



Morphological variations of distal humeral epiphysis: An anatomical variation with clinical implications

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ABSTRACT

Supratrochlear septum, a thin plate of compact bone usually separates the olecranon fossa from the coronoid fossa in the distal end of humerus in supratrochlear region. Perforation of this bony septum it can lead to supratrochlear foramen; which is termed as Septal aperture. The length of olecranon process is also acts as a potential contributor in developing septal aperture; further predispose to distal humeral fracture. Another rare anatomic variant is the supracondylar process or spur; is a hook-like bony process present on anteromedial surface of the humerus. This supracondylar spur can be visualized in the radiographs which can be mistaken sometimes as osteochondromas by the clinician's especially orthopedic surgeons. At times, ligament of Struthers extends from the spur to the medial condyle of humerus and can be a cause for entrapment neuropathy. Though it is a rare vestigial process in human, but this type of anatomical variations should be kept in mind by the anatomists, anthropologists and clinicians. Anatomical texts describe many structural deformities regarding different parts of humerus but total absence of olecranon fossa and nodular appearance of supracondylar spur along with the lateral supracondylar ridge which is totally unusual; not been mentioned very routinely. Keeping this in mind, we report anatomical variations in the distal epiphysis of two completely ossified humerus which is expected to play a great role in the functional anatomy of the elbow joint.

Key words: distal epiphysis; humerus; septal aperture; supracondylar spur; olecranon fossa

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INTRODUCTION

Humerus is the longest and thickest bone of the upper extremity which represents the only bony skeleton of the arm [1]. This bone is termed as a typical long bone having two epiphyseal ends and a diaphysis [2]. This is one of the bone of choice for morphological evaluation as it bears lots of anthropological and medico legal importance [3, 4]. Bony deformities or anatomic variations have been described for this bone as morphological variations acts as a guide to find the correlation of each stage in the evolutionary process [5]. Developmental anomalies regarding the distal epiphysis of humerus have been mentioned in the previous literature; among them septal aperture or supratrochlear foramen have been emphasized [6]. Supratrochlear foramen is a relatively common but important anatomical variation which has recently become a concern topic for the clinicians also [6]. A thin plate of compact bone called as supratrochlear septum lined by synovial membrane; normally separates the olecranon fossa from the coronoid fossa in the distal end of humerus in the supratrochlear region [7, 2]. Its perforation can turn into supratrochlear foramen which was first described by Meckel [8] and it has got evolutionary significance with clinical importance. Structural variations due to deformed supratrochlear aperture can predispose to fracture of the distal epiphysis of humerus [9]. Another variation in the distal part of humerus is supracondylar process or spur which has not been elaborated in a great detail; to the best of our knowledge, it has been explained in a very few previous literatures. It is described as an occasionally present, developmental deformity of beak shaped projection measuring 2- 20 cm length; an outgrowth from the anteromedial surface of the diaphysis connecting the medial border just above the medial condyle [10]. This process or spur is most commonly seen in lower animals which give a contribution to the formation of bony tunnels in the lower third of humerus [11]. But later it gets disappeared in the evolutionary process from lower vertebrates to human. But, if persists become a cause for vascular entrapment or entrapment neuropathy that can easily be missed on imaging [12]. So, anatomical

variations in the distal epiphysis of humerus hold a great role in proper movements of elbow joint to restore its functionality. As very little emphasis have been given towards distal epiphyseal variations of humerus in conventional text books; so it is expected that the Knowledge of this variations will carry a lot of importance to academicians, anthropologists and clinicians specially orthopedic surgeons to diagnose the clinical cases and to decide the treatment modalities.

MATERIAL AND METHODS

CASE REPORT

During routine demonstration of undergraduate teaching program for the 1st phase MBBS students in SGT Medical College, Gurugram, anomalous presentation of the distal epiphysis of two humerus were observed which were less frequently reported in previous literatures. Both of the two osteology specimens were examined in detail, some relevant measurements were taken and photography were done for proper documentation. Observations are described in the Table 1 and Table 2.

Features observed	Specimen 1	Specimen 2
Architecture	Adult morphology	Adult morphology
Side of the specimen	Left	Left
Total length	29.01 cm	31.37 cm
Proximal end / epiphysis	Showed normal anatomical features	Showed normal features
Diaphysis / shaft	Showed all borders & surfaces	All borders & surfaces present
Distal end / epiphysis	Showed multiple anatomical variations	Variations observed

Table 1: displaying the general morphological features of both the specimen

Features observed in distal epiphyseal area	Specimen 1	Specimen 2
Medial condyle with epicondyle	Seen, on its posterior surface bony nodule was observed	visible
Lateral condyle with epicondyle	seen	Almost merged with the capitulum
Distance between medial to lateral condyles	71.45mm	54.65 mm
Architecture of trochlea	Deformed (without having medial & lateral flanges)	Very big & having a projected medial flange extending towards the coronoid fossa
Architecture of capitulum	Hardly visible; deformed & porous in nature	Not properly demarcated; Small portion was smooth , rest merged with lateral condyle
Coronoid fossa	Was present ; dimension 21.94 mm width	Semilunar shaped as most of it has been covered by medial flange of trochlea
Radial fossa	Seen and the width was 17.54 mm	Extremely deeper & wider (21.6 mm in width)
Olecranon fossa	2/3 rd of the fossa was covered by nodular overgrowth of trochlea; a thin bony bar / septum was noticed in the medial wall of the fossa	Totally absent; instead of fossa blinded small foraminas were observed &a sharp bony projection was also seen
Supracondylar process	Present; 4mm x2.5mm dimension; along with lateral supracondylar ridge & was projecting towards the posterior surface	Not present
Septal aperture or Supratrochlear foramen	Not seen	Not present
Supracondylar ridges (medial & lateral)	Lateral ridge was well demarcated as compared to medial	Both were visible

Table 2: exhibiting the features present in the distal epiphysis of humerus for both the specimens

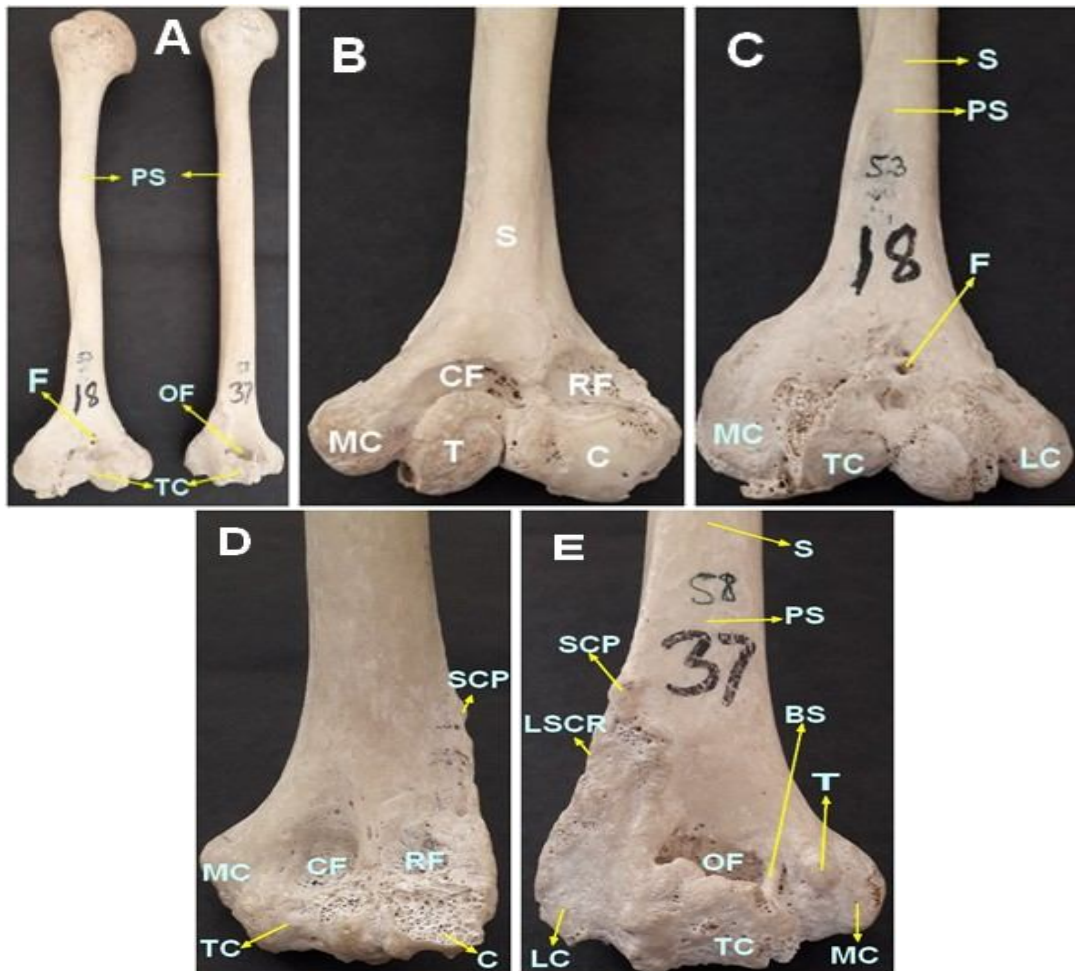


Fig 1: A) showing posterior aspect of specimen 2 and 1 respectively for the proximal & distal epiphysis and diaphysis; B) displaying anterior aspect of distal epiphysis of 2nd specimen; C) Posterior aspect of distal epiphysis without olecranon fossa in 2nd specimen; D) anterior aspect of distal epiphyseal parts of 1st specimen with supracondylar process showing in the arrow; E) posterior aspect of 1st specimen with prominent supracondylar process with almost hidden olecranon fossa(F- foramen; OF- olecranon fossa; CF- coronoid fossa; RF- radial fossa; TC- trochlea; C- capitulum; MC- medial condyle; LC- lateral condyle; SCP- supracondylar process; BS- bony septum; LSCR- lateral supracondylar ridge; PS- posterior surface of shaft/ diaphysis)

RESULTS AND DISCUSSION

Supracondylar process (SCP) or supracondylar spur was described as a bony projection on the anteromedial surface of the humerus by Sir John Struthers in 1854 which was extending from medial epicondyle to the ligament of Struthers [13]. In 2014, it was observed by Vinila et al. in two osteology specimens of left side among Karnataka population in Indians and the incidence was 2.8% and their dimensions were .6 cm and .7cm in length; breadth was 1.3cm [5]. The ligament of Struthers described as a osseofibrous band which connects the SCP to the medial epicondyle; can be a rare cause of median nerve entrapment leading to supracondylar process syndrome [12]. They stated that though it was a vestigial structure in human but can be misdiagnosed as myositis ossificans or osteochondromas. In a cadaveric study performed by Caetano EB in 2017 among Brazilian population, 2 cases were identified with Struthers' ligament without any supracondylar spur; one on right and another on left side [14]. In a case series performed by Hyun Chul et al. in 2018, diagnosed two cases of supracondylar process where one patient was suffering from bronchitis presented with pain and numbness and the SCP was of 15 mm in length. In another case it was diagnosed in the X- Ray and later in CT Scan which was 11mm in length and there were symptoms of median nerve compression [12]. The incidence of SCP among Indian was 0.26% was length was 0.3cm [15]. Among Nigerian, study performed by Oluymikayode A et al. both supracondylar and infracondylar process were observed; the length was 1.6 cm which was little higher [16]. This bony process can be easily detected on X-ray images obtained in oblique views but may not be identified in antero posterior radiographs [12]. A septal aperture is thought to be consequences of

excessive resorption of cancellous bone in the distal humerus during early age of life [17]. This peculiar bony defect can be a stress-rising factor to play a major role in altering fracture patterns and selecting appropriate management [18]. The various morphological variations of olecranon fossa including its absence or distortion can correlate the occurrence of fractures of the olecranon fossa and neighborhood structures [19]. So, anatomic variations regarding different parts of distal epiphysis of humerus should be taken care of while investigation malfunctions of elbow joint.

CONCLUSION

To the best of our knowledge, distorted olecranon and its absence have not been presented in previous literature as in our present case. Also, the nodular appearance of supracondylar process from lateral supracondylar ridge is a unique feature demonstrated in our specimen will be an anatomical record to be remembered by the academicians as well as clinicians also. They should be well aware with this type of diverge appearance of the distal epiphysis of humerus while interpreting the radiographs which will be a great help for the diagnosis of clinical cases and to decide appropriate management of the patients.

CONFLICT OF INTEREST

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