrochlear foramen and the outer border of the lateral epicondyle, was measured by a digital vernier caliper (Mitutoyo Digital Caliper, Kawasaki, Japan). The septum was classified as translucent or opaque in the humerus where the supratrochlear foramen was absent.

RESULTS

In the present study, 22 (20.37%) supratrochlear foramens were identified in 108 dry humeri (R: 56 and L: 52). The supratrochlear foramen was observed in 11 (19.64%) cases on the right side and 11 (21.15%) cases on the left side. On the right side, 5 (8.93%) fo-

How to cite: Bahşi İ. An Anatomic Study of the Supratrochlear Foramen of the Humerus and Review of the Literature. Eur J Ther 2019; 25(4): 295–303.

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Received: 15.08.2018 • **Accepted:** 19.06.2019

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Figure 1. a-c. Different shapes of the supratrochlear foramen on dry bone and illustration (a: round-shaped, b: oval-shaped, c: kidney-shaped)

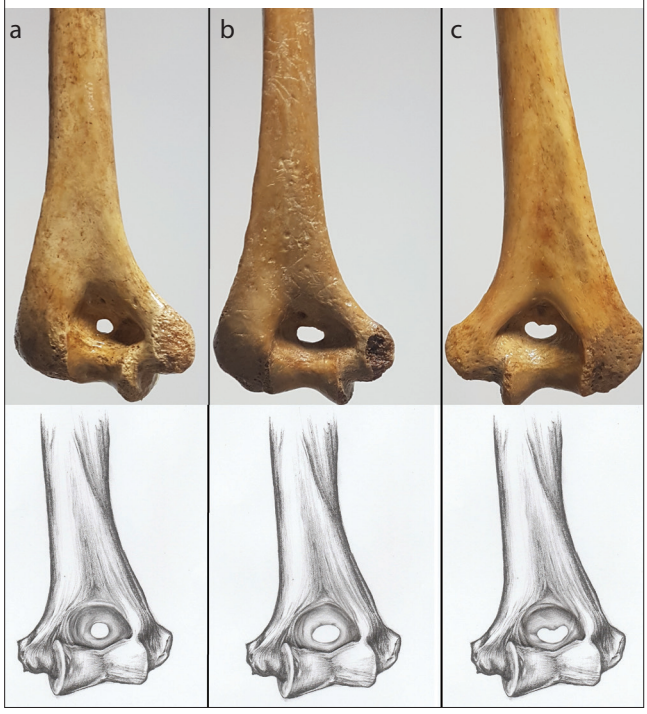


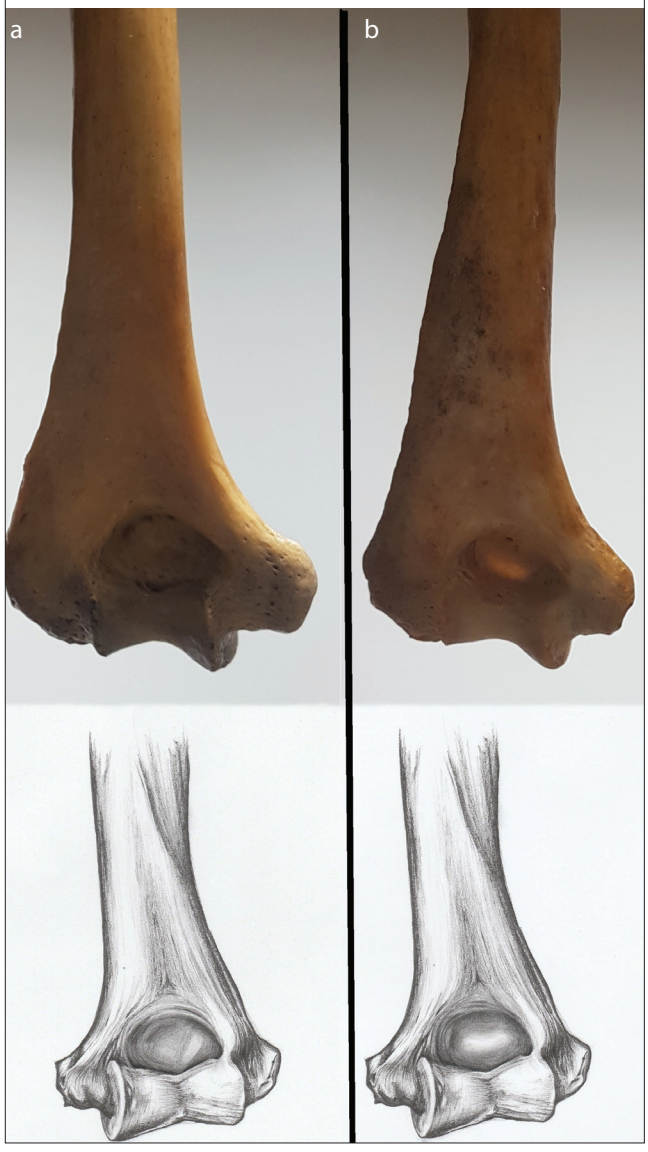
Table 1. Evaluation of the diameters of the supratrochlear foramen

Side	n (%)	Transverse diameter (mm)	Vertical diameter (mm)
Right	11 (19.64)	6.55±2.84	4.81±1.38
Left	11 (21.15)	5.64±1.96	4.82±1.33
Total	22 (20.37)	6.09±2.43	4.86±1.32

ramens were detected to be round-, 3 (5.36%) oval-, and 3 (5.36%) kidney-shaped, whereas on the left side, 6 (11.54%) foramens were detected to be oval- and 5 (9.62%) round-shaped (Figure 1). The diameters of the supratrochlear foramen are shown in Table 1. The distances between the medial edge of the supratrochlear foramen and the outer border of the medial epicondyle were 25.00±3.07 mm on the right side and 24.73±3.04 mm on the left side, whereas the distances between the lateral edge of the supratrochlear foramen and the outer border of the lateral epicondyle were 26.19±2.64 mm on the right side and 26.91±1.97 mm on the left side. No statistically significant difference was detected by the side (p=0.122 and p=0.80, respectively).

The supratrochlear foramen was absent in the 86 dry humeri. The septum of these humeri was classified as translucent or opaque (Figure 2). Of the 86 dry humeri, 57 (66.28%, R: 30 and L: 27) had a translucent septum, and 29 (33.72%, R: 15 and L: 14) had an opaque septum. In the present study, the cribriform septum was not observed.

Figure 2. a, b. The distal end of the humerus showing different types of the septum on dry bone and illustration (a: opaque septum, b: translucent septum)



DISCUSSION

Terminology

In the literature, this formation can be referred to as the supratrochlear foramen (1–40), septal aperture (1, 3, 5–7, 10–15, 17–25, 27, 29, 30, 32, 33, 38, 40–44), supratrochlear aperture (2, 5, 11, 36, 37, 39), intercondylar foramen (3, 5, 11, 15, 16, 18, 20, 21, 23, 27, 28, 32, 39), epitrochlear foramen (3, 5, 11, 15, 16, 18, 39), olecranon foramen (15, 21, 32, 39), or olecranon perforation (1). The reasons for these names are as follows:

- Supratrochlear foramen, supratrochlear aperture, and epitrochlear foramen are termed due to being located on the upper of the trochlea of the humerus.

- Septal aperture is termed due to the perforated septal part on the distal end of the humerus.
- Intercondylar foramen is termed due to being located between the medial and the lateral epicondyles.
- Olecranon foramen and olecranon perforation are termed due to being formed as a result of olecranon pressure.

Mathew et al. (15) stated that the reason for the use of many terms to express the same structure is the fact that the function and etiology of this formation have not yet been understood. There is no term for this formation in the Terminologia Anatomica (45). It is thought that using the term supratrochlear foramen is more appropriate, as this is the most commonly used term in the previous studies.

Many publications (3, 5, 6, 10, 16) reported that the supratrochlear foramen formation was first described by Meckel in 1825. Later on, the presence of the supratrochlear foramen in dogs, rats, cattle, hyenas, and other primates was investigated, especially by anthropologists (3, 6, 30, 46). Hirsh (8) stated that perforation is very commonly seen in primates other than humans. Erdogmus et al. (5) stated that the supratrochlear foramen attracts the great interest of anthropologists who believe that it is an important formation in establishing a relationship between lower animals and humans.

Causes

There is no precise information about the formation mechanism and incidence of this variation. In the literature, there are publications state that this variation might originate from interracial differences (5, 17, 30, 40). However, it is thought that this deduction cannot be made, as most of these studies were conducted on dry bones and it was hard to determine the race of these bones precisely. Moreover, some of these publications include inconsistencies. Singhal and Rao (30) stated that their study was conducted on a South Indian population. On the other hand, Das (47) expressed that the possibility that all bones belonged to a South Indian population is very low since Singhal and Rao (30) conducted their studies in a cosmopolitan city. Although Öztürk et al. (1) did not mention the racial origin of the bones used in their study conducted at Istanbul University, Istanbul Faculty of Medicine located in İstanbul (Turkey), Erdogmus et al. (5) referred to the study by Öztürk et al. (1) as a study performed on a Turkish population. Interestingly, Li et al. (17), Arunkumar et al. (25), Shivaleela et al. (39), Nayak et al. (29), Singhal and Rao (30), and Burute et al. (20) stated that Öztürk et al. (1) performed measurements on Egyptian bones. Owing to these conflicting studies, it is thought that it would not be appropriate to infer a relationship between the occurrence rate of the supratrochlear foramen and bone studies based on race. On the other hand, it is believed that this deduction may be made from studies conducted on living humans using radiologic imaging methods, as the age, gender, and ethnicity of these individuals are known.

It is not clearly known to what extent nutrition, work, and cultural factors affect the supratrochlear foramen and whether it has genetic factors (48, 49). There are publications reporting that the formation mechanism of the supratrochlear foramen can be due to genetic and/or environmental factors (1, 48, 49). Trotter (50) stated that the formation of the supratrochlear foramen may be associated with elbow hyperextension. Mays (42) and Papaloucas et al. (40) suggested that it may be associated with coronoid and/or olecranon process impingement. Myszka and Trzciński (51) reported that it may form as a result of osteoarthritis. Papaloucas et al. (40) stated that the formation may originate from osteoporosis. Hirsh (8) mentioned that the pressure of the olecranon may lead to form the septal aperture by reducing the blood supply.

Age of Occurrence

Akabori (43) reported that the supratrochlear foramen was not seen in embryonic and infantile humeri. Hirsh (8) stated that the septum exists until age 7 years and then becomes cribriform, and that lamellar atrophy begins, the intralamellar spaces enlarge, and absorption of the central part of the septum finally occurs. Trotter (50) reported that the incidence of the supratrochlear foramen was the highest in Caucasians aged 20–29 years and in Blacks aged 20–39 years. Koyun et al. (27) stated that the highest incidence of the supratrochlear foramen is seen in the second decade of life.

Incidence Rates, Diameters, Shapes, and Distance from the Epicondyles

The incidence rates of the supratrochlear foramen (Table 2) (1–3, 5–7, 9–12, 14–22, 25–32, 34, 36–39, 52, 53), the diameters of the supratrochlear foramen (Table 3) (1–3, 5, 6, 9, 10, 13–18, 20, 21, 25, 26, 28–31, 34, 36, 37, 39, 52–54), the shapes of the supratrochlear foramen (Table 4) (1–3, 5, 6, 9–16, 18–21, 25, 29–31, 34, 36, 37, 39, 52, 53), and the distance of the supratrochlear foramen from the epicondyles (Table 5) (5, 7, 13–15, 29, 31, 34) have been evaluated in various publications in the literature.

Evaluation of the Septum with Respect to Being Translucent or Opaque

In the previous studies, the septum has been evaluated into 2 groups consisting of translucent and opaque (Table 6) (5–7, 9, 10, 12, 14, 15, 22, 25, 29, 30, 36, 37, 39, 52, 53).

Clinical Significance

The existence of the supratrochlear foramen has been reported as clinically significant (5, 41). Sahajpal and Pichora (41) believed that the septal apertures in their otherwise healthy humeri probably act as stress risers from which these atypical fractures emerge following a low energy impact. The supratrochlear foramen located on the distal end of the humerus is associated with the intramedullary canal. The diameter of the intramedullary canal in the humeri that lack the supratrochlear foramen is approximately 6–8 mm, whereas this diameter is approximately 4 mm in cases that have the supratrochlear foramen (11, 33, 53). The incidence of the distal humerus intramedullary fixation has increased today due to traumatic injuries and pathologic fractures (33). Mahitha et al. (2) stated that the anatomical structure of the humerus may play an important role in the intramedullary fixation, thereby stressing the need for prior anatomical knowledge and preoperative planning in the presence of variations, such as the supratrochlear foramen in the distal end of the humerus. Radiologic imaging may be used to evaluate pathological lesions and abnormal cysts in the humerus (52). It is important not to

Table 2. The ratios of the supratrochlear foramen and comparison with the literature

	Right		Left		Total	
Study	**n**	**no. of STF (%)**	**n**	**no. of STF (%)**	**n**	**no. of STF (%)**
Arunkumar et al. (25)	188	37 (19.68)	167	39 (23.35)	355	76 (21.41)
Bhanu and Sankar (6)	49	13 (26.53)	72	24 (33.33)	121	37 (30.58)
Burute et al. (20)	58	12 (20.69)	55	18 (32.73)	113	30 (26.55)
Chagas et al. (26)	145	28 (19.31)	185	46 (24.86)	330	74 (22.42)
Dang et al. (52)	46	12 (26.09)	54	18 (33.33)	100	30 (30)
Diwan et al. (10)	905	183 (20.22)	871	245 (28.13)	1776	428 (24.10)
Erdogmus et al. (5)*	48	1 (2.09)	30	5 (16.67)	78	6 (7.69)
Erdogmus et al. (5)**	37	5 (13.51)	51	7 (13.73)	88	12 (13.64)
Jadhav and Zambare (12)	113	39 (34.51)	109	38 (34.86)	222	77 (34.68)
Joshi et al. (7)	85	20 (23.53)	85	41 (48.24)	170	61 (35.88)
Kaur and Zorasingh (38)	40	10 (25)	40	12 (30)	80	22 (27.5)
Krishnamurthy et al. (37)	84	(18)	96	(28)	180	42 (23.33)
Koyun et al. (27)*, ***					367	26 (7.1)
Koyun et al. (27)**, ***					342	35 (10.2)
Kumar et al. (3)	151	26 (17.22)	119	31 (26.05)	270	57 (21.11)
Kumarasamy et al. (14)	131	48 (36.64)	83	19 (22.89)	214	67 (31.31)
Li et al. (17)	137	9 (6.57)	125	18 (14.4)	262	27 (10.31)
Mathew et al. (15)	114	41 (35.96)	130	19 (14.62)	244	60 (24.59)
Mahitha et al. (2)	52	6 (11.54)	44	12 (27.27)	96	18 (18.75)
Mayuri et al. (18)		12		19	76	
Mahajan (22)*	36	6 (16.67)	36	9 (25)	72	15 (20.83)
Mahajan (22)**	14	5 (35.71)	14	6 (42.86)	28	11 (39.29)
Naqshi et al. (9)	40	10 (25)	40	12 (30)	80	22 (27.50)
Nayak et al. (29)	164	73 (44.51)	220	59 (26.82)	384	132 (34.38)
Ndou et al. (34)		87		140	453	227 (50.11)
Öztürk et al. (1)	54	4 (7.41)	60	5 (8.33)	114	9 (7.89)
Paraskevas et al. (32)					240	26 (10.83)
Patel et al. (36)	279	53 (19)	286	80 (27.97)	565	133 (23.54)
Ramamurthi (21)	82	22 (26.9)	78	16 (20.7)	160	38 (23.75)
Savitha and Dakshayani (11)	22	4 (18.18)	28	10 (35.71)	50	14 (28)
Singhal and Rao (30)	78	22 (28.21)	72	20 (27.78)	150	42 (28)
Shivaleela et al. (39)	72	16 (22.22)	70	22 (31.43)	142	38 (26.76)
Soni et al. (31)****		1				
Varalakshmi et al. (28)	41	9 (21.95)	44	13 (29.55)	85	22 (25.88)
Veerappan et al. (53)	35	5 (14.29)	39	9 (23.08)	74	14 (18.92)
This study	56	11 (19.64)	52	11 (21.15)	108	22 (20.37)

*: male (M); **: female (F); ***: bilaterally; ****: case report. All studies were conducted on dry bone except the study by Koyun et al. (27). The study by Koyun et al. (27) was conducted on radiogram and CT

STF: supratrochlear foramen; CT: computerized tomography

Table 3. Evaluation of the diameters of the supratrochlear foramen and comparison with the literature

			Transverse diameter (mm)						Vertical diameter (mm)					
	n		Right		Left		Total		Right		Left		Total	
Study	R	L	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Arunkumar et al. (25)	188	167	5.67± 1.71		5.39± 1.57				3.9± 1.32		3.84± 1.2			
Bhanu and Sankar (6)	49	72	6.68± 0.80		6.92± 2.00				5.75± 1.50		4.86± 1.20			
Blakely et al. (54)	115		3.79± 1.55		4.18± 1.78				4.78± 2.18		5.96± 2.76			
Burute et al. (20)	58	55					6.3						4.3	
Chagas et al. (26)	145	185	2.365± 1.396		2.332± 1.234				2.778± 2.197		2.780± 2.050			
Dang et al. (52)	46	54	5.14± 1.165		5.21± 2.13				3.79± 0.68		3.94± 1.40			
Diwan et al. (10)	905	871							****					
Erdogmus et al. (5)*	48	30	6.52± 0.0	6.7–6.7	6.7± 2.2	4.1–8.9			2.72± 0.0	2.7–2.7	4.26± 0.0	2.9–5.1		
Erdogmus et al. (5)**	37	51	5.34± 0.95	4.3–6.2	5.64± 1.66	2.7–7.9			4.59± 0.36	4.2–4.9	3.92± 0.93	2.1–5		
Joshi et al. (7)	85	85	5.5± 2.89		6.48± 2.47				3.75± 1.48		4.68± 1.43			
Kumarasamy et al. (14)	131	83	6.50± 2.26	2.20–10.04	5.82± 2.07	3.30–10.3			4.48± 1.86	2–8.10	3.98± 1.68	2.10–7.60		
Kumar et al. (3)	151	119	5.76± 2.22		6.36± 2.88				4.64± 2.45		4.76± 2.64			
Krishnamurthy et al. (37)	84	96	5.26± 2.47		6.50± 2.59				4.00± 1.52		4.70± 1.69			
Li et al. (17)	137	125	3.26± 1.15		4.47± 2.27				3.56± 1.30		5.07± 2.26			
Mahitha et al. (2)	52	44	4.6 (2–7)		6.2 (3–9)				3.4 (2–5)		4.2 (2–6)			
Mathew et al. (15)	114	130	5.12		4.9				3.48		3.27			
Mayuri et al. (18)	76							4–18						2.5–10
Nayak et al. (29)	164	220	5.99± 1.47	3.1–8.9	6.55± 2.47	2.3–10.3			3.81± 0.97	2.2–5.5	4.85± 1.64	2–7.5		
Naqshi et al. (9)	40	40	5.3± 2.37		6.6± 2.53				3.9± 1.32		4.6± 1.63			
Ndou et al. (34)*	164						6.2						4	
Ndou et al. (34)**	289						6.3						4.11	
Öztürk et al. (1)	54	60	6.51± 1.97		6.86± 2.07		6.70± 1.91	3.65–8.90	4.07± 0.99		4.95± 1.60		4.56± 1.37	2.85–6.95
Paraskevas et al. (13)***		1					7.81						5.09	
Patel et al. (36)	279	286	7.31± 1.77		7.03± 1.49				4.77± 1.15		4.90± 1.68			
Ramamurthi (21)	82	78	6.5		5.8				4.4		3.9			
Singhal and Rao (30)	78	72					6.92						4.64	
Soni et al. (31)***	1						6.22						4.64	
Varalakshmi et al. (28)	41	44	4.46		4.60				3.13		3.08			
Veerappan et al. (53)	35	39	8.30± 1.07		7.53± 1.28		7.94± 1.19		4.09± 1.13		5.35± 1.60		6.01± 1.49	
This study	56	52	6.55± 2.84		5.64± 1.96		6.09± 2.43		4.81± 1.38		4.82± 1.33		4.86± 1.32	

*: male; **: female; ***: case report; ****: the average vertical and transverse diameters of round-shaped STF were 0.28 mm on the right side and 0.23 mm on the left side, the vertical diameters of oval-shaped STF were 3.6 mm on the right side and 3.8 mm on the left side, the transverse diameters of oval-shaped STF were 5.5 mm on both sides, the height of triangular-shaped STF was 3.1 mm on the right side and 3.06 mm on the left side, and the length of triangular STF was 4.73 mm on the right side and 4.22 mm on the left side

R: right; L: left; STF: supratrochlear foramen

Table 4. Evaluation of the shapes of the supratrochlear foramen and comparison with the literature

	n		Oval		Round		Irregular		Triangular		Semilunar		Sieve		Reniform		Kidney	
Study	**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**	**R**	**L**
Mahitha et al. (2)	52	44	2	6	2	4	2	2										
Kumar et al. (3)	151	119	19	26	5	5			1		1							
Bhanu and Sankar (6)	49	72	9	17	4	7												
Joshi et al. (7)	85	85	8	32	2	0												
Diwan et al. (10)	905	871	152	201	28	37			3	7								
Dang et al. (52)	46	54	4	8	8	10												
Savitha and Dakshayani (11)	22	28	1	3	1	4			1	1			1	2				
Jadhav and Zambare (12)	113	109	27	25	6	7	6	6										
Paraskevas et al. (13)***		1		1														
Mathew et al. (15)	114	130	8	23	5	8			2	1			1	4	1	6		
Öztürk et al. (1)	54	60	4	5														
Singhal and Rao (30)	78	72	20		2	19				1								
Soni et al. (31)***	1		1															
Erdogmus et al. (5)*	48	30	1	4						1								
Erdogmus et al. (5)**	37	51	2	6	1	1				1				1				
Shivaleela et al. (39)	72	70	6	10	8	10	2	2										
Ndou et al. (34)	453		136		77		34		9									
Veerappan et al. (53)	35	39	6		5				2				1					
Burute et al. (20)	58	55	****		5		8											
Naqshi et al. (9)	40	40	20		2													
Kumarasamy et al. (14)	131	83	55		12													
Mayuri et al. (18)	76		15		13				2				1					
Veerappan et al. (16)	35	39	6		5				2				1					
Patel et al. (36)	279	286	125		6				2									
Krishnamurthy et al. (37)	84	96	*****															
Arunkumar et al. (25)	188	167	71		2				3									
Nayak et al. (29)	164	220	123		7				2									
Ramamurthi (21)	82	78	55		12													
This study	56	52	3	6	5	5											3	

*: male; **: female; ***: case report; ****: transversely: 16 and vertically: 1; *****: oval–shaped STF was more common than vertical–shaped STF
R: right; L: left; n: total humerus

evaluate the supratrochlear foramen as an osteolytic lesion. In addition, it is significant to be aware of the existence of the supratrochlear foramen for an accurate radiologic diagnosis in individuals who have this variation (17). The supratrochlear foramen is also very important to the work of radiologists, anatomists, anthropologists, and orthopedic surgeons.

CONCLUSION

It is apparent that the supratrochlear foramen has been evaluated on dry bones generally in the literature, and that there are differences in incidence rates. It is thought that studying on a wider population of living individuals using radiologic imaging methods will contribute to the literature owing to the clinical

Table 5. Evaluation of the distance of the supratrochlear foramen from the epicondyles and comparison with the literature

	n			STF-medial epicondyle (mm)		STF-lateral epicondyle (mm)	
Study	**R**	**L**	**T**	**R**	**L**	**R**	**L**
Joshi et al. (7)	85	85	170	24.7±3.3	25.2±3.2	24.7±1.9	25.7±2.7
Paraskevas et al. (13)***		1			21.59		
Kumarasamy et al. (14)	131	83	214	24.4±2.89	24.5±2.50		
Mathew et al. (15)	114	130	244	24.91±2.93	24.39±3.15	27.2±2.95	26.92±2.46
Nayak et al. (29)	164	220	384	28	26.1		
Soni et al. (31)***	1			24		29	
Erdogmus et al. (5)*	48	30	78	30.56	28.97±1.59	29.54	28.68±1.23
Erdogmus et al. (5)**	37	51	88	24.70±1.95	23.93±2.65	26.65±0.68	26.92±1.28
Ndou et al. (34)*	228	225	453	27.6		28.1	
Ndou et al. (34)**				24.0		25.1	
This study	56	52	108	25.00±3.07	24.73±3.04	26.19±2.64	26.91±1.97

*: male; **: female; ***: case report
R: right; L: left; STF: supratrochlear foramen

Table 6. Evaluation of the septum and comparison with the literature

	R			L			T		
Study	**N**	**Translucent (%)**	**Opaque (%)**	**N**	**Translucent (%)**	**Opaque (%)**	**N**	**Translucent (%)**	**Opaque (%)**
Bhanu and Sankar (6)	49	27 (55.10)	6 (12.24)	72	42 (58.33)	9 (12.50)	121	69 (57.02)	15 (12.40)
Joshi et al. (7)	85	35 (41.18)	30 (35.29)	85	27 (31.76)	17 (20)	170	62 (36.47)	47 (27.65)
Naqshi et al. (9)	40	22 (55)	8 (20)	40	19 (47.50)	9 (22.5)	80	41 (51.25)	17 (21.25)
Diwan et al. (10)	905	658 (72.70)	64 (7.07)	871	497 (57.06)	129 (14.81)	1776	1155 (65.03)	193 (10.87)
Dang et al. (52)	46	18 (39.13)	16 (34.78)	54	12 (22.22)	24 (44.44)	100	30 (30)	40 (40)
Jadhav and Zambare (12)	113	9 (7.96)	42 (37.17)	109	6 (5.50)	48 (44.03)	222	15 (6.76)	90 (40.54)
Kumarasamy et al. (14)	131	41 (31.30)	42 (32.06)	83	23 (27.71)	41 (49.40)	214	64 (29.91)	83 (38.79)
Mathew et al. (15)	114	70 (61.40)	25 (21.93)	130	69 (53.08)	20 (15.38)	244	139 (56.97)	45 (18.44)
Mahajan (22)*	36	27 (75)	3 (8.33)	36	21 (58.33)	6 (16.67)	72	48 (66.67)	9 (12.50)
Mahajan (22)**	14	8 (57.14)	1 (7.14)	14	6 (42.86)	2 (14.29)	28	14 (50)	3 (10.71)
Arunkumar et al. (25)	188	106 (56.38)	45 (23.94)	167	76 (45.51)	52 (31.14)	355	182 (51.27)	97 (27.32)
Nayak et al. (29)	164	54 (32.93)	37 (22.56)	220	89 (40.45)	52 (23.64)	384	143 (37.24)	89 (23.18)
Singhal and Rao (30)	78	51 (65.38)	5 (6.41)	72	48 (66.67)	4 (5.56)	150	99 (66)	9 (6)
Erdogmus et al. (5)*	48	10 (22.22)	37 (77.08)	30	7 (23.33)	18 (60)	78	17 (21.79)	55 (70.51)
Erdogmus et al. (5)**	37	7 (18.92)	25 (67.57)	51	10 (19.61)	34 (66.67)	88	17 (19.31)	59 (67.05)
Ramamurthi (21)	82	41 (50)		78	23 (29.49)		160	64 (40)	
Patel et al. (36)	279	126 (45.16)	100 (35.84)	286	101 (35.31)	105 (36.71)	565	227 (40.18)	205 (36.28)
Krishnamurthy et al. (37)	84	37 (44.05)		96	55 (57.29)		180	92 (51.11)	
Shivaleela et al. (39)	72	36 (50)	20 (27.78)	70	32 (45.71)	16 (22.86)	142	68 (47.89)	36 (25.36)
Veerappan et al. (53)	35			39			74	30 (40.54)	30 (40.54)
This study	56	30 (53.57)	15 (26.79)	52	27 (51.92)	14 (26.92)	108	57 (52.78)	29 (26.86)

*: male; **: female. All studies were conducted on dry bone
R: right; L: left; T: total

significance of this formation. In addition, although there are different terms used to express this formation in the literature, it is thought that adopting the name, which is commonly used as supratrochlear foramen, is most appropriate.

Ethical statement: Author declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Informed consent was not required because research was performed on anatomic specimens.

Peer-review: Externally peer-reviewed.

Acknowledgments: The author thanks Zeynep Türkan, student of School of Medicine, University of Gaziantep for drawings.

Conflict of Interest: The author has no conflicts of interest to declare.

Financial Disclosure: The author declared that this study has received no financial support.

REFERENCES

1. Öztürk A, Kutlu C, Bayraktar B, Ari Z, Sahinoglu K. The supratrochlear foramen in the humerus: anatomical study. Ist Tip Fak Mecmuasi 2000; 63: 72-6.
2. Mahitha B, Jitendra R, Janaki V, Navakalyani T. Supratrochlear foramen of humerus in telangana state: a morphometric study. Int J Anat Res 2016; 4: 2450-3. [CrossRef]
3. Kumar U, Sukumar C, Sirisha V, Rajesh V, Murali Krishna S, Kalpana T. Morphologic and Morphometric Study of Supra Trochlear Foramen of Dried Human Humeri Of Telangana Region. Int J Cur Res Rev 2015; 7: 95-8.
4. De Wilde V, De Maeseneer M, Lenchik L, Van Roy P, Beeckman P, Osteaux M. Normal osseous variants presenting as cystic or lucent areas on radiography and CT imaging: a pictorial overview. Eur J Radiol 2004; 51: 77-84. [CrossRef]
5. Erdogmus S, Guler M, Eroglu S, Duran N. The importance of the supratrochlear foramen of the humerus in humans: an anatomical study. Med Sci Monit 2014; 20: 2643. [CrossRef]
6. Bhanu PS, Sankar KD. Anatomical note of supratrochlear foramen of humerus in south costal population of Andhra Pradesh. NMJ 2012; 1: 28-34.
7. Joshi MM, Kishve PS, Wabale RN. A morphometric study of supratrochlear foramen of the humerus in western indian dry bone sample. Int J Anat Res 2016; 4: 2609-13. [CrossRef]
8. Hirsh IS. The supratrochlear foramen: clinical and anthropological considerations. Am J Surg 1927; 2: 500-5. [CrossRef]
9. Naqshi BF, Shah AB, Gupta S, Raina S, Khan HA, Gupta N, et al. Supratrochlear foramen: an anatomic and clinico-radiological assessment. Int J Health Sci Res 2015; 5: 146-50.
10. Diwan RK, Rani A, Rani A, Chopra J, Srivastava AK, Sharma PK, et al. Incidence of supratrochlear foramen of humerus in North Indian population. Biomed Res 2013; 24: 142-5.
11. Savitha V, Dakshayani K. Study of supratrochlear foramen of humerus. Int J Anat Res 2016; 4: 2979-83. [CrossRef]
12. Jadhav SD, Zambare BR. Supratrochlear foramen and its clinical significance. Asian J Biomed Pharmaceut Sci 2015; 5: 13-5. [CrossRef]
13. Paraskevas GK, Natsis K, Anastasopoulos N, Ioannidis O, Kitsoulis P. Humeral septal aperture associated with supracondylar process: a case report and review of the literature. Ital J Anat Embryol 2012; 117: 135-41.
14. Kumarasamy SA, Subramanian M, Gnanasundaram V, Subramanian A, Ramalingam R. Study of intercondyloid foramen of humerus. Rev Arg de Anat Clin 2011; 3: 32-6.
15. Mathew AJ, Gopidas GS, Sukumaran TT. A study of the supratrochlear foramen of the humerus: anatomical and clinical perspective. J Clin Diagn Res 2016; 10: 5-8. [CrossRef]
16. Veerappan V, Ananthi S, Gopal N, Kannan G, Prabhu K. Anatomical and radiological study of supratrochlear foramen of humerus. World J Pharm Pharm Sci 2013; 2: 313-20.
17. Li J, Mao Q, Li W, Li X. An anatomical study of the supratrochlear foramen of the Jining population. Turk Journal Med Sci 2015; 45: 1369-73. [CrossRef]
18. Mayuri J, Aparna T, Pradeep P, Smita M. Anatomical study of supratrochlear foramen of humerus. J Res Med Dent Sci 2017; 1: 33-5.
19. Hima BA, Narasinga RB. Supratrochlear foramen-a phylogenıc remnant. Int J Intg Med Sci 2013; 3: 130-2.
20. Burute P, Singhal S, Priyadarshini S. Supratrochlear Foramen; morphological correlation and clinical significance in western maharashtrian population. IJA 2016; 5: 275-9. [CrossRef]
21. Ramamurthi K. Morphometric analysis of supratrochlear foramen of humerus in south indian population. Sch Acad J Biosci 2016; 4: 908-10.
22. Mahajan A. Supratrochlear foramen; study of humerus in North Indians. Professional Med J 2011; 18: 128-32.
23. Kubicka AM, Myszka A, Piontek J. Geometric morphometrics: does the appearance of the septal aperture depend on the shape of ulnar processes? Anat Rec (Hoboken) 2015; 298: 2030-8. [CrossRef]
24. Williams E, Weinstock J, Spencer N. Holey Goats: Multiple Cases of Supratrochlear Foramina in the Humerus of Caprines from the New Kingdom Pharaonic Town of Amara West, Northern Sudan. Envir Archaeol 2017: 1-6. [CrossRef]
25. Arunkumar K, Manoranjitham R, Raviraj K, Dhanalakshmi V. Morphological study of supratrochlear foramen of humerus and its clinical implications. Int J Anat Res 2015; 3: 1321-5. [CrossRef]
26. Chagas CA, Gutfiten-Schlesinger G, Leite TF, Pires LA, Silva JG. Anatomical and Radiological Aspects of the Supratrochlear Foramen in Brazilians. J Clin Diagn Res 2016; 10: AC10-3. [CrossRef]
27. Koyun N, Aydinlioğlu A, Gümrukcüoğlu FN. Aperture in coronoid-olecranon septum: A radiological evaluation. Indian J Orthop 2011; 45: 392-5. [CrossRef]
28. Varalakshmi K, Shetty S, Sulthana Q. Study of Supratrochlear foramen of humerus and its clinical importance. J Dent Med Sci 2014; 13: 68-70. [CrossRef]
29. 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: 90-4. [CrossRef]
30. Singhal S, Rao V. Supratrochlear foramen of the humerus. Anat Sci Int 2007; 82: 105-7. [CrossRef]
31. Soni S, Verma M, Ghulyani T, Saxena A. Supratrochlear foramen: An incidental finding in the foothills of Himalayas. OA Case Reports 2013; 2: 75-6. [CrossRef]
32. Paraskevas GK, Papaziogas B, Tzaveas A, Giaglis G, Kitsoulis P, Natsis K. The supratrochlear foramen of the humerus and its relation to the medullary canal: a potential surgical application. Med Sci Monit 2010; 16: BR119-23.
33. Akpinar F, Aydinlioglu A, Tosun N, Dogan A, Tuncay I, Ünal Ö. A morphometric study on the humerus for intramedullary fixation. Tohoku J Exp Med 2003; 199: 35-42. [CrossRef]
34. Ndou R, Smith P, Gemell R, Mohatla O. The supratrochlear foramen of the humerus in a South African dry bone sample. Clin Anat 2013; 26: 870-4. [CrossRef]
35. Ndou R. The significance of the supratrochlear aperture (STA) in elbow range of motion: an anatomical study. Anat Sci Int 2016: 1-10. [CrossRef]

36. Patel SV, Sutaria LK, Nayak TV, Kanjiya DP, Patel BM, Aterkar SH. Morphometric study of supratrochlear foramen of humerus. Int J Biomed Adv Res 2013; 4: 89-92. [CrossRef]
37. Krishnamurthy A, Yelicharla AR, Takkalapalli A, Munishamappa V, Bovinndala B, Chandramohan M. Supratrochlear foramen of humerus–a morphometric study. Int J Biol Med Res 2011; 2: 829-31.
38. Kaur J, Zorasingh. Supratrochlear foramen of humerus-A morphometric study. Indian J Basic Applied Med Res 2013; 7: 651-4.
39. Shivaleela C, Afroze KH, Lakshmiprabha S. An osteological study of supratrochlear foramen of humerus of south Indian population with reference to anatomical and clinical implications. Anat Cell Biol 2016; 49: 249-53. [CrossRef]
40. Papaloucas C, Papaloucas M, Stergioulas A. Rare cases of humerus septal apertures in Greeks. Trends Med Res 2011; 6: 178-83. [CrossRef]
41. Sahajpal DT, Pichora D. Septal aperture: an anatomic variant predisposing to bilateral low-energy fractures of the distal humerus. Can J Surg 2006; 49: 363-4.
42. Mays S. Septal aperture of the humerus in a mediaeval human skeletal population. Am J Phys Anthropol 2008; 136: 432-40. [CrossRef]
43. Akabori E. Septal apertures in the humerus in Japanese, Ainu and Koreans. Am J Phys Anthropol 1934; 18: 395-400. [CrossRef]
44. Ming-Tzu PA. Septal apertures in the humerus in the Chinese. Am J Phys Anthropol 1935; 20: 165-70. [CrossRef]
45. FCAT. Terminologia anatomica: Georg Thieme Verlag; 1998.
46. Haziroglu RM, Ozer M. A supratrochlear foramen in the humerus of cattle. Anat Histol Embryol 1990; 19: 106-8. [CrossRef]
47. Das S. Supratrochlear foramen of the humerus. Anat Sci Int 2008; 83: 120. [CrossRef]
48. Benfer RA, McKern TW. The correlation of bone robusticity with the perforation of the coronoid-olecranon septum in the humerus of man. Am J Phys Anthropol 1966; 24: 247-52. [CrossRef]
49. Glanville EV. Perforation of the coronoid-olecranon septum humero-ulnar relationships in Netherlands and African populations. Am J Phys Anthropol 1967; 26: 85-92. [CrossRef]
50. Trotter M. Septal apertures in the humerus of American whites and negroes. Am J Phys Anthropol 1934; 19: 213-27. [CrossRef]
51. Myszka A, Trzciński D. Septal aperture and osteoarthritis-the same or independent origins? Adv Anthropol 2015; 5: 116-21. [CrossRef]
52. Dang B, Malik VS, Parmar P. Supratrochlear foramen: incidence, importance and clinical implications in North-Indian Population. Int J Intg Med Sci 2016; 3: 265-9. [CrossRef]
53. Veerappan V, Thotakura B, Aruna S, Kannan G, Narayanan GKB. Study of intercondylar foramen of humerus - clinical and radiological aspect. IOSR-JNHS 2013; 2: 24-7. [CrossRef]
54. Blakely RL, Marmouze RJ, Wynne DD. The incidence of the perforation of the coronoid-olecran septum in the middle mississippian population of Dickson Mounds, Fulton County, Illinois. Proceedings of the Indiana Academy of Science 1968; 78: 73-82.