BJCR
BRAZILIAN JOURNAL OF CASE REPORTS

PCAA
PUBLICAÇÕES CIENTÍFICAS DE ACESSO ABERTO

Case Report

Case Report on a Supracondylar Process of the Humerus: Morphological and Morphometric analysis

José Aderval Aragão [1,*], Marcelo Lucas de Lima Prado [2], Iapunira Catarina Sant'Anna Aragão [3], Felipe Matheus Sant'Anna Aragão [4], Francisco Prado Reis [5], Deise Maria Furtado de Mendonça [6]

[1] Titular Professor of Clinical Anatomy, Department of Morphology, Federal University of Sergipe (UFS), Aracaju, SE, Brazil.
[2] Medical Student, Department of Medicine, Federal University of Sergipe (UFS), Aracaju, SE, Brazil.
[3] Medical Clinic Resident of Municipal Hospital Munir Rafful (HMMR), Volta Redonda, RJ, Brazil.
[4] Medical Clinic Resident of Faculty of Medicine of São José do Rio Preto (FAMERP), São José do Rio Preto, São Paulo, Brazil.
[5] Titular Professor, Medical School of Tiradentes University (UNIT), Aracaju, SE, Brazil.
[6] Associate Professor of Human Anatomy, Department of Morphology, Federal University of Sergipe (UFS), Aracaju, SE, Brazil.

* Correspondence: adervalufs@gmail.com.

Citation: Aragão JA, Prado MLL, Sant'Anna Aragão IC, Sant'Anna Aragão FM, Reis FP, Mendonça DMF. Case Report on a Supracondylar Process of the Humerus: Morphological and Morphometric analysis. Brazilian Journal of Case Reports. 2024 Oct-Dec;04(4):50-56.

Received: 3 March 2023
Accepted: 26 March 2024
Published: 28 March 2024

Abstract: The supracondylar process is a rare anatomical variation characterized by an irregular bone prominence with a variable size. Found in the anteromedial part of the distal region of the humerus, can compress the median nerve and other structures. The aim of this paper was to perform a morphological and morphometric evaluation of this variation in a right dry humerus. Faces, margins, and shape of the process were observed. Measurements was taken from the process and the entire bone. The apex of the process points toward the transition between the trochlea and the humeral capitulum. The bony spicule was 6.24 mm long. The base of the spicule measured 6.80 mm in length and 4.18 mm in width. Longitudinal crests associated with the base of the process and a deep longitudinal depression were observed. The combined longitudinal length of the caudal and cranial crests together was 32.37 mm. The distance from the bone spicule to the medial epicondyle was 65.29 mm. In pathological cases, vascular disturbances, sensory deficits, and decreased muscle strength can be observed. A comprehensive description of this variation is crucial for enhancing current knowledge and awareness in clinical practice, as it aids in accurate diagnosis and treatment.

Keywords: Anatomical Variation; Entrapment Syndrome; Humerus; Medial Epicondyle; Supracondylar Process.

1. Introduction

The supracondylar process is a rare anatomical variation found in the distal region of the humerus. It is a bony projection found in the anteromedial part of the bone [1-3]. It usually points downward and toward the medial epicondyle [4-6]. Histologically, it consists of normal bone tissue with an unaltered humeral cortex [7]. Although infrequent, the supracondylar process is a well-known variation, having been described more than two centuries ago [5]. Teidemann was the first to describe an exostosis of the humerus in apes in 1818, and in 1822 it was recognized as an anatomical variation. In 1841, Knox described it in humans and, in 1848, John Struthers described a fibrous band that extended from the supracondylar process to the medial epicondyle, known as the Struthers' ligament.

The supracondylar process, along with the Struthers' ligament, can create a pathway for the median nerve and brachial artery. However, the process can be present without the ligament, and vice versa, the ligament may be present even in the absence of the supracondylar process. From a phylogenetic and evolutionary perspective, this anatomical variation has been considered a remnant of the supracondylar foramen found in climbing animals [8]. In fact, the foramen is present in various animals, including orangutans, gorillas, chimpanzees, pigs, lemurs, meerkats, cats, dogs, wolves, and others [9-16]. In some of these animals, the supracondylar foramen serves as a safe route for the median nerve and brachial artery.

In humans, the supracondylar process has clinical significance as it is often associated with compression of the neurovascular bundle. Furthermore, describing this structure as an anomaly is not uncommon. The supracondylar process is commonly described as a congenital condition [17,18], but most cases reported in the literature have shown the identification of the spike in adults, some of them in post-trauma conditions [6,19]. It may be worth reconsidering Teidemann's terminology, as a tunnel to protect the median nerve and brachial artery along the condylar surface may have a phylogenetic relationship to protect the vasculo-nervous structures. However, a bone fragment developed during adulthood may be closely associated with cases of neurovascular bundle compression.

The aim of this paper is to perform a morphological and morphometric evaluation of this anatomical variation in a dry humerus. The purpose is to enhance the current knowledge on its identification and diagnosis, thereby contributing to the existing literature.

2. Case Report

From macroscopic morphological analysis, it was observed that the bone was intact and without any sign of blemish. The bone did not present pathological signs such as the presence of osteolytic or osteoblastic lesions, signs of periosteal reaction, subchondral sclerosis, signs of low bone mass, erosions, fractures, presence of osteophytes or signs of the presence of cysts. Regarding supracondylar process, a bony spicule was seen in the center of an outer area formed by depressions and ridges. A deep depression could be seen longitudinally and medially to the process, following the length of the structure. Two longitudinal crests could be seen directly associated with the base of the process, forming a beard from which the bone spicule projects. One crest is positioned cranially to the process, and the other is positioned caudally to it. Some of these elements from the supracondylar process can be observed in Figure 1.

The bone spicule resembles a shark fin, with a concave anterior surface and a convex posterior surface. Three margins can be seen on the spicule, longitudinally, in relation to the body of the humerus: an oblique upper margin, a curvilinear medial margin and a half-moon-shaped lower margin. The apex of the process points toward the transition between the trochlea and the humeral capitulum (Figure 1).

The bony spicule was 6.24 mm long, projecting from the body of the humerus. It was considered the upper and medial margins. The base of the spicule measured 6.80 mm in length and 4.18 mm in width. The combined longitudinal length of the caudal and cranial crests together was 32.37 mm. The distance from the bone spicule to the medial epicondyle was 65.29 mm. The distance from the process to the largest and smallest tubercles, respectively, was 28cm and 27cm. The total length of the humerus was 35cm. The data collected are presented in Table 1.

3. Discussion

The supracondylar process, an irregular bone prominence with a variable size, is a rare anatomical variation that is usually asymptomatic. However, in some cases, patients may experience complications. Consequently, it is crucial to provide a comprehensive description of this variation to enhance awareness in clinical practice and to assist imaginologists and clinicians. The supracondylar process of the humerus, also known as the supraepitrochlear process, epicondyloid process or supratrochlear spur [4, 20], has a highly variable frequency as indicated by the literature. There is even greater variability when studies on cadavers and living subjects are considered separately [21, 22].

Some studies from the last century have shown that the incidence of supracondylar process of the humerus ranges from 0.1% to 2.7% [23], with significant variations between Caucasians and Negroes. Terry found an incidence of 0.1% in black population and 1.16% in Europeans [22]. Parkinson and Adachi found incidences of 0.4% and 0.8%, respectively, in a mixed population [21,24]. Incidences of 1.15% and 2.7%, in Europeans, and 0.26%, 0.4%, and 1.25%, in the Indian population were already found [5,25,26]. Natsis observed an incidence of 1.3% in Caucasians [27]. Despite some imprecision, the incidence of supracondylar process of the humerus is generally low. Beyond that, it is predominantly found in females and often occurs unilaterally [28]. These findings together with morphometric data evidenced in other studies are found in Table 2.

Figure 1. Humerus and its supracondylar process. It is possible to observe the supracondylar process (SP) in (A, B) anterior and (C) posterior view. In anterior view, it is possible to observe cranial and caudal crests (arrows). In posterior view, it is observed the apex (*), oblique upper margin (u), medial margin (m) and lower margin (l). Scale bar: 5 cm.

The supracondylar process can occur alone or in combination with other variations. One common structure associated with the process is the Struthers' ligament [29]. This ligament extends from the process to the medial epicondyle and forms a structure that resembles the supracondylar foramen found in certain animals. Like what occurs in these animals, the foramen allow passage for the median nerve and brachial arteries. Other findings in the literature include an increased insertion of the coracobrachialis muscle and an increased origin of the pronator teres [3, 30]. These cases may just be variations that will not lead to pathological conditions and, therefore, are asymptomatic [5].

In some cases, these anatomical variations can lead to disorders, usually caused by the compression of nearby soft tissues, such as nerves, blood vessels, muscles, and fascia. The compression of these tissues can result in a fibrotic reaction, thickening of the tissue (such as the epineurium in cases of nerve compression), loss of myelin, impairment of axonal transport, various morphofunctional changes in muscle fibers, narrowing of blood vessels, and blood supply disturbances. This pathogenic entity is known as the supracondylar process syndrome [31].

Table 1. Osteological measurements from the humeral bone.

Measurements	Length
Length of the process	6,24 mm
Width of process basis	4.18 mm
Vertical length of process basis	6.80 mm
Length between the cranial and caudal crests of the process	32.37 mm
Distance from the process to the medial epicondyle	65.29 mm
Distance from the process to the humerus capitulum	71.09 mm
Distance from the process to the transition between capitulum and trochlea of the humerus	69.11 mm
Distance from the apex of the process to the cranial region of the greater tubercles	28 cm
Distance from the apex of the process to the cranial region of the lesser tubercles	27 cm
Humerus total length	35 cm

Table 2. General aspects of the supracondylar process identified by other authors.

Authors	Population	Incidence	Process length	Width of process basis	Distance from the process to the ME*	Humerus total length
Adachi (1928)	Mixed	0.8%	-	-	-	-
Terry (1930)	Negroes	0.1%	-	-	-	-
Terry (1930)	Europeans	1.16%	-	-	-	-
Parkinson (1954)	Mixed	0.4%	-	-	-	-
Gupta (2008)	Indians (Gujrat)	0.26%	3 mm	11 mm	65 mm	-
Natsis (2008)	Caucasians	1.3%	-	-	-	-
Prabahita et al. (2012)	Indians (Assam)	1.25%	11 mm	15 mm	44 mm	-
Shivaleela et al. (2014)	Indians (Karnataka)	0.41%	5 mm	10mm	60mm	31 cm
Nikumbh (2016)	Indians (Maharashtra)	0.36%	11 mm	10 mm	55 mm	32.5 cm
Present study	-	-	6.24 mm	4.18 mm	65.29 mm	35 cm

Clinically, symptoms such as radiating or acute pain, complaints of sensory disturbances and reports of decreased grip strength are common in pathological cases [19, 31, 32]. During physical examination, vascular disturbances, sensory deficits, and decreased muscle strength, related to regions and structures innervated by the median nerve, can be observed. These deficits can be exacerbated by elbow and wrist extension. Additionally, the process can be detected through palpation near the medial epicondyle.

The signs and symptoms will develop in accordance with the different variations of the regional anatomy, considering the anatomical characteristics of the supracondylar process, the course and thickness of the ligament, when present, and how soft structures pass through these elements. Diagnosis relies on physical examination and imaging tests, including oblique view radiographs of the forearm, computed tomography, and magnetic resonance imaging [32, 33]. Electroneuromyography can be used to assess the severity of neurovascular compression [29]. The differential diagnosis usually involves excluding heterotopic ossification or osteochondroma and treatment is surgical, with removal of the bone process [2].

In the humerus bone evaluated in this study, it was observed longitudinal crests associated with the base of the process, cranially and caudally. It is known in anatomy, that crests serve as an attachment point for muscles, ligaments, and fascia. Crests are even increased over time by traction forces. Based on this and the fact that basically brachialis muscle passes through this region, it could be possible to assume that this case was associated with the presence of soft tissue like Struthers' ligament, third head of coracobrachialis muscle and/or supracondylar head of the pronator teres, as fixing structures of these crests. In the dry humerus bone, it was also observed a deep longitudinal depression, medially to the base of the process and perhaps this could indicate the development and establishment of the neurovascular bundle in this region.

Considering this hypothesis as true, all these elements could be signs that the structure evolved in early stages of development. More detailed studies of the process would be important to establish these correlations and better understand the anatomy and pathological conditions associated with the supracondylar process.

The apex of the process points downward. In accordance with what is described in the literature about the supracondylar process and the size of the spicule was within the range already described in some studies [25, 34]. The width of the process investigated in this study seemed much smaller than that described in the literature (Table 2) [5, 34]. It is possible to hypothesize that chances of compression of neurovascular structures and other soft tissues are increased by the width of the base of the process. The greater the width of the base of the process, the greater the chances of compression. This is a point that would need to be further investigated through imaging and cadaver examinations.

The knowledge of the morphological characteristics of the supracondylar process, including its location, shape, size, width, and extension, is crucial in radiology, diagnosis, understanding its relationship with adjacent tissues, and determining the best treatment and patient care. To succeed in this goal, basic anatomy research and case reports are of great importance. Understanding the complications of an anatomical variation can only be achieved with basic insight.

4. Conclusions

In this work, detailed anatomical characteristics of the supracondylar process, an anatomical variation, of a dry humerus were described. Location, shape, size, and description of the area surrounding the process were carefully evaluated and presented. This paper was intended to assist the scientific community and clinicians in identifying this variation and its possible complications. Despite the limitation of this study in relation to the sample size, the results show that there are many details still to be evaluated and discussed regarding supracondylar process. It is possible that a greater number of meticulous analyzes will allow for in-depth knowledge of cases that may evolve into pathological processes and how they should be treated. Anatomical studies have enormous characteristics and potential for translational research, providing evidence that can be immediately used in treatment for the benefit of human health.

Funding: None.

Research Ethics Committee Approval: We declare that the patient approved the study by signing an informed consent form and the study followed the ethical guidelines established by the Declaration of Helsinki.

Acknowledgments: The authors wish to sincerely thank those who donated their bodies to science so that anatomical research could be performed. Results from such research can potentially improve patient care and increase mankind's overall knowledge. Therefore, these donors and their families deserve our highest gratitude.

Conflicts of Interest: None.

Supplementary Materials: Appendix A: Supplementary Materials.

References

1. Gamble JG, Krygier JE. Fracture of the Supracondylar Process in a Child: A Case Report and Review of the Literature. JBJS Case Connect. 2019 Dec;9(4):e0396.
2. May-Miller P, Robinson S, Sharma P, Shahane S. The Supracondylar Process: A Rare Case of Ulnar Nerve Entrapment and Literature Review. J Hand Microsurg. 2019 Oct;11(Suppl 1):S06-S10.
3. Varlam H, St Antohe D, Chistol RO. Le processus sus-condylien et le foramen sus-trochleen de l'humerus. Etude comparative et anatomo-clinique [Supracondylar process and supratrochlearforamen of the humerus: a case report and a review of the literature]. Morphologie. 2005 Sep;89(286):121-5.
4. Newman A. The supracondylar process and its fracture. Am J Roentgenol Radium Ther Nucl Med. 1969 Apr;105(4):844-9.
5. Shivaleela, C., Suresh, B.S., Kumar, G. V., Lakshmiprabha, S. Morphological study of the supracondylar process of the humerus and its clinical implications. J Clin Diagn Res. 2014 Jan;8(1):1-3.
6. Suresh SS. Fracture of supracondylar process of the humerus. Sultan Qaboos Univ Med J. 2008 Jul;8(2):223-5.
7. Engber WD, McBeath AA, Cowle AE. The supracondylar process. Clin Orthop Relat Res. 1974 Oct;(104):228-31.
8. Aydinlioglu A, Cirak B, Akpinar F, Tosun N, Dogan A. Bilateral median nerve compression at the level of Struthers' ligament. Case report. J Neurosurg. 2000 Apr;92(4):693-6.
9. Adams, B.J., Crabtree, P.J. Comparative Skeletal Anatomy. Humana Press, Totowa, NJ. 2008 https://doi.org/10.1007/978-1-59745-132-1
10. Kirberger RM, du Plessis WM, Turner PH. Radiologic anatomy of the normal appendicular skeleton of the lion (Panthera leo). Part 1: thoracic limb. J Zoo Wildl Med. 2005 Mar;36(1):21-8.
11. Makungu M, Groenewald HB, du Plessis WM, Barrows M, Koeppel KN. Thoracic Limb Morphology of the Ring-tailed Lemur (Lemur catta) Evidenced by Gross Osteology and Radiography. Anat Histol Embryol. 2015 Aug;44(4):288-98.
12. Orellana, Elise R., "Genus Varecia : anatomy, morphology, and pathology". Graduate Research Theses & Dissertations. 3266. 2015. https://huskiecommons.lib.niu.edu/allgraduate-thesesdissertations/3266
13. Schultz, A.H. Proportions, Variability and Asymmetries of the Long Bones of the Limbs and Clavicles in Man and Apes. 1937 Hum Biol 9, 281–328.
14. Siqueira RC, Rahal SC, Inamassu LR, Mamprim MJ, Felix M, Castilho MS, Mesquita LR, Ribeiro VL, Teixeira CR, Rassy FB. Osteology and radiology of the Maned Wolf (Chrysocyon brachyurus) pelvic limb. Anat Histol Embryol. 2017 Dec;46(6):572-581.
15. Sisson, S., Grossman, J.D., Getty, R., 1975. Sisson and Grossman's the Anatomy of the Domestic Animals, 5th ed. Philadelphia.
16. van Staden SL. The thoracic limb of the suricate (Suricata suricatta): osteology, radiologic anatomy, and functional morphologic changes. J Zoo Wildl Med. 2014 Sep;45(3):476-86.
17. Miyake J, Kawabata H, Takeuchi M. Rapid growth of supracondylar process: a case report. J Pediatr Orthop B. 2013 Mar;22(2):141-3.
18. Talha H, Enon B, Chevalier JM, L'Hoste P, Pillet J. Brachial artery entrapment: compression by the supracondylar process. Ann Vasc Surg. 1987 May;1(4):479-82.
19. Spinner RJ, Lins RE, Jacobson SR, Nunley JA. Fractures of the supracondylar process of the humerus. J Hand Surg Am. 1994 Nov;19(6):1038-41.
20. Ay S, Bektas U, Yilmaz C, Diren B. An unusual supracondylar process syndrome. J Hand Surg Am. 2002 Sep;27(5):913-5.
21. Adachi B. Das Arterien system der Japaner. Kyoto: Verlag der Kaiserlich-Japanischen Universitat, Kenyusha Press. 1928.
22. Terry RJ. A study of the supracondyloid process in the living. Am J Phys Anthropol. 1921; 4: 129-39.
23. Camerlinck M, Vanhoenacker FM, Kiekens G. Ultrasound demonstration of Struthers' ligament. J Clin Ultrasound. 2010 Nov-Dec;38(9):499-502.
24. Parkinson CE. The supracondyloid process. Radiology. 1954 Apr;62(4):556-8.
25. Prabahita B, Pradipta RC, Talukdar KL. A study of supracondylar process of humerus. Journal of Evolution of Medical and Dental Sciences. 2012; 1(5):822.
26. Gupta RK, Mehta CD. A study of the incidence of supracondylar process of the humerus. J Anat Soc. 2008; 57 (2):111-15.
27. Natsis K. Supracondylar process of the humerus: study on 375 Caucasian subjects in Cologne, Germany. Clin Anat. 2008 Mar;21(2):138-41.

28. Martin-Schütz GO, Arcoverde M, Barros G dos R, Babinski MA, Manaia JHM, Silva CRC de M, et al. A Meta-Analysis of the Supracondylar Process of the Humerus with Clinical and Surgical Applications to Orthopedics. International Journal of Morphology 2019;37(1):43–7.
29. Caetano EB, Sabongi JJ Neto, Vieira LA, Caetano MF, de Bona JE, Simonatto TM. Struthers' Ligament and Supracondylar Humeral Process: An Anatomical Study and Clinical Implications. Acta Ortop Bras. 2017 Jul-Aug;25(4):137-142.
30. Opanova MI, Atkinson RE. Supracondylar process syndrome: case report and literature review. J Hand Surg Am. 2014 Jun;39(6):1130-5.
31. Shon HC, Park JK, Kim DS, Kang SW, Kim KJ, Hong SH. Supracondylar process syndrome: two cases of median nerve neuropathy due to compression by the ligament of Struthers. J Pain Res. 2018 Apr 16;11:803-807.
32. Pedret C, Balius R, Alomar X, Vilaró J, Ruiz-Cotorro A, Minoves M. Stress fracture of the supracondylar process of the humerus in a professional tennis player. Clin J Sport Med. 2015 Jan;25(1):e20-2.
33. Bhatnagar S, Iwanaga J, Dumont AS, Tubbs RS. Lateral Supracondylar Spur Process of the Humerus. Cureus. 2021 Feb 23;13(2):e13514.
34. Nikumbh, Roopali & Nikumbh, Dhiraj & Doshi, Megha. Morphometric Study of the Supracondylar Process of the Humerus with its Clinical Utility. Int J Anat Res 2016;4(1):1941-1944.