

Morphometric Evaluation of Rarely Seen Supratrochlear Foramen and Supracondylar Process in the Humerus in Turkish Population

Türk Populasyonunda Humerus'da Nadir Görülen Foramen supratrochleare ve Processus supracondylaris'in Morfometrik Değerlendirilmesi

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Abstract

Background: Sometimes seen distal to humerus foramen supratrochleare and supracondylar process are rare variations. Supracondylar process is a variations observed on the distal side of humerus. The supracondylar process is a variant located 1/3 distal side of the humerus. The supratrochlear foramen may appear between the coronoid fossa and olecranon fossa. Since the foramen may appear in a semi-transparent form, it may be misdiagnosed as an osteolytic lesion. The aim of the present study was to identify the prevalence and morphology of supratrochlear foramen and the supracondylar process of the humerus in Turkish population. Furthermore, we believe considering these variations by looking at this variation in the previously taken radiological images of the people, help identification of that person in any forensic case.

Materials and Methods: The present study was conducted on 460 humerus samples (237 right; 223 left) with unclear age and gender in the Anatomy Laboratories of Necmettin Erbakan Meram, KTO Karatay, Yozgat Bozok, Kayseri Erciyes Faculties of Medicine. Morphometric measurements of such formations on the humerus were performed through a digital calliper and osteometric board. Furthermore, along with supratrochlear typing, the prevalence in the process and humerus was also detected.

Results: In the present study, the supracondylar process was detected in 11 (2.4%) individuals (4 right; 7 left); however, it was not detected in 449 (97.6%) humerus samples. The supratrochlear foramen was detected in 63 (13.7%) of 460 humeri. The foramen supratrochlear was seen in 10.8% of the humerus on the right side in 16.5% (29) and in 16.5% of the left humerus. The prevalence of both process and foramen on the humerus was 0.7% (3). The average lengths of right supracondylar process and left supracondylar process were 9.47±1.94 mm and 16.24±14.06 mm, respectively. The vertical diameter was 3.45±1.07 mm on the right supratrochlear foramen, and 3.57±1.17 mm on the left supratrochlear foramen; mean transverse diameter of the right foramen was 4.73±2.81 mm, and mean transverse diameter was detected 4.41± 2.49 mm on the left.

Conclusions: The prevalence of supratrochlear foramen and the supracondylar process was higher on the left side; however, both are detected on the right side. We believe that the data obtained would be helpful for an orthopaedic surgeon during intramedullary nailing, and for differential diagnosis of some osteolytic lesions for a radiologist. In addition, these variations can be an important indicator in the differentiation of different races.

Key Words: Humerus, Supracondylar process, Supratrochlear foramen, Morphometry, Variation

Öz.

Amaç: Humerus'un distalinde bazen görülen foramen supratrochleare ve processus supracondylaris nadir görülen varyasyonlardır. Foramen supratrochlearis; fossa coronoid ve fossa olecranon arasında görülebilir. Bazen de foramen yarı saydam olarak görüldüğü için osteolitik bir lezyon olarak tanımlanır ve yanlış teşhise neden olabilir. Bu çalışmanın amacı humerus'taki foramen supratrochlearis ve processus supracondylaris'in Türk populasyonuna ait prevalansını ve morfolojisini tanımlamaktır.

Materyal ve Metod: Çalışmamız KTO Karatay, Yozgat Bozok, Kayseri Erciyes Üniversitesini Tıp Fakülteleri ve Necmettin Erbakan Üniversitesi Meram Tıp Fakültesi Anatomi Laboratuvar'ında bulunan kemik koleksiyonlarındaki yaşı ve cinsiyeti belli olmayan 460 humerus (237 sol, 223 sağ) üzerinde gerçekleştirilmiştir. Humerus'ta bu oluşumların morfometrik ölçümleri digital kumpas ve osteometrik tahta ile gerçekleştirildi. Ayrıca çalışmamızda foramen supratrochlearis'in tiplendirilmesi yanı sıra hem foramen hem de processus humerus'da görülme yüzdesi belirlendi.

Bulgular: Çalışmamızda processus supracondylaris 11 bireyde %2.4 oranında (sağ 4, sol 7) görülürken 446 humerus'da (%97.6) görülmedi. 460 humerus'un 63 tanesinde (%13.7) de foramen supratrochlearis görüldü. Humerus'un %10.8'inde sağ tarafta %16.5 (29), sol humerus'ların ise %16.5'inde foramen supratrochlearis görüldü. Humerus'da hem processus hemde foramen görülme sıklığı %0.7 (3) olarak belirlenmiştir. Sağ processus supracondylaris uzunluğu ortalama 9.47±1.94 mm, sol tarafta ise ortalama 16.24±14.06 mm olarak belirlenmiştir. Sağ foramen supratrochlearis vertikal çapı ortalama 3.45±1.07 mm, sol taraf çapı ise 3.57±1.17 mm; sağ foramen supratrochlearis transvers çapı ortalama 4.73±2.81 mm sol taraf çapı ise 4.41± 2.49 mm olarak tespit edildi.

Sonuç: Elde edilen verilerin ortopedik cerrahlar için intramedüller çivileme yaparken ve radyolog için o bölgedeki bazı osteolitik lezyonların ayırıcı tanısından yardımcı olacağı kanısındayız. Ayrıca bu varyasyonlar farklı ırkların ayırımında önemli bir gösterge olabilir.

Anahtar kelimeler: Humerus, Processus supracondylaris, Foramen supratrochlearis, Morfometrik, Varyasyon

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Introduction

The supracondylar process (SCP) is a bony protuberance located at 5 cm above the medial epicondyle on the antero-medial surface of the distal humerus (1-3). Since such bony protuberance may cause compression neuropathies or vascular obstructive diseases through compression by a tunnel covering important formations (the median nerve, the ulnar artery, the ulnar nerve) by ossification or by attaching onto the medial epicondyle of humerus through Struther's ligament, the existence of SCP should be considered (1,4,5) stated that the brachial artery may cause neural compression as well as involve associated muscles and formations (3).

The supratrochlear foramen (STF) is located on the trochlea on the distal humerus; therefore, it is a variation identified under different names by some researchers (6). Important vessels and nerves extend inside the foramen formation located on the bones. Although any anatomic formation extending inside STF is usually mentioned, Roaf (7) reported that the median nerve extends inside the STF and causes pain and decrease in the muscle strength. STF has different incidences depending on the race. Some researchers such as DE Wilde et al.(8) suggest that individuals with such variation have excessively longer elbow joint however, Hirsh (9) reported that the septum on the distal humerus is open until seven years of age. STF may have a septal formation with an incidence between 82.14% and 6.36%. It may appear as a completely opaque formation; the incidence of opaque ST varies between 68.7% and 6%.

Supracondylar fracture is the most common fracture type detected in children (10); therefore, rare anatomic formations (SCP and STF) detected on this region may guide the surgeons for possible surgical procedures (12).

In consideration of all clinical and surgical approaches the importance of the anatomical condition of SCP and STF has been revealed. This study was planned to provide detailed information about morphometric structure of both SCP and STF, and to reveal possible anatomic variations in the Central Anatolia population.

Materials and Methods

The present study was conducted on 460 dried humerus samples (237right; 223left) with unclear age and gender in Anatomy Departments of Necmettin Erbakan Meram, KTO Karatay, Yozgat Bozok and Kayseri Erciyes Faculties of Medicine. Humerus samples without intact trochlear area due to trauma or surgical procedure were not included in the study. Approvals were obtained from the Board of Ethics for Pharmaceuticals and Non-Medical Devices Research of Karatay University (2019/0039). Digital calliper was used for humerus measurements. Bone measurements were performed on 2 parts including SCP and STF. Furthermore, the existence of SCP and STF was evaluated (Figure 1).

Samples were classified according to the existence of STF and opaque or translucent septum formation in case of absence (Figure 2). However, STF form was categorized into 4 types including type 1, round; type 2, oval; type 3, rough, and type 4, kidney-shaped (Figure 3). All bones were photographed from same distance through micrometre scale of STF for typing; measurements were performed both on the bone and image by a single researcher.

SCP measurements (Figure 1);

SCPL: SCP length (Figure 1x)

SCPW:SCP width (Figure 1y)

SCPE: The distance between SCP and medial epicondyle (Figure 1z)

SCPFor: The distance between SCP and closest nutrient foramen (Figure 1l).

PSY: The location of SCP on the humerus was detected as the posterior face, anteromedial and anterolateral sides.

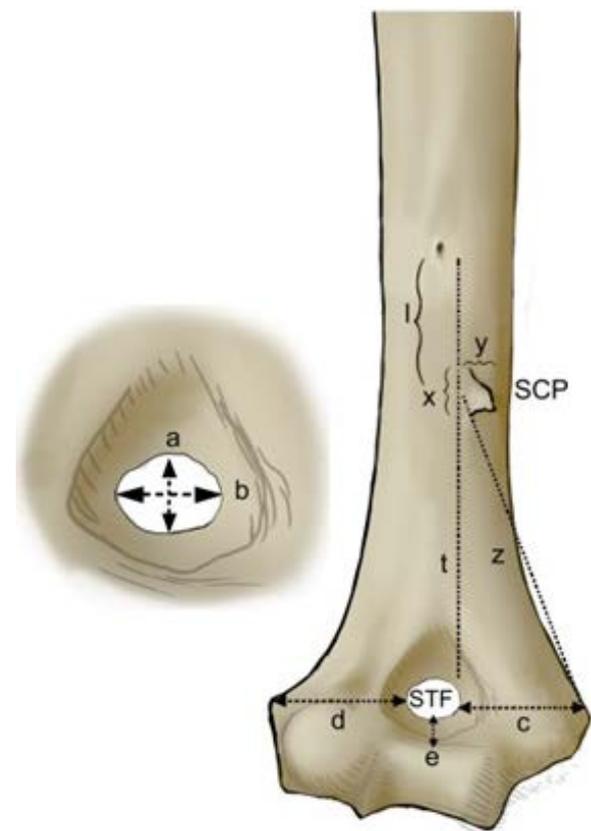


Figure 1. Photograph representing the various measurements in relation to the supratrochlear foramen (STF) and supracondylar process (SCP) in the lower end of humerus (a-vertical diameter of STF, b-horizontal diameter of STF, c- distance between the medial epicondyle of STF, d-distance between the lateralis epicondyle of STF, e- distance between the trochlea humeri, x- SCP length, y- SCP width, z- distance between the medial edge of SCP, t- distance between the STF of SCP, l- distance between the nutrient foramen of SCP).

SFT measurements (Figure 1);**STFV:** Vertical diameter of STF (Figure 1a)**STFT:** Transverse diameter of STF (Figure 1b)**STFE:** The distance between STF and medial epicondyle (Figure 1d)**STFL:** The distance between STF and lateral epicondyle (Figure 1c)**STFTH:** The distance between STF and lateral epicondyle (Figure 1e)**Existence of both STF and SCP;****t:** The distance of SCP to STF was measured.

All data were evaluated by SPSS 21.0 (Statistical Package for Social Science; IBM, Chicago, IL, USA). Mean values, standard deviations, maximum and minimum values, and percentages were detected for descriptive analysis. Furthermore, the independent student t-test was used for comparison of right and left ($p < 0.05$).

Results

A total of 460 dried humeri (223 right sides and 237 left sides) were examined to determine the presence of SCP and STF in the middle Anatolia belonging to Turkish population (Table 1).

The SCP (Figure 1) was detected on 11 (2.4%); it was observed in 1.8% cases on right side in 1.8% of the cases, and on the left side in 3% of the cases. SCP was detected more commonly on (81.8%) the anteromedial face (Table 1). Among 460 bones studied for presence of STF, was detected on 63 (13.7%) bones only. The prevalence of STF was higher on the right side (24 bones; 10.8%) when compared to the left side (39 bones; 16.5%) (Table 1). In bones where the foramen was absent, there was translucent septum 12 (2.6%) to opaque variety 358 (83.7%) of the septum (Table 1, Figure 2). The highest was seen on the left by 16.5% (39). Both SCP and STF are more common on the left side (Table 1). The incidence of both SCP and STF on the same humerus was found 0.7% (3), mostly on the right humerus.

After identification of STF, the mean vertical and the horizontal diameter were measured. The mean vertical and transverse diameter was 4.73 ± 2.81 mm and 3.45 ± 1.72 mm, respectively on the right side; and 4.41 ± 2.49 mm and 3.57 ± 1.71 mm, respectively on the left side. Differences between the diameters of the right and left sides were not statistically significant (Table 2, Figure 1).

The mean distance between the medial epicondyle and medial edge of the STF (MB) was 25.01 ± 3.91 mm (range; 15.87–31.84 mm) on the right side, and 23.94 ± 4.67 mm (range; 2.55–79 mm) on the left side. The mean distance between lateral epicondyle and lateral border of the STF (LB) was 27.58 ± 2.66 mm (range; 22.55–32.49 mm) on the right, and 27.5 ± 1.5 mm (range; 23.23–31.96 mm) on the left side. We observed the position of the STF located adjacent to the medial epicondyle.

The mean value for trochlea of humerus (TH) was 4.34 ± 1.25

mm (range; 3.17–8.61 mm) on the right, and 4.32 ± 1.19 mm (range; 2.45–6.98 mm) on the left side (Table 2, Figure 1). A significant and positive correlation was found between both SCP and STF measurement parameters.



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

The STF was round, oval, irregular, and kidney-shaped in 16 (25.4%), 19 (30.2%), 24 (38.1%), and 4 (6.3%) bones, respectively; the round shape was common on the right side, and the irregular shape was common on the left side (Table 1, Figure 3).



Figure 3. Different shapes of the supratrochlear foramen on dry bone and illustration (Type 1: round-shaped, Type 2: oval-shaped, Type 3: irregular, Type 4: kidney-shaped)

Table 1. Incidence of both supratrochlear foramen and supracondylaris procces of 460 humerus

		Total		Right Side		Left Side		
		n	%	n	%	n	%	
FORAMEN	Supracondylaris procces	11	2.4	4	1.8	7	3	
	Supratrochlear foramen & supracondylaris procces	3	0.7	2	0.9	1	0.4	
	Supratrochlear foramen	63	13.7	24	10.8	39	16.5	
	Round	16	25.4	9	37.5	7	17.9	
	Oval	19	30.2	7	29.2	12	30.8	
	Irregular	24	38.1	7	29.2	17	43.6	
	Kidney	4	6.3	1	4.2	3	7.7	
	SEPTUM	No Translucency	385	97	192	96.5	193	97.5
		Transluceny	12	3	7	3.5	5	2.5
		Foramen	63	13.7	24	10.8	39	16.5
Translucent septum		12	2.6	7	3.1	5	2.1	
Opaque septum		358	83.7	192	86.1	193	81.4	
Total		460	100	223	100	237	100	

(n: Number of individuals, %: Incidence rate)

Table 2. The different measurements in supracondylaris procces and supratrochlear foramen (mm).

Measurements	Total				Right side				Left side				p
	n	Min.	Max.	Mean±SD	n	Min.	Max.	Mean±SD	n	Min.	Max.	Mean±SD	
SCPL	11	2.24	45.72	13.78±11.46	4	7.09	11.85	9.47±1.94	7	2.24	45.72	16.24±14.06	0.254
SCPW	11	0.92	16.25	3.44±4.34	4	.97	2.87	2.07±0.79	7	.92	16.25	4.23±5.4	0.336
SCPE	11	26.96	99.15	57.3±18.5	4	50.80	59.89	54.37±4.16	7	26.96	99.15	58.97±23.52	0.630
STFT	62	0.77	10.96	4.53±2.60	24	1.08	10.96	4.73±2.81	38	0.77	9.76	4.41±2.49	0.657
STFV	62	0.86	7.24	3.52±1.7	24	1.38	7.17	3.45±1.72	38	.86	7.24	3.57±1.71	0.785
STFE	62	2.55	31.84	24.35±4.39	24	15.87	31.84	25.01±3.91	38	2.55	31.79	23.94±4.67	0.335
STFL	62	22.52	32.49	27.29±2.52	24	22.52	32.49	27.58±2.66	38	23.23	31.96	27.1±2.44	0.478
SCPFor	44	2.45	8.61	4.33±1.25	20	3.17	8.61	4.34±1.34	24	2.45	6.98	4.32±1.19	0.951
PSFSU	3	31.65	52.96	42.83±10.69	2	43.87	52.96	48.42±6.43	1	31.65	31.65	31.65	0.279

(n: Number of individuals, Min.: Minimum, Max.: Maximum, SD: Standard deviation, SCP: Supracondylar procces, STF: Supratrochlear foramen, SCPL: SCP length, SCPW: SCP width, SCPE: The distance between SCP and medial epicondyle, SCPFor: The distance between SCP and closest foramen nutrient, PSY: The location of SCP on the humerus was detected as the posterior face, anteromedial and anterolateral sides, STFV: Vertical diameter of STF, STFT: Transverse diameter of STF, STFE: The distance between STF and medial epicondyle, STFL: The distance between STF and lateral epicondyle, STFTH: The distance between STF and lateral epicondyle)

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

Researchers	No of humerus	Population	Incidence	Length	Widht	Distance from ME	Distance from NF
Oluşyemi et al., (33)	40 Kadavra	Nigeria	2.5	16	-	55	53
Kumar and Mehta (34)	380	Indians (Gujrat)	2.6	3	11	65	
Prabahita et al., (35)	80	Indians (Assam)	1.24	11	15	44	65
Vandana & Patil, (36)	133 dry	Indian (South)	0.75	8	12	53	38
Shivaleela et al., (3)	240	Indians (Karnataka)	0.41	10	10	60	47
Hema & Tanuja, (37)	125	India (Nellore)	0.65	10	-	-	-
Present study	460 dry	Turkey	2.4	13.77±11.45	3.44±4.34	57.3±18.50	46.02±17.20

(ME: Medial epicondyle, NF: Nutrient foramen)

Discussion

SCP is an abnormal bone variant located on the anteromedial surface on one-third of distal humerus (3). SCP extends to the towards medial epicondyle in some cases and forms the Struther ligament. This ligament may exist asymptotically; however, it may be diagnosed randomly (12). SCP and Struther ligament may together cause neurovascular compression (14). It was reported that SCP may be sufficient for compression of neurovascular structures (14). Some studies are indicating that existence of SCP may cause compression of the median nerve (4), brachial artery (14), ulnar artery (3), and ulnar nerve (5). Symptoms that occur on the forearm become different by compression of each structure. For example, vascular compression (in association with the brachial artery) causes ischemic pain, hematoma and cyanosis on the forearm. Pain, muscle loss and numbness may occur in the nerve compression. Such symptoms may increase through heavy manual operation. Recurrent heavy manual operations may become worse by existence of SCP at flexion and pronation (4,5,14). Symptoms similar to those of the carpal tunnel cause the presence of SCP and Struther ligament pain in the correct diagnosis Recognition of this variation is important for clinical presentation. Kumar et al. (13) stated about existence of the median nerve extending beneath the Struther ligament is 2 of 5 individuals who have referred due to pain on the distal humerus. It has caused paraesthesia on the forearm without any motor weakness. These patients were treated surgically through excision of the ligament and protuberance. Detection of SCP is essential for final diagnosis and treatment.

Incidence percentages for SCP presented in were results of studies on different races. The incidence of SCP varies between 0.4% and 3.6% (Table 3). Although a researcher suggests that the difference in incidence is dependent to hereditary formation of SCP (11), some researchers associate this existence with Theory of Evolution by Darwin. Peeters (11) reported in his study that SCP is transported by an autosomal recessive gene in Cornelia de Lange syndrome which may be observed on unilateral humerus in one of 10.000 live births. The incidence of SCP was detected as 2.4% in this study. Although there is not any incidence value for SCP in Turkish population, different values were obtained for SCP by different researches Bilge et al. (15) and Aydinlioglu et al. (16). Bilge et al. (15) reported that SCP was more prevalent on the left side whereas. Aydinlioglu et al. (16) reported bilateral existence of SCP. Martin-Schitz et al. (17) concluded in their meta-analysis that the prevalence for SCP existence was 0.68% in studies conducted up to date. They indicated that SCP is dominantly on the left side. In the present study, SCP prevalence was 2.4% (11) on all humerus samples (460); it was commonly detected on the left side by 3%. The study conducted by Martin-Schitz et al. (17) was also supported with abovementioned study.

Studies indicate a SCPL between 24 and 3 mm (Table 2). In our study, such length was 7.09-11.83 mm on the right side, and 2.24-45.72 mm on the left side. SCPW varied between 1 mm and 15 mm in previous studies whereas it was measured between 0.92 mm and 16.25 mm in our study. SCPE varies between 44 mm and 70.5 mm. Such value varied between 26.96 mm and 99.15 mm in our study. SCPF distance varies between 38 mm and 65 mm. Such value varied between 3.686 mm and 66.06 mm in our study. In our study, SCPL, SCPW, SCPE and SCPF were longer on the left side.

STF is a variant formation in the form of an opaque or thin bone plate or a hole, separating the coronoid fossa and olecranon fossa on trochlea humerus (18). Many hypotheses were suggested about STF. Some studies suggest SFT as an indicator for evolution (19,32); some indicated that it is detected more in primates when compared with human (17,18); however, Kaur (21) reported that SFT causes an excessive mechanic effect through hyperextension movements whereas there are studies on different incidence level of SFT on different races, and more existence on the left. The prevalence of SFT was detected by 13.7% (63) in our study. Furthermore, the incidence in studies conducted on Turkish population varies between 7.9% and 20.37% (Table 4). Previous studies detected significantly higher levels on semi-transparency characteristics than our study. The septal (translucent) aperture was found larger than our studies. Similar to other races, the septal aperture was detected on the left with a higher prevalence in our study (Table 4).

Supracondylar fractures consist of 75% of all paediatric injuries. Majority of these fractures locate on posterior side of the distal part (95%). Therefore, recognition of incidence of SFT is very important for surgical procedures to be performed on that region. Because, different procedures may be needed for nailing during supracondylar treatment Akpınar et al. (13), The existence of STF should be checked radiologically on the area before the procedure in order to plan the surgery. The nailing procedure of intramedullary humerus may cause a secondary supracondylar fracture when SFT exists. Antegrade medullary nailing technique may be preferred rather than retrograde technique in the presence of SFT.

SFT form was classified in single Ozturk (22) ; two Joshi and Wabale (23) , Naqshi et al. (24), Kumarasamy et al. (25) three Shivaleela et al. (3); Singhal and Rao (32); Arunkumar et al. (26) and Nayak et al., (27) four Bahşi (28), Kumar et al. (29), Erdogmus et al. (30) ; Veerappan et al. (31). We classified in 4 groups including round, oval, rough and kidney-shaped. The most common STF type detected in previous studies was rough (38.1%) followed by oval type (30.2%). The shape was round on the right side and rough on the left side. Detection of the STF type would prevent inaccurate interpretation by the radiologist, and help the surgeon to select the nail to be used in the surgical procedure on distal side of humerus (Table 4).

Table 4. Incidence of supratrochlear foramen and comparison with the literature

Researchers	Total						Right						Left						
	Translucent		Opaque		Foramen		Translucent		Opaque		Foramen		Translucent		Opaque		Foramen		
Total	n	%	n	%	n	%	Total	n	%	n	%	n	%	Total	n	%	n	%	
Öztürk et al. (22)	114				9	7.9	54					4	7.41	60			5	8.33	
Singhal and Rao (32)	150	99	66	9	6	42	28	78	51	65.38	5	6.41	22	28.21	72	48	66.67	4	5.56
Nayak et al. (27)	384	143	37.24	89	23.18	132	34.38	164	54	32.93	37	22.56	73	44.51	220	89	40.45	52	23.64
Kumarasamy et al.(25)	214	64	29.91	83	38.79	67	31.31	131	41	30.3	42	32.06	48	36.64	83	23	27.71	41	49.4
Krishnamurthy et al. (20)	180	92	66.6			42	23	84	37	40.2			18	96	55	60.1		28	
Bhanu and Sankar (39)	121	69	82.14					33	27	81.82	6	18.18	13	26.53	51	42	82.35	9	17.65
Diwan et al. (40)	1776	1155	65.03	193	10.87	428	24.1	905	658	72.7	64	7.07	183	20.22	871	497	57.06	129	14.81
Erdoğan et al. (30)	166	34	20.5	114	68.7	18	10.8	85	17	20	62	72.9	6	7.1	81	17	21	52	64.2
Arunkumar et al. (26)	355	182	51.27	97	27.32	76	21.41	188	106	56.38	45	23.94	37	19.68	167	76	45.51	52	31.14
Shivaleela et al. [3]	142	68	47.89	36	25.36			72	36	50	20	27.78	16	22.22	70	32	45.71	16	22.86
Mathew et al. (38)	244	139	56.97	45	18.44	60	24.59	144	70	61.4	25	21.93	41	35.96	130	69	53.08	20	15.38
Başı (28)	108	57	52.78	29	26.86	22	20.37	56	30	53.57	15	26.79	11	19.64	52	27	51.92	14	26.92
Present study	460	12	2.6	358	83.7	63	13.7	223	7	3.1	192	86.1	24	10.8	237	5	2.1	193	81.4

(n: Number of individuals, %: Incidence rate)

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

Study	n	Population	Right		Left	
			TD	VD	TD	VD
Öztürk et al. (22)	114	Turkish	6.51±1.97	4.07±0.99	6.86±2.07	4.95±1.60
Nayak et al. (27)	384	India	5.99±1.47	3.81±0.97	6.55±2.47	4.85±1.64
Kumarasamy et al. (25)	214	India	6.50±2.26	4.48±1.86	5.82±2.07	3.98±1.68
Krishnamurthy et al. (20)	180	South Indians	5.26±2.47	4±1.52	6.5±2.59	4.70±1.69
Bhanu and Sankar (39)	121	India	6.68±0.8	5.75±1.5	6.92±2.0	4.86±1.2
Veerappan et al. (31)	74	India	8.30±1.07	4.09±1.13	7.53±1.28	5.35±1.60
Erdogmus et al. (30)	166	Turkish	5.63±0.97	4.12±0.98	6.01±1.86	4.04±0.9
Kumar et al. (29)	270	India	5.76±2.22	4.64±2.45	6.36±2.88	4.76±2.64
Naqshi et al. (24)	80		5.3±2.37	3.9±1.32	6.6±2.53	4.6±1.63
Joshi et al. (23)	170	India	5.5±2.89	3.75±1.48	6.48±2.47	4.68±1.43
Mathew et (38)	244		5.12	3.48	4.9	3.27
Başı (28)	108	Turkish	6.55±2.84	4.81±1.38	5.64±1.96	4.82±1.33
Present study	460	Turkish	4.73±2.81	3.45±1.72	4.41±2.49	3.57±1.71

(n: Number of individuals. TD: Transverse diameter; VD: Vertical diameter)

Table6. The percentage of the septum and comparison with the according to the researchers (mm)

Study	n	Population	STF-Medial epicondyle		STF-Lateral epicondyle		STF-trochlea humeri	
			Right	Left	Right	Left	Right	Left
Kumarasamy et al. (25)	214	India	24.4±2.89	24.5±2.50				
Erdogmus et al. (30)	88	Turkish	24.70±1.95	23.93±2.65	26.65±0.68	26.92±1.28		
Joshi et al. (23)	170	India	24.7±3.3	25.2±3.2	24.7±1.9	25.7±2.7	24.7±1.9	25.7±2.7
Mathew et al (38)	244		24.91±2.93	24.39±3.15	27.2±2.95	26.92±2.46		
Başı (28)	108	Turkish	25±3.07	24.73±3.04	26.19±2.64	26.91±1.97		
Present study	460	Turkish	25.01±3.91	23.94±4.67	27.58±2.66	27.1±2.44	4.34±1.34	4.32±1.19

(n: Number of individuals, STF: Supratrochlear foramen)

Due to higher incidence for the STF in Turkish population, the distance between the STF and transverse, vertical, medial and lateral epicondyle, namely trochlea humeri is important (Table 5-6). Measurements taken in our study is slightly smaller than the values obtained by Bahşi (28) on Turkish population. Erdogmus et al. (30) detected higher values. The cause may depend on regional difference. It was found higher than other studies; the possible cause may be different racial characteristics.

The distance between STF and medial epicondyle was shorter than lateral epicondyle (Table 2). This may be used as an important data in order to determine the nail for surgical procedures of distal humerus fractures. It was stated that the best point for nail placement seemed anteromedial point (14).

Anatomic and radiological appearance and incidence of SCP and SFT are quite useful for orthopaedic surgeons and radiologists. Because skeletal data are very important for anthropologists in race estimation, for anatomists in definition of anatomical variations, for radiologists in interpretation of radiological images to detect normal structure and cause of disease, and variational status, and for surgeons in diagnosis and treatment with general results (32). X-ray images are used to detect bone cysts, tumours and other lytic lesions in daily clinical practice. Presence of a septum on STF areas may be confused with osteolytic or cystic lesions, and result with false positive diagnosis. Therefore, TSF information may prevent inaccurate interpretation of X-ray images by radiologists.

This study was carried out on 460 dried humeri in Central Anatolia population. Incidence of SCP and STF was detected 2.4% and 13.7%, respectively in this study. Furthermore, the prevalence of combined existence of the SCP and STF was found 0.7%.

Rather than evaluation of SCP and SFT as a normal anatomical variant, it causes misdiagnosis as a pathological bone condition. SCP usually does not present a clinical finding; however, it may be identified as a mass and become symptomatic and turn into a clinical symptom with compression of the artery, nerve or muscle in the area. This study was focused on the morphometric and morphological evaluation of SCP and SFT as two variants that may be detected on the distal end of humerus. Although majority of the studies evaluated the SCP and SFT individually, combined evaluation of SCP and SFT in our study would contribute to the literature. Previous studies found that both SCP and SFT prevalence may present racial differences. Important data on Turkish population of Central Anatolia was presented in our study. Furthermore, both SCP and STF are located on the left humerus. The incidences of SCP and SFT were found 2.4% and 13.7%, respectively, commonly on the left humerus. In addition, the incidence of both SCP and STF in our study was 0.7% and commonly observed on the right humerus. Shapes of SFT were found rough, oval, round and kidney-shaped, respectively.

Conclusion

This study may reveal the difference between genders or the change according to right- or left-hand use by working on more individuals using radiological images. Recognition of morphometric measurements of STF and SCP would be effective on successful orthopaedic surgeries. We believe that information of SCP and STF should be useful for anthropologists, orthopaedic surgeons as well as radiologists in order to detect the variations to prevent misdiagnosis as an osteolytic or cystic lesion. Furthermore, we believe that considering these variations by looking at this variation in the previously taken radiological images of the people may help identification of that person in any forensic case.

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