Acute Biceps Brachii Injuries

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Contents

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Abstract

Acute injuries to the biceps range in severity from mild strains and contusions to complete tendon and muscle belly ruptures. As with many muscles and tendons, injuries tend to occur during eccentric loading of the muscle, such as resisting a force attempting to extend the elbow and pronate the forearm. While distal biceps ruptures are more common, proximal rupture of the long head and more rarely the short head have also been reported. Proximal ruptures can result in a “popeye” deformity, while distal ruptures can be diagnosed on physical examination through the use of the hook test and occasionally the presence of a reverse “popeye” deformity. While plain films are generally negative, MRI or ultrasound can confirm either diagnosis. Complete ruptures of the long head of the biceps tendon may be asymptomatic, particularly in elderly patients and those with lower functional demands. Such injuries are frequently treated nonoperatively. Conservative treatment of complete distal ruptures is generally less favorable, with significant residual weakness and cosmetic deformity noted. Operative treatment is generally indicated, with the exception of the elderly and patients with low functional demands.

8.1 Introduction

The majority of biceps tendon pathology evaluated and treated by orthopedic surgeons is chronic in nature. This pathology most frequently involves the long head of the biceps tendon and is often associated with rotator cuff and labral pathology. This chapter however focuses on acute injuries of the biceps brachii muscle and tendons, both distally and proximally. Acute injuries to the biceps range in severity from mild strains and contusions to complete tendon and muscle belly ruptures. This chapter will address relevant anatomy, injury mechanisms, symptoms, physical exam and imaging findings, and treatment options.

8.2 Definition of the Injury

8.2.1 Anatomy

The proximal origin of the biceps brachii muscle consists of two heads: the long head and the short head. The long head takes its origin on the supraglenoid tubercle inside the shoulder joint capsule where its fibers blend with those of the superior labrum. The tendon passes above the humeral head just posterior to the coracohumeral ligament and enters the bicipital groove on the anterior humeral head [2]. Fibers from the coracohumeral ligament, superior glenohumeral ligament, and subscapularis tendon coalesce to form the biceps pulley that secures the tendon in the groove [43]. The tendon then passes distally in the groove and under the transverse humeral ligament (Fig. 8.1). The total tendon length prior to the myotendinous junction is about 9 cm [20].

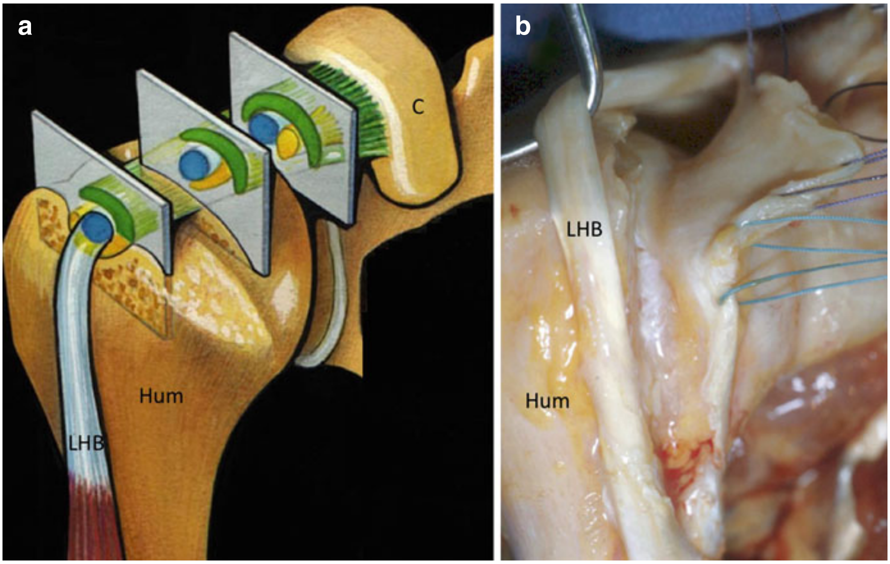

Fig. 8.1 (**a**) Drawing demonstrating the relationship between the long head of the biceps tendon (*LHB*), the coracohumeral ligament (*green*), and superior glenohumeral ligament (*yellow*) as they proceed toward the bicipital groove. The coracoid (*C*) and humerus (*Hum*) are labeled. (**b**) Anatomical dissection of a right shoulder viewed anteriorly. The biceps sling and transverse humeral ligament (*tagged with blue sutures*) have been elevated to reveal the long head biceps tendon (*LHB*), which has been retracted laterally out of its groove on the anterior humerus (*Hum*)

The short head of the biceps tendon takes origin on the tip of the coracoid process just lateral to the attachment of the pectoralis minor tendon. This shared origin with the coracobrachialis is known as the conjoined tendon. Recent work suggests that this origin consists of muscle fibers taking origin directly on the coracoid with an aponeurosis on its anterior surface rather than a true tendon as seen in the long head [10]. The musculocutaneous nerve passes just posterior to the short head prior to entering the muscle belly of the coracobrachialis.

The muscle bellies of both heads of the biceps are located just anterior to the brachialis muscle. Distal to the myotendinous junction, the bicipital aponeurosis (lacertus fibrosus) continues distally and medially while the distal tendon of the biceps crosses the elbow joint and continues toward the radial tuberosity. The fibers rotate as they approach the tuberosity, with medial fibers attaching to the anterior portion of the tuberosity and more lateral fibers attaching more posteriorly [28].

8.2.2 Injury Mechanism

As with many muscles and tendons, injuries tend to occur during eccentric loading of the muscle, such as resisting a force attempting to extend the elbow and pronate the forearm. Injuries can also result from a direct blow to the muscle belly itself.

The long head of the biceps is the most common site of rupture. This injury was first described in 1781 [17, 31]. The vast majority of these injuries are chronic in nature, often found in association with rotator cuff pathology [21, 55]. Acute injuries of the long head of the biceps account for a very small proportion of ruptures [48]. Injuries to the short head of the biceps tendon are also rare. Case reports have associated this injury with a forceful abduction of the shoulder in situations such as waterskiing [12], skydiving [34], and automobile accidents [50]. It has also been reported in cases of minimal trauma in the presence of significant degenerative change in the tendon [42].

Distal ruptures are less common than proximal ruptures, occurring at a rate of 3 per 100,000 people per year and representing between 3 and 10 % of all biceps tendon ruptures [36, 46]. These injuries more commonly affect the dominant arm and are almost exclusively seen in males in their fifth and sixth decades [36]. Distal biceps ruptures are extremely rare in women. Smoking has been noted to increase the risk of a distal biceps rupture sevenfold [46]. Several authors have noted degenerative changes in ruptured tendons, possibly contributing to the risk of a tear [25].

8.3 Symptoms and Signs

Patients suffering a contusion to the muscle belly from a direct blow report typical symptoms of pain and discoloration with short-term limitation of function secondary to pain. Patients suffering an acute complete rupture typically describe feeling or hearing a pop followed by pain and a loss of strength. Bruising and swelling in the arm are commonly reported. Partial ruptures of the long head are often more symptomatic than complete ruptures [48], while more functional loss is typically noted with a distal rupture than a proximal injury.

8.3.1 Physical Examination

Physical examination of an acute rupture may reveal bruising of the upper arm, distal arm, or forearm depending on the location of the rupture. Pain on palpation or with motion of the elbow is to be expected. Weakness in elbow flexion and especially supination is common immediately following injury but may improve with time [45].

Patients with an acute rupture of the long head may experience tenderness over the bicipital groove during palpation, especially in cases of partial tearing [48]. Patients with a complete rupture may present with a "popeye" deformity in which the muscle belly of the long head of the biceps forms a mass in the distal portion of the arm (Fig. 8.2) [22]. Resisted elbow flexion or supination may highlight this finding. Findings following complete rupture of the short head of the biceps are similar. Bruising and tenderness of the proximal medial arm is typically noted along with a palpable gap in the muscle tissue in this same area. A popeye sign is common but is typically located more medial than in cases of rupture of the long head [34, 50].

Fig. 8.2 Clinical photograph of a right arm in a patient with a long head biceps rupture. The classic "popeye" deformity is visible as the muscle belly of the long head of the biceps balls up in the distal portion of the arm

A distal rupture of the biceps tendon often results in significant distal bruising and a palpable gap in the muscle. This gap may not be easily palpable in cases in which the lacertus fibrosus and brachialis tendons are still intact. However, the "hook test" has been demonstrated to be highly specific and sensitive in making the diagnosis [38]. The elbow is flexed to 90° and maximally supinated. The examiner can then hook the lateral edge of the biceps tendon with his or her index finger. Failure to palpate the tendon in this position confirms the diagnosis [38].

8.3.2 Clinical Classification

No formal classification system has been described for acute ruptures of the biceps. Lesions are typically described by location (long head, short head, or distal). Ruptures of the long head of the biceps can either involve the tendon itself or avulse a portion of the superior labrum. This situation represents a type 2 SLAP (superior labrum anterior posterior) tear [51].

8.4 Imaging

Although physical examination is often sufficient for diagnosis, imaging studies often provide additional useful information regarding tear extent and location and allow the physician to rule out associated injuries.

8.4.1 Plain Radiographs

Plain radiographs are generally normal (with the exception of soft tissue swelling) in cases of isolated biceps muscle injuries. Plain radiographs are generally not useful in cases of proximal tendon rupture. Rarely, one can visualize irregularities of the radial tuberosity associated with a distal avulsion injury [44]. The greatest value of plain radiographs probably lies in ruling out associated elbow injury in cases of distal rupture [53].

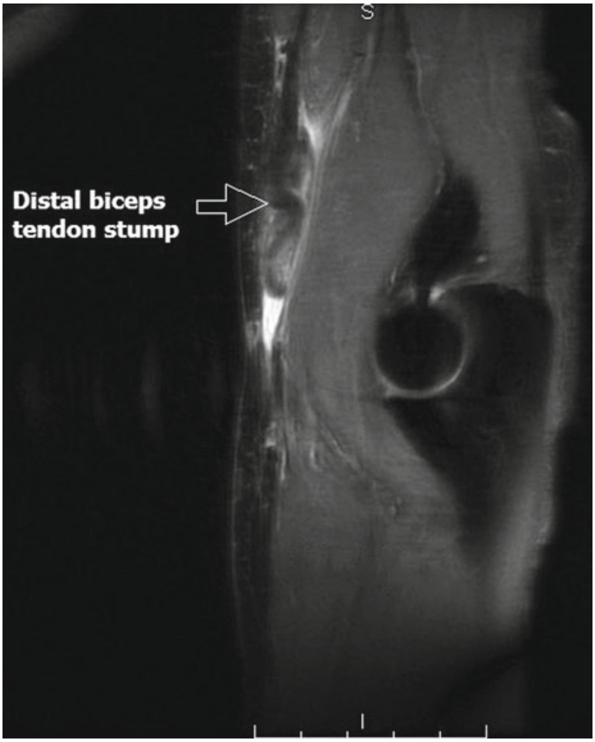

Fig. 8.3 Sagittal plane MRI image demonstrated a complete rupture of the distal biceps tendon. The tendon can be seen retracted proximally in the arm (*arrow*) (© Luke S. Oh, MD, Boston, MA, USA)

8.4.2 Ultrasound

Ultrasound imaging has proven to be an efficient and cost-effective means of evaluating both proximal [35] and distal [4, 19] injuries to the biceps tendon. Advantages include its low cost and rapidity, although its sensitivity and specificity are highly operator dependent [19].

8.4.3 Magnetic Resonance Imaging (MRI)

MRI is frequently the most useful imaging modality when evaluating potential tears of the biceps. Proximally, MRI is used in differentiating partial from complete ruptures, the degree of retraction of complete tears, and in ruling out other intra-articular shoulder pathology. Both SLAP tears [7] and rotator cuff injuries [14, 21] are frequently associated with long head biceps ruptures. MRI can be especially useful in the evaluation of distal ruptures (Fig. 8.3). It has been shown effective in differentiating partial from complete tears and defining other pathology such tenosynovitis and hematomas [15].

8.5 Treatment

8.5.1 Nonoperative

Biceps contusions and other minor injuries are best treated with rest, ice, and anti-inflammatory medication. Complete ruptures of the long head of the biceps tendon may be asymptomatic, particularly in elderly patients and those with lower functional demands [52]. However, more recent comparative studies have demonstrated poorer functional outcomes and cosmetic appearance with nonoperative management, especially in patients with high functional demands [32]. Partial ruptures of the long head of the biceps tendon are generally due to underlying degenerative change and can be quite painful [48]. Natural progression to complete rupture may result in significant improvement of symptoms.

Distally, partial biceps tendon tears are less common than complete tears. Several authors have reported good results of conservative management of partial tears [13, 18] and recommend a trial of conservative management in these patients. Conservative treatment of complete ruptures is generally less favorable, with significant residual weakness and cosmetic deformity noted [8]. Nonoperative treatment is generally limited to the elderly and patients with low functional demands.

8.5.2 Operative

Surgical repair is the treatment of choice for symptomatic complete ruptures of the biceps brachii in active patients.

8.5.3 Surgical Technique

Surgical options for the treatment of ruptures of the long head of the biceps include tenotomy or tenodesis in cases of partial rupture and tenodesis in cases of complete rupture. Tenotomy is less likely to result in persistent pain in the bicipital groove but may lead to variably symptomatic weakness in supination or a popeye deformity [24]. Numerous surgical techniques have been described for performing a tenodesis of the biceps tendon. Tenodesis can be performed either into the bicipital groove or more distally in the humeral diaphysis. Tenodesis into the bicipital groove can be performed via an open technique utilizing suture fixation with [23] or without [30] a periosteal flap. Alternatively, the tendon stump can be fixed within the humerus using either the keyhole technique [16], sutures [41], or an interference screw (Fig. 8.4) [37]. Tenodesis into the humeral shaft can also be performed via a subpectoral approach using the same interference screw technique [33]. Subpectoral tenodesis has the theoretical advantage of removing any degenerative and potentially

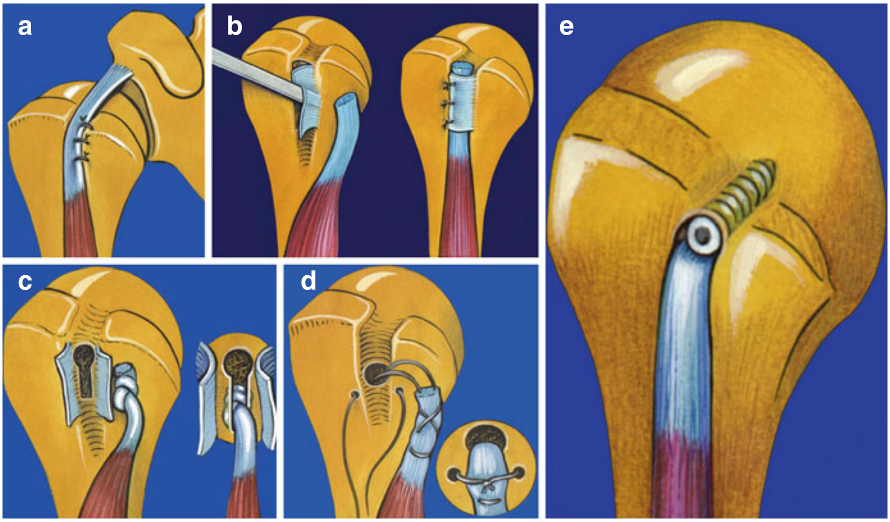

Fig. 8.4 Techniques for long head biceps tenodesis: (**a**) Suture technique of Lippman [30]. (**b**) Suture and periosteal cover technique of Hitchcock [23]. (**c**) Keyhole technique of Fromison [16]. (**d**) Suture technique of Post [41]. (**e**) Interference screw technique

symptomatic tendon from the bicipital groove, but cases of fracture through the tenodesis site have been reported [47]. Arthroscopic techniques for biceps tenodesis have been described in cases of tendon degeneration but are generally not applicable to cases in which rupture has already occurred [5].

There are significantly fewer published reports on surgical treatment of ruptures of the short head of the biceps tendon. Acute primary repair of the ruptured muscle belly is most commonly reported, usually utilizing a Kessler- or Bunnell-type suture technique [34, 50]. One case of tenodesis to the intact coracobrachialis tendon has also been reported with a good outcome [42].

Repairs of distal ruptures generally focus on restoring the insertion of the distal biceps tendon on the radial tuberosity, although tenodesis to the brachialis tendon has also been reported [11, 27]. The tendon and muscle can generally be mobilized to facilitate anatomic repair in acute cases, while augmentation is occasionally required in more chronic situations [45]. Repair was traditionally performed through an extensile Henry approach to the anterior elbow [53]. A high complication rate led Boyd and Anderson to develop the classic two-incision approach to anatomic repair [6]. This approach includes an anterior incision over the distal arm to identify and mobilize the tendon stump and a second approach to the dorsal radius to facilitate fixation (Fig. 8.5). The approach was modified to a muscle-splitting technique by Kelly et al. to avoid damage to the periosteum of the ulna and subsequent high rate of heterotopic ossification [26]. Recent advancements in fixation have also facilitated repair through a single, smaller volar incision [1]. Fixation options for repair of the tendon to the radial tuberosity include the use of bone tunnels [26], cortical buttons [49], suture anchors [29, 54], and interference screws [3, 9].

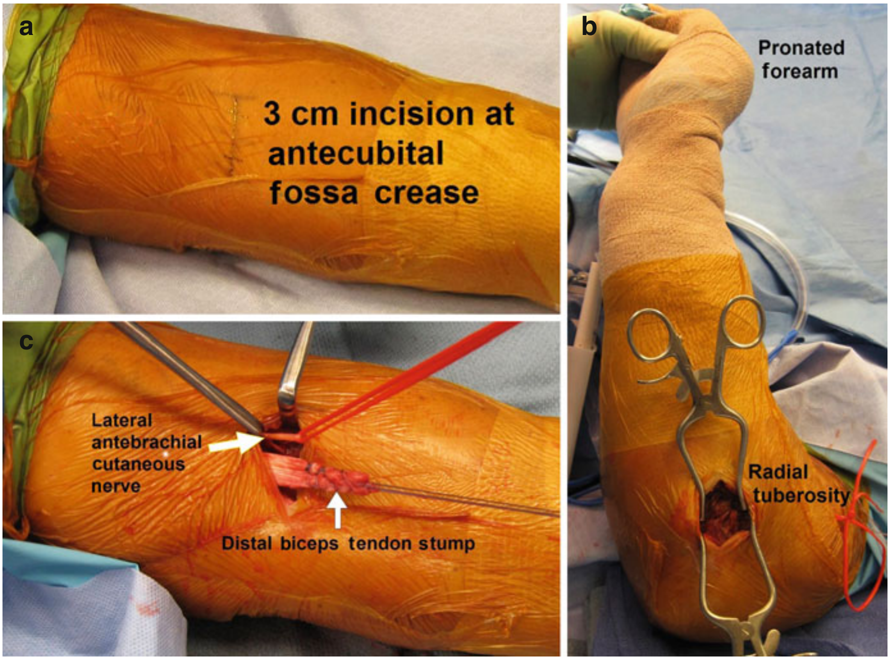

Fig. 8.5 (**a**) Intraoperative photograph demonstrating the small, transverse volar incision to be used for distal biceps tendon repair. (**b**) The distal biceps tendon stump has been identified and prepared for fixation. The lateral antebrachial cutaneous nerve has been identified and protected. (**c**) A small dorsal incision is utilized to access the radial tuberosity for fixation (© Luke S. Oh, MD, Boston, MA, USA)

Biomechanical studies have shown increased stiffness of fixation performed through bone tunnels with a two-incision technique when compared to single-incision repair with suture anchors [40]. However, one comparative clinical study demonstrated no difference in outcome in patients treated with bone tunnels, suture anchors, or cortical buttons [39].

8.5.4 Findings at Surgery

Following rupture of the long head of the biceps, the muscle contracts into the distal part of the arm. The degree of tendon retraction is variable, but the tendon is often quite distal in the bicipital groove and difficult to locate. When it is identified it can generally be mobilized proximally enough to perform a tenodesis into the groove except for some chronic cases where contracture of the muscle prevents tendon mobilization [55].

Distal ruptures of the biceps tendon result in retraction of the muscle and tendon proximally. The status of the lacertus fibrosus and the chronicity of the tear are important predictors of the degree of retraction. If the lacertus fibrosus remains intact, it may limit the degree of proximal retraction and facilitate mobilization of the tendon stump [45]. More chronic cases are generally associated with more retraction and scarring that can complicate identification of the stump.

Conclusion

Acute biceps muscle injuries are relatively rare compared to the more common degenerative conditions associated with lesions of the rotator cuff. Ruptures of the biceps tendon mostly occur during eccentric contraction of the biceps muscle. Physical examination may reveal hematoma and a distalization or proximalization of the muscle belly. Ultrasound and MRI are useful in confirming the diagnosis. Conservative treatment may be effective in cases of proximal rupture and in cases of partial distal rupture. Operative treatment is often preferred in cases of distal ruptures in order to restore muscle function.

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