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An anatomical and clinical insight on brachialis with emphasis on portal's muscle

RAJANIGANDHA VADGAONKAR, RAJALAKSHMI RAI, S. R. NAYAK, SUJATHA D'COSTA, VASUDHA SARALAYA, DHANYA

Department of Anatomy,
Kasturba Medical College (affiliated to Manipal University), Bejai, Mangalore, India

Abstract

There have been conflicting descriptions regarding the anatomy of portal's muscle in the literature. The purpose of the present study seeks to clarify the presence, morphology, and potential function of this muscle in order to refine surgical techniques around the elbow. Forty-eight formalin fixed upper extremities were dissected and observed for attachments of brachialis meticulously and particularly over the anterior elbow joint capsule with special emphasis to the anatomical relation of the deeper fibers to the joint. It was found that there were varying patterns of muscular attachments over the anterior joint capsule with majority of the fibers of brachialis simply passing superficial to the joint capsule. The highest concentration of fibers was noted on the inferior part of the joint capsule, which was attached via connective tissue. These fibers were the deepest fibers of brachialis muscle that had no affect on the joint capsule following tension. Knowledge of this muscle may help the surgeons who operate in the elbow region to be tension free in preserving such fibers of clinically less importance.

***Keywords*:** brachialis, capsular muscle, elbow joint.

Introduction

Owing to its hybrid nature with a dual nerve supply from the musculocutaneous and the radial nerve, brachialis (anticus) has been a topic of interest to many anatomists, physicians and surgeons. Among the chief flexors in the upper arm, brachialis is the largest contributor to elbow flexion and is regarded as the key muscle for controlling flexion spasticity [1]. Much of research work has been done in description of the perplexing brachialis muscle anatomy, which has varying and contrasting presentations. Unfortunately, the anomalies pertaining to flexor muscles are commonly found in the extant literature with few variations being reported on the brachialis [2]. The brachialis muscle arises from distal half of the anterior surface of the humerus and the adjacent intermuscular septum, passes anterior to the elbow joint to insert into the ulnar tuberosity and on to a rough impression on coronoid process of ulna [3]. There is a deepest part of brachialis, which inserts onto the anterior joint capsule of the elbow, which is referred as portal's muscle [4]. These rare reported capsular fibers have received little attention in anatomical and medical literature. It has been classified as a capsular muscle, a term that has been suggested for a similar muscle articularis genu of the lower limb [5]. We as anatomists believe that a comprehensive knowledge of variations and the presence of capsular fibers of brachialis could be utilized effectively and reliably in surgical repairs and rehabilitation. Due to scant review in the literature about the portal's muscle, the present study is undertaken to contribute to the present knowledge of morphology and potential function of the same and also to clarify the brachialis muscle anatomy.

Material and Methods

Forty-eight upper limbs from twenty-four formalin fixed adult cadavers were dissected for the present study. From the departmental records, the ages of these specimens ranged from 55 to 78 years. Specimens with deformities, congenital anomalies and previous scars of surgeries were noted and excluded from the study. With the cadaver in supine position, the gross morphological features, relations and innervation of the brachialis muscle were recorded. Following this, the muscle was transected at the lower one-third of the humerus and carefully traced distally towards the elbow joint. Presence of the capsular fibers and their attachment to the anterior joint capsule were recorded meticulously. To note down the findings the anterior joint capsule was divided into superior, middle and inferior one thirds. Effects of manual tension on brachialis muscle fibers associated with anterior joint capsule were observed using a forceps. Additionally joint capsules were observed during flexion and extension of elbow joint continuing tension on the capsular fibers.

Results

In all specimens, brachialis muscle morphology and innervation followed the classical description found in literature considerably. No obvious difference was noted in the age and gender of the specimens used in the study. Upon transecting the brachialis muscle, forty-

three elbows (89.58%) were found to have attachment of capsular fibers to the anterior elbow joint capsule. However, there was variety in the attachment of fibers. These were the deepest fibers of brachialis that had a more intimate attachment to the capsule either directly as a broad band or multiple muscular slips or through connective tissue fibers. The greatest concentration of these muscular fibers attached to the anterior joint capsule was in the inferior third 62.79% (27 specimens), followed by in the central part 30.23% (13 specimens), and the least was observed in the superior one third 6.9% (three specimens). Among the sides, left side showed a predominance of 100% of capsular fibers as compared to the right side (79.16%). There were no signs of toughness upon application of tension on brachialis muscle fibers associated with the anterior joint capsule (Figure 1).

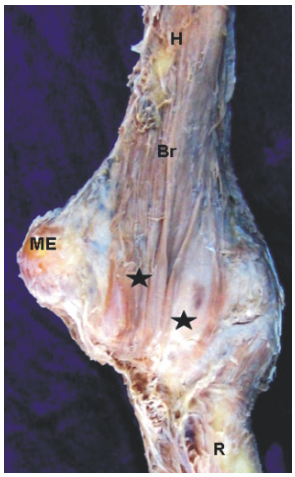

Figure 1 – ***Dissection of front of elbow region showing capsular fibers (★) of brachialis. ME: Medial epicondyle; Br: Brachialis; H: Humerus; R: Radius.***

Discussion

Surgeons, anatomists and anthropologists depend greatly on research reports to acknowledge the rare variations as standard textbooks fail to list the same. Muscle attachments into the capsule of the joints nearby are not regarded as unique feature owing to evolution of the musculature and erect posture. Among the most well explained muscle with an attachment to capsule of the joint is that of articularis genu (capsular muscle of Meckel) [5]. It is identified as a separate muscle with distinct identity that prevents the synovial membrane of knee joint from being pinched during sudden extension of leg [6]. DiDio LJA *et al*. have mentioned that there are increased chances of capsular nipping of the knee joint in old age due to the possible atrophy of articularis genu [5]. Kjaersgaard P has found in the tapir that the fibers of articularis humeri (a muscle arising from neck of scapula and inserting into the neck of humerus) are inserted directly to the shoulder joint capsule [7].

The most frequent variation of brachialis muscle consists of its subdivisions in to two or more parts where the distal insertions are irregular and variable. Apart from rarely being absent, it may also be fused with the muscles of forearm [8, 9]. Brachialis is normally innervated by musculocutaneous nerve but the median and radial nerves also participate in its innervation. In the present study, brachialis muscle showed normal anatomy. Thereafter a detail evaluation of capsular fibers attaching to the capsule of elbow joint was done. The capsular fibers attaching to anterior part of joint capsule is considered as one of different presentations commonly referred to as 'articularis cubiti or capsularis subbrachialis' [10]. In a study done by Suleman S *et al.*, capsular fibers of brachialis were in the form of an inverted "V" with the central fibers being longer than the medial and lateral fibers [11]. These authors proposed that the capsular fibers of brachialis attributed to pain of elbow joint by interposition of capsular folds between the articular surfaces.

On the contrary, Leonello DT *et al.* reported that the capsular fibers of the brachialis would prevent impingement of the elbow joint capsule during flexion by pulling the capsule anteriorly when the brachialis contracts [12]. Anterior or posterior surgical exposure of elbow joint that might involve the capsular fibers include synovectomy, intra-articular elbow fractures and total elbow arthroplasty [13]. According to a study done by Leonello DT *et al.*, brachialis muscle anatomy follows a varying pattern that differs from the descriptions in the standard textbooks [12]. They demonstrated two heads of the muscle with a large superficial head that is bulky to provide flexion strength and a smaller head, which is deep and oblique, may facilitate the initiation of elbow flexion. Due to the unavailability of forearm muscle donors, brachialis muscle is proposed to be a useful substitute in reconstruction surgeries or repairs of wrist extensors or pronation of forearm with average active motion recovery [14, 15]. In a peculiar case reported by Mehta V *et al.*, brachialis muscle arose as an unusual long tendon close to the deltoid tuberosity. Such origins of muscle means predisposing for inadvertent injuries that could alter the biomechanics of flexor as the elbow is considered as buttress [16].

Conclusions

Elbow joint surgery is cumbersome due to its complex anatomy, which is an area of concern for surgeons. The current study may be of paramount importance for orthopedicians, plastic surgeons and rehabilitation physicians owing to the unusual patterns of presentation of brachialis and its association with anterior joint capsule (portal's muscle). Based on our findings and the available literature we opine that a comprehensive knowledge of brachial muscle and its capsular fibers in relation to the anterior joint capsule is extremely important in reconstructive surgeries and post elbow surgery rehabilitation.

References

[1] BUCHANAN TS, ERICKSON JC, *Selective block of the brachialis motor point. An anatomic investigation of musculocutanous nerve branching*, Reg Anesth, 1996, 21(2):89–92.

[2] PAI MM, NAYAK SR, VADGAONKAR R, RANADE AV, PRABHU LV, THOMAS M, SUGAVASI R, *Accessory brachialis muscle: a case report*, Morphologie, 2008, 92(296):47–49.

[3] STANDRING SUSAN (ed), *Gray's Anatomy: the anatomical basis of clinical practice*, 39th edition, Elsevier Churchill Livingstone, New York, 2005, 855.

[4] BERGMANN RA, THOMPSON SA, AFIFI AK, *Catalogue of human variation*, Urban and Schwarzenberg, Baltimore, 1984, 51–52.

[5] DIDIO LJA, ZAPPALÁ A, CARDOSO AD, DIAZ RA, *Musculus articularis genus in human fetuses, newborn and young individuals*, Anat Anz, 1969, 124(2):121–132.
[6] AHMAD I, *Articular muscle of the knee – articularis genus*, Bull Hosp Joint Dis, 1975, 36(1):58–60.
[7] KJAERSGAARD P, *A note on m. articularis humeri in the wild boar, bear, tapir, and rhinoceros*, Gegenbaurs Morphol Jahrb, 1974, 120(1):143–145.
[8] HOLLINSHEAD WH, *Anatomy for surgeons. Vol. 3: the back and the limbs*, 3rd edition, Harper and Row Publishers, Philadelphia, 1982, 341–435.
[9] SCHAEFFER JP (ed), *Morris' human anatomy: a complete systematic treatise*, 11th edition, The Blakiston Company, New York, 1953, 545–547.
[10] CLEMENTE CD, *Anatomy: a regional atlas of the human body*, 4th edition, Lippincott Williams & Wilkins, Baltimore, 1997.
[11] SULEMAN S, SZABO PL, AGUR AMR, Capsular fibres of brachialis: an anatomical study (Abstract). In: ***, *4th Joint Meeting of the American Association of Clinical Anatomists and the British Association of Clinical Anatomists*, New York, 2005.
[12] LEONELLO DT, GALLEY IJ, BAIN GI, CARTER CD, *Brachialis muscle anatomy. A study in cadavers*, J Bone Joint Surg (Am), 2007, 89(6):1293–1297.
[13] PIERCE TD, HERNDON JH, *The triceps preserving approach to total elbow arthroplasty*, Clin Orthop Relat Res, 1998, 354:144–152.
[14] BERTELLI JA, *Brachialis muscle transfer to the forearm muscles in obstetric brachial plexus palsy*, J Hand Surg Br, 2006, 31(3):261–265.
[15] BERTELLI JA, GHIZONI MF, *Brachialis muscle transfer to reconstruct finger flexion or wrist extension in brachial plexus palsy*, J Hand Surg Am, 2006, 31(2):190–196.
[16] MEHTA V, SURI RK, ARORA J, RATH G, DAS S, *Peculiar tendinous origin of brachialis muscle: anatomic and clinical insight*, Rom J Morphol Embryol, 2009, 50(1):141–143.

Corresponding author
Rajalakshmi Rai, Senior Lecturer, Department of Anatomy, Center for Basic Sciences, Kasturba Medical College (Affiliated to Manipal University), Bejai, Mangalore, 575004 Karnataka, India; Phone +91824–2211746, Fax +91824–2421283, e-mail: rajalakshmi.rai@manipal.edu

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