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REVIEW ARTICLE

Complete Rupture of the Insertional Tendon of Biceps Brachii: What We Know

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Abstract

Purpose and objective: Ruptures of the distal biceps tendon present surgeons with a complex set of potential management options, and significant variation in practice exists. This review aims to succinctly collate the current evidence with regards to epidemiology, diagnosis, and management, in order to allow clinicians to inform themselves as to how best to deal with this increasingly frequently encountered phenomenon.

Background and principle results: This review focuses on an area of orthopaedics which demonstrates significant heterogeneity in its management. It was felt that the overwhelming amount of published work on the subject of distal biceps tendon ruptures had yet to be collated into a succinct article, and so literature review and summarization was performed and presented herein.

Summary and major conclusions: The relative frequency of the injury, relevant functional anatomy, pathophysiology, management options, and notes on post-operative rehabilitation are included.

Keywords

Distal biceps, Tendon rupture, Biceps repair, Upper limb, Sports injuries, Biceps brachii

Review

Functional anatomy of the distal insertion

The role of the biceps brachii (biceps) as a powerful supinator of the forearm has been well described [1] and will be self-evident to most. Despite sharing a 'common' distal tendinous insertion, the fibres of the long and short heads remain distinct, with the long head occupying a much larger ovoid footprint on the radial tuberosity, and the short inserting in a slender distally orientated outcropping [2]. The long head therefore influencing supination more so than the short head. In addition to the true bony attachment, the insertional tendon also gives of the lacertus fibrosus. Also referred to as the bicipital aponeurosis, this thick fibrous structure blends with the deep fascia of the forearm and prevents over-lateralisation of the ulna during supination [3]. Its historical moniker of the *Grace à Dieu* fascia derives from the fact that it would protect the neurovascular structures of the antecubital fossa from inadvertent injury during supposedly therapeutic phlebotomy of the median cubital vein [4].

In ruptures of the distal biceps tendon distal to the lacertus, it acts like a vinculum, tethering the muscle and impeding complete retraction towards the shoulder. This accounts for the inconsistent appearance of the "reverse Popeye sign". It may also lead to a false-negative "hook test"; the examiner may believe they can feel an intact insertional tendon when they are in fact palpating the remnant lacertus. In addition to these clinical findings the patient will present with pain and describes a "popping" or "tearing" sensation in the antecubital fossa. Radiological investigations are usually not required, but where doubt exists, ultrasound examination or magnetic resonance imaging are both equally as diagnostically useful (particularly in the case of incomplete rupture) [5]. Plain films are not usually helpful without the context of concomitant trauma, but may demonstrate hypertrophy about the radial tuberosity in the case of very longstanding insertional tendinopathy.

Seiler, et al. [6] described three zones for the insertional tendon of biceps, numbered from proximal to distal, and defined by their vascular supply; Zone

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1 about the musculotendinous junction receiving its supply in much the same way as the muscular bulk proximal to it. I.e.via anastomosing arterioles which in turn each derive from the brachial artery itself. Zone 3 about the insertion's footprint on the tuberosity is fed by the same branches of the posterior interosseous artery which supply the radial neck. The interposed Zone 2 is somewhat of a watershed area between the two supplies.

Tears, epidemiology and pathophysiology

Tears of the distal biceps tendon occur relatively infrequently, occurring in 0.8-1.9 patients in a population of 100,000 per year [7] (c.f tendo achillis ruptures; 21.5 per 100,000 per year [8], the most common tendon rupture [9]). The typical patient is male, over 30-years-old, and is predominantly affected on the dominant arm [10]. The Zone 2 vascular watershed is by far the most common rupture site. It is unfortunate that this particular region also appears to be most affected by mechanical impingement during pronosupination, resulting in fibrous attrition [6]. Factors thought to particularly increase risk are smoking and the use of corticosteroids [11]. Bilateral, or consecutive bilateral ruptures occur on occasion and are particularly associated with severe chronic kidney disease, hyperparathyroidism, and a recent history of quinolone-based antibiotic use [12]. Subjects who abuse testosterone and related compounds (anabolic steroids) for cosmetic purposes are also pre-disposed to tendon ruptures [13], possibly due to dysplastic organisation of collagen fibrils. Perhaps of most importance however is a pattern of acute injury on a background of overuse-weightlifters and manual labourers being particularly affected; An excessive eccentric loading force acts at the elbow as it is brought from extension into flexion [14]; the "flexed elbow unacceptably challenged". In 1953 Chevallier [15] described a two-stage pathophysiological model which remains consistent with a contemporary understanding of the disease process. An interstitially weakened tendon ruptures acutely, and thereafter the lacertus fibrosis may also be torn as a result of un-opposed muscular contraction.

Conservative management and its outcomes

Many patients with an acute painful injury will be reluctant to "leave it alone" where an established surgical repair option exists. Outside of the context of patients with severe cognitive impairment or those whose medical comorbidities preclude operative intervention, conservative management of these injuries is generally reserved for the so-called "low-demand" patient [14]. Such subjective evaluations of patient needs are inherently coloured by clinicians' inherent biases; in reality there are very few people whose quality of life is not heavily dependent on their normal upper limb function. Counselling patients as to their options is also made difficult by the scarcity of evidence. No randomised clinical trials exist in the literature, and although some retrospective studies are reported, they are either underpowered [16,17], or effectively uncontrolled [18]. However what they can tell us is that outcomes for conservatively managed patients are generally poor [19], and although as much as 88% of elbow flexion power may be retained following complete distal biceps tendon rupture (compared with the uninjured arm), supination power and strength in resisted supination can be reduced to as little as 65% and 14% respectively [20]. Another point to consider is that conservatively managed patients who initially cope well may ultimately re-present with accelerated rotator cuff degeneration after adapting to their loss of supination strength by increasingly relying on external rotation at the shoulder as a compensatory technique [21].

Surgical management and history

Storhsin first identified the lesion at autopsy in 1842 [22]. Case reports on living subjects date back to the late 19th century [23], and by the 1950s about 100 cases had been described [24]. Even at that stage there is debate in the literature as to appropriate management techniques. Some cautioned that careful selection of operative candidates was imperative given the relatively minimal disability encountered by conservatively managed patients [25]. The earlier operative techniques consisted of either passing a heavy suture through the proximal part of the tear and attempting to approximate its anatomical footprint at the bicipital tuberosity by tying the suture ends about the whole of the proximal radius [26], or an alternative in the form of tendodesis of the distal biceps tendon to the brachialis (or to the ulna itself) [27]. This went some way to restoring strength in flexion but naturally could not be expected to assuage the supination deficit. Both techniques suffered from high failure rates, and disabling neurovascular complications were not unusual [28].

Modern surgical management

Surgical repair aiming to restore anatomy and function now represents the treatment goal for the majority of patients. Some technical variation exists in how surgeons go about achieving this, namely in the approach to fixation, as well as in the materials utilised.

One- versus two-incision techniques

Retrieval of the tendon stump and its re-attachment to the radius can be achieved by various approaches, but broadly speaking either one or two incisions are made. In the single incision technique, this may take the form of a small transverse incision just distal to the antecubital fossa, or a more extensile S-shaped incision can be used in cases where it is felt the stump may have more markedly retracted up the arm [29]. This technique is associated with a lower rate of heterotopic ossification

and radio-ulnar synostosis (which can necessitate re-operation) than is seen in the dual incision alternative [30].

In the two incision variant, a second site is created over the radial head in order to receive material passed through a bony tunnel made through the proximal radius. This was developed with the intention of more closely approximating the native anatomy [31], but recent meta-analysis has confirmed it also carries a lower risk of neurovascular injury [32], particularly to the lateral cutaneous nerve of the forearm (the lateral antebrachial cutaneous nerve, LACN). The same analysis also found no significant difference between the two techniques in terms of restoration of supination strength. The single incision approach was found to have better results in terms of range of motion in flexion and pronation, but this was caveated by heterogeneity in the rehabilitation regimens employed in the various included studies. Fortunately when LACN injuries do occur, they frequently take the form of self-limiting traction neuropraxiae [33], however more serious and disabling nerve injuries are also encountered in both approaches.

Surgical management and fixation technique

Various methods of re-attaching the tendon have been proposed and remain in use. For primary repair of the native tendon, it can either be anchored to its footprint with an interference screw, or breasted with suture material which itself is made fast to the radius by suture anchors (SA), trans-osseous sutures (TO) or via an endo-cortical button (ECB). In the single incision approach, an ECB is sometimes passed through the proximal cortex only, with the button sitting within the intramedullary canal of the radius.

There is a significant body of literature comparing the efficacy of these various materials. In cadaveric biomechanical studies, ECB has been found to be stronger than TO [34] but no observable real-world clinical differences were found in a retrospective cohort study [35]. Another biomechanical study found no difference in failure rates for SA versus ECB [36], and once again no real-world outcome differences were noted in a clinical study [37]. It would seem reasonable to conclude that when it comes to materials selection for these cases, *the best way is the way you know best.*

Post-operative rehabilitation

The ultimate goal of both repair and rehab is to enable the patient to return to work and recreational activities as quickly and as safely as possible. The exact nature of the rehabilitation programme advised will vary by centre, surgeon, and repair technique employed. In general however, an initial period of immobilisation is employed to protect the wound. This is followed by limited passive movement, and extension at the elbow may be restricted by a lockable range-of-motion or elbow hinge brace. Thereafter strengthening can begin. Biomechanical analyses have demonstrated that pull-out type failure is unlikely during physiological biceps contraction for various repairs [38], and this may reassure surgeons who are reluctant to “let them go” in the immediate post-operative period, but restricting higher intensity activities such as weights training is naturally a sensible precaution. Physiotherapists have demonstrated good outcomes with sequential, criterion-based, progressive rehabilitation programmes [39].

It is difficult to determine whether patients can expect their outcome to reflect their pre-injured state. Although anecdotally some patients report a return to competitive body-building and other high-demand work, it may be advisable to manage patients’ expectations to a certain extent, but to what degree will always be a function of individual experience.

Conclusion

- Distal biceps tendon rupture is relatively uncommon
- Clinical assessment is usually sufficient in order to establish a diagnosis
- Where doubt exists, ultrasound examination or magnetic resonance imaging may be sought
- It is highly disabling and most patients benefit from operative repair
- No single repair material has demonstrated superiority
- Dual incision approaches result in less heterotopic ossification
- Single incision approaches have fewer neurovascular complications
- Structured rehabilitation under a physiotherapist’s supervision is vital

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Conflict of interest

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Informed consent (patient/guardian)

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Authors contribution

Single author.

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