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Case Report
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Supracondylar Foramen of Humerus - Embryology and Clinical Aspect

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ABSTRACT

Introduction: supracondylar foramen of humerus is a rare finding while supracondylar spur has been found with variable incidences in different population groups. Presence of complete foramen can be attributed to ossification of struther's ligament. Reporting about this type of variation is sparse in literature. It may cause supracondylar syndrome by compression of median nerve, ulnar nerve and brachial artery leading to neurovascular compromise in forearm and hand.

Case Report: during routine bone demonstration of humerus to undergraduate MBBS students, supracondylar foramen was found in one specimen. Completely ossified bony bridge extending from medial epicondyle to anteromedial surface of humerus was found.

Conclusion: generally, this type of variation is asymptomatic. Sometimes, it can be symptomatic if median nerve, ulnar nerve or brachial artery is/are compressed within this foramen. It is important to include this variation in differential diagnosis in patients with neurovascular symptoms around elbow, forearm and hand. Also, it can mimic as benign and malignant tumors involving lower end of humerus. The mainstay of management is removal of ossified bony bridge by either open or arthroscopic surgical approach.

Keywords: Supracondylar Foramen; Humerus, Supracondylar Spur; Supracondylar Syndrome; Anatomical Variation.

Introduction

Supracondylar foramen of humerus is a rare anatomical variation formed by osseous bridge extending from medial epicondyle to anteromedial surface of humerus. This osseous bridge can be correlated with ossified part of struther's ligament. Complete supracondylar foramen has been found in primates, cats, lemurs and other climbing animals. In human, Supracondylar process has been reported by different authors which is a beak shaped projection on anteromedial surface of lower 1/3rd of humerus. It has also been termed as "epicondyloid", "supraepitrochlear", "supracondyloid" process. It is a normal variant in 0.1%-5.7% of the population[1]. This type of spur along with the associated ligament was first described by Struther in 1848. Struther's ligament forms an osseofibrous tunnel through which median nerve, ulnar nerve and brachial artery can pass[2]. Generally, these types of cases are asymptomatic and diagnosed incidentally on radiological investigation of upper limb. Sometimes, this can act as site for nerve entrapment and brachial artery compression presenting with pain and paraesthesia in forearm along the distribution of branches of median nerve. There is aggravation of symptoms with elbow extension and forearm pronation. Size of the spur varies from 0.7 cm to 1.2 cm and distance from the medial epicondyle to spur range from 4.5 cm to 7 cm.[3] Sometimes, spur can be palpable but generally confirmed on anteroposterior (AP) and lateral radiograph of elbow joint. Treatment consists of complete excision of spur with periosteum and ligament. Compression of neurovascular structures may be related to distance of spur from medial epicondyle. Shorter the distance of spur from medial epicondyle may form tight foramen with struther's ligament causing more compression. This spur may mimic benign and malignant tumours of bone like osteochondroma.[4] Also, fracture of spur may cause similar types of neurovascular symptoms.Reporting and proper description of complete supracondylar foramen was not found in literature search in PubMed, Scopus and google scholar. Presence of supracondylar foramen/spur must be included as differential diagnosis in cases with neurovascular symptoms of forearm and hand mainly along distribution of medial nerve. So, acquaintance about this would be imperative to clinicians, surgeons, radiologists and orthopaedicians for clinical diagnosis and planning further management.

Case Report

During routine bone demonstration to undergraduate MBBS students, we have found a supracondylar foramen in lower 1/3 part of left humerus (Fig 1). The foramen is formed by supracondylar bony bridge extending from medial epicondyle to medial surface of humerus. This is the most common location of struthers' ligament. This may be the case of ossified struthers's ligament forming the supracondylar foramen. As per literature search in pubmed, scopus and google scholar, we have

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not found any of the similar case report with ossified struthers's ligament forming complete supracondylar foramen.

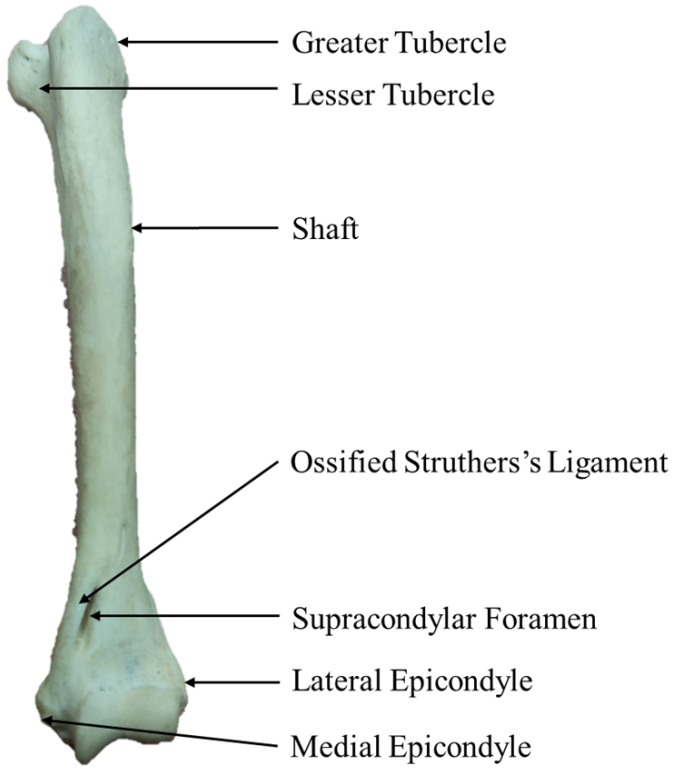

Figure 1. Left humerus with ossified struther'a ligamente and supracondilar forame

Discussion

Incidence of medial supracondylar spur is variable in different population groups. It varies from 0.1%-5.74%. Studies in relation to this spur have been tabulated (Table 1). A metanalysis by Guilherm *et al* shown 0.68% pooled prevalence of supracondylar spur[5]. They also revealed more prevalence in female and in left side. Geographically, incidence is more in European region as compared to other parts of the world. Previously, it was thought to be present in animals only but Knox in 1841 reported first case in man. Later it was described in details along with struther's ligament by Struthers. In contrast to medial supracondylar spur, incidence of supracondylar foramen is extremely rare. No report on presence of this type of foramen was found in literature review as per our knowledge.

Formation of supracondylar foramen can be caused due to ossification of struther's ligament. Struther's ligament is considered as a remnant of third head of coracobrachialis[6]. Anthropologically, struther's ligament was found to be formed by different bundles. Two bundles namely coracobrachialis superficialis and coracobrachialis profundus were found in reptilia. Three bundles namely coracobrachialis superficialis, medius and profundus were found in monotremata (mammalians)[7]. Third head of coracobrachialis had been described to originate from medial epicondyle in lower animals. This third head may remain as struther's ligament in human. In humans, only coracobrachialis medius remains and struther's ligament remains only as fibrous band which connects tendon of latissimus dorsi to tendon of coracobrachialis[8,9]. This is also considered as a part of latissimo-condyloideus muscle[8]. Supracondylar foramen may be formed by ossification of part of medial intermuscular septum or struther's ligament. Ligaments and intermuscular septum are dense hypocellular structure embraced with fibroblasts and plenty of extra-cellular matrix. Developmental aspects of these structures are not well defined in literature. Few markers have been described in relation to ligament development like Scleraxis. Also, development of ligamentous or fibrous structures have been described to be linked with developmental

Table 1. Incidence of supracondylar spur in different population group (n-Number of humerus with supracondylar spur, N- Total number of humerus).

Authors	Percentage (n/N×100)	Population Group
Terry *et al*., 1923	0.1	Afro-American
Parkinson *et al*., 1954	0.2	Mixed
Pieper *et al*., 1925	0.25	Euro-American
Hrdlicka *et al*., 1923	0.26	American Indian
Gupta & Mehta, 2008	0.26	Indian
Roopali D *et al*., 2016	0.36	Indian
Shivaleela C *et al*., 2014	0.41	Indian
Aydinlioglu *et a*l., 2010	0.50	Turkey
Hema & Tanuja, 2015	0.65	Indian
Cady *et al*., 1922	0.65	Euro-American
Ravi & Patil, 2014	0.75	Indian
Terry *et al*., 1926	0.77	Euro-American
Cady & Francis, 1927	0.82	Euro-American
Hema & Tanuja, 2015	0.65	Indian
Dellon *et al*., 1986	1.0	European
Case and Burnett, 2000	1.08	Ancient Nubians
Prabahita *et al*., 2012	1.25	Indian
Natsis *et al*., 2008	1.30	Caucasian
Hrdlicka *et al*., 1923	1.56	Eskimo
Hrdlicka *et al*., 1923	2.14	Hrdlicka European
Oluyemi *et al*., 2007	2.5	Nigerian
Cady & Francis, 1927	3.71	Zagni's Criminals
Cady *et al*., 1922	3.91	Nicolas' Insane
Ugolotti *et al*., 1899	5.74	Ugolotti's Criminals

factors related to adjoining joints. Scleraxis acts as early marker of ligament development. Wnt14, Gdfs (Gdf5 and Gdf6) and Fgf10 have also been found to be linked with development of ligament and fibrous joints. Exact mechanism of ossification of medial intermuscular septum or struther's ligament has not been identified yet. This may be cause by derangement of developmental factors which is probably controlled by factors involved in development of adjoining joint and ligaments. Defective activity of Scleraxis, Wnt14, Gdf5, Gdf6 and Fgf10 may have role in development of defect in this ligament too[10-12]. Further, it has been claimed that osteoblasts have also been found in relation to ligament (like anterior longitudinal ligament of vertebral column), which can also cause ossification of ligaments[13]. Abnormal increased activities of osteoblasts in region of intermuscular septum or struther's ligament can cause ossification of these structures, which need to be investigated.

Supracondylar spur is generally asymptomatic and usually identified as an incidental finding during radiological investigation of upper limb for some other reasons. Sometimes, it can cause neurovascular symptoms due to compression of median nerve or brachial artery under struther's ligament and these symptoms together termed as supracondylar process syndrome[14]. Patients present with pain, hypesthesia, paraesthesia, weakness along distribution of median nerve and branches of brachial artery. Sometimes, patients may present with traumatic fracture of this process with symptoms of pain in lower part of arm during movements of elbow joint. Generally, this type of finding is unilateral but bilateral occurrence with median nerve involvement has also been seen previously[15]. Such type of cases can also be associated with higher branching pattern of brachial artery, origin of anterior interosseous nerve in forearm, and high origin of humeral head of pronator teres.[16] It may show similarities with clinical presentation of rare conditions like osteochondroma, myositis ossificans and should be ruled out with proper investigations. Osteochondroma can be differentiated from this spur on the basis of characteristic features like projecting away from elbow joint and continuation of bony cortex with tumour[3,5]. Treatment usually consists of initial symptomatic management. In case of persistence of symptoms, removal of bony spur and associated ligament along with the periosteum to prevent recurrence is treatment of choice[17]. Endoscopic removal of supracondylar spur was also done to release the ligament and excision of supracondylar process. Endoscopic technique provides excellent visualization to remove the spur precisely with minimal dissectio[18]. Ulnar nerve compression though rare, can occur if the ligament instead of insertion to the medial epicondyle extends to blend with the fibrous arch between the two heads of flexor carpi ulnaris. Lund presented the first case of a fracture of the supracondylar process. The process gets fractured occasionally when it is felt as a tender mobile piece of bone just above the elbow medially and it is easily made out in radiographs. If it has fractured, the treatment is excision with due care to the neurovascular structures. Conservative management is recommended if there are no neurovascular symptoms after a fracture. Typically, these involve the median nerve or brachial artery (or both), but on occasion, the ulnar nerve may also be stretched over the spur[19]. Opanova and Atkinson previously reported that sensory abnormalities, with numbness and weakness, were the primary symptoms of median nerve compression after evaluating 43 cases of supracondylar process syndrome. Pain tends to worsen when the forearm is medially rotated [20].

So, symptoms of supracondylar process syndrome of fracture of this process are variable extending from minor symptoms like pain around elbow joint to major neurovascular symptoms involving associated nerves (median or ulnar) and branches of brachial artery. So, presence of this type of variation should always be kept in mind while evaluating patients with these types of symptoms. Early intervention with proper diagnosis and management may not only provide relief to patients but also prevents long term complications.

Conclusion

The knowledge of anatomical variations in lower 1/3rd of humerus like supracondylar spur and foramen is imperative for anatomists, orthopedicians, radiologists, and surgeons to avoid any iatrogenic injury to neurovascular structures during any procedure and also for better diagnosis and management. High index of suspicion is required for probable median or ulnar nerve entrapment or brachial artery compression due to this variation in cases of neurovascular symptoms in forearm and hand. Caution about presence of ossified struther's ligament needs to be taken during open or arthroscopic procedures in this region and management should be done accordingly.

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Mini Curriculum and Author's Contribution

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