Distal biceps reconstruction 13 years post-injury

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Abstract: Distal biceps tendon ruptures are relatively rare injuries most commonly caused by an eccentric contraction of the biceps brachii. The majority of complete ruptures receive early surgical intervention, however, some patients do present in a delayed fashion. There are many surgical options at this time for acute and chronic injuries, and this case report describes an Achilles allograft reconstruction in a male who sustained a complete tear 13 years prior to presentation. At 12-month follow up, he had regained full function of his dominant extremity as evidence by returning to work with no limitations and by a Disabilities of the Arm, Shoulder, and Hand (DASH) score of zero. We are unaware of a successfully surgically reconstructed distal biceps tendon of this chronicity. As the literature on this subject is sparse, this case report gives credence to the idea that certain patients with a chronic distal biceps rupture should be considered for operative reconstruction and not relegated to continued failed conservative treatment. Discussed are the surgical treatment options and controversies for chronic distal biceps ruptures, and we review various outcome studies using different surgical techniques.

Keywords: chronic, distal biceps, reconstruction

Introduction

An active, otherwise healthy 45-year-old male laborer presented 13 years after sustaining a complete distal biceps rupture which had thus far been treated nonoperatively. Owing to progressive disability from the injury and difficulty with work activities, we opted for operative intervention. Chronic ruptures such as this one often require reconstruction using soft tissue autografts or allografts due to scarring to the underlying brachialis and difficulty with distal mobilization. Using an Achilles allograft, the patient regained full strength, painless elbow range of motion, and was able to return back to full work activities. The patient provided written informed consent for print and electronic publication of this report.

Case report

A 45-year-old man sustained a distal biceps rupture during an eccentric contraction while lifting a living room chair. He initially presented to an orthopaedic surgeon 24 months after the injury secondary to continued antecubital fossa

discomfort. Owing to the chronicity of the injury and high functional level of the patient, nonoperative treatment was recommended at that time. After a period of 156 months (i.e. 13 years and 2 months), he returned to the orthopaedic clinic because of worsening elbow flexion and supination strength as well as persistent antecubital fossa soreness. As this was his dominant right arm and his work as an owner of an air-conditioning company required physical activity, he was interested in pursuing operative intervention after receiving no benefit from 3 months of physical therapy.

His physical exam at that time consisted of a right arm popeye deformity approximately a hand width superior to the antecubital fossa. He had no palpable tendon with the hook test, was tender over the tendon stump, and complained of muscular cramping with resisted supination and elbow flexion. Strength was graded at 4/5 elbow flexion and 4-/5 supination, and he had full elbow range of motion. An MRI demonstrated that the distal biceps was scarred to the brachialis

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Figure 1. T1-weighted MRI sequences showing the end of the biceps tendon (circled in red) (A) scarred to the underlying brachialis muscle and (B) retracted approximately 11 cm from the radial tuberosity. The white line originates from the biceps tuberosity and terminates at the biceps tendon.

Figure 2. The Achilles tendon allograft is prepared using a locking Krackow stitch with the suture ends passed through three bone tunnels.

Figure 3. Intra-operative image of the reconstructed distal biceps tendon using the Achilles allograft. Distal is to the left of the image.

approximately 11 cm proximal to the biceps tuberosity, but, fortunately, there was no MRI evidence of biceps atrophy as defined by fatty infiltration (Figure 1A and B). After discussing the complexity of the reconstruction, the risks of the procedure, and the possibility of incomplete relief of symptoms, the patient opted for operative treatment.

Using an L-shaped incision with a vertical medial limb, the proximal dissection located the distal biceps tendon approximately 7 cm from the antecubital fossa. As expected due to the chronicity of the injury, there was very minimal tendon excursion due to scarring to the underlying brachialis so it was decided to use an Achilles tendon allograft (Figure 2). The allograft tissue was obtained from LifeNet Health and sterilized using the Allowash XG process (LifeNet Health, Virginia Beach, VA) which includes low dose (1.2–1.9 Mrad) irradiation. Allograft fixation was achieved by using a second dorsal incision over the proximal radius, a 1.5 cm × 1 cm × 1 cm bone trough centered over the biceps tuberosity corresponding to the size of the bone block on the allograft, three bone tunnels in the block and radius, and #5-0 Ethibond suture (Johnson and Johnson, New Jersey). To complete the fixation, a locking Krackow stitch secured the native tendon to the soft tissue portion of the allograft (Figure 3). Finally, a long arm posterior splint was placed with the elbow in 90° of flexion and 45° of supination.

Per the post-operative protocol for distal biceps ruptures, the patient is kept immobilized while working on wrist range of motion (ROM) and shoulder pendulum exercises for the first 3 weeks. From post-operative weeks 3 to 6, progressive

active extension and gentle forearm active range of motion at 90° of flexion is allowed in a hinged elbow brace. Full elbow extension should be achieved by weeks six to eight, and isometric wrist and grip strengthening is begun. The brace is discontinued at week eight with the commencement of active elbow flexion and shoulder isometrics (other than shoulder flexion). The patient is allowed to start shoulder flexion isometrics at week 9 and is allowed to progress back to full activity after week 12. A more formal work conditioning program is considered for high demand workers, and a slightly accelerated version of this protocol is allowed for acutely repaired ruptures.

At 5 months post-operatively, this patient's elbow range of motion was 0–150° with 80° of supination and pronation and, as measured by the same pre-operative examiner, 5-/5 strength for supination and elbow flexion. At 12 months post-operatively, he had no pain with full strength and range of motion of his elbow. He had returned to all pre-injury activities with no limitations. A Disabilities of the Arm, Shoulder, and Hand (DASH) form was completed with a score of 0 for the DASH Disability/Symptom Score as well as for the Work Module.

Discussion

Distal biceps rupture is a relatively rare injury most commonly caused by an eccentric contraction of the muscle, often seen with a sudden pull or jerk. An epidemiology study showed an incidence of 1.2 ruptures per 100,000 patients per year with an average age of 47 years [Safran and Graham, 2002]. Due to pain and loss of elbow function, the majority of these present acutely and are thus diagnosed and treated soon after the injury. Consensus opinion is that acute ruptures should be repaired primarily if possible, and there are a variety of fixation methods including bone anchors, suspension techniques, bone tunnels with interference screws, and transosseous sutures [Miyamoto *et al.* 2010]. No one technique has emerged as the gold standard, and the choice remains surgeon dependent. Occasionally, patients present in a delayed fashion and, if surgery is indicated, are thought to undergo a more complicated reconstruction with more variable results. However, a recent cohort study comparing acute *versus* chronic injuries showed DASH scores and ROM to be similar at 1 year post-operatively when using the modified Morrey 2-incision technique [Anakwenze *et al.* 2013].

Nonoperative treatment in symptomatic patients has been shown to result in a 30–50% loss in supination strength and 20% loss in elbow flexion strength [Baker and Bierwagen, 1985]. Unfortunately, this deficit is noticeable in high demand male laborers, and thus this treatment option is rarely recommended in this population. However, lower demand individuals with chronic ruptures should be considered for nonoperative management.

Chronic distal biceps ruptures, defined as presenting beyond 4–6 weeks after the injury, introduce additional technical dilemmas not encountered when treating acute ruptures. Tendon retraction into the arm, scarring to the underlying brachialis, biceps brachii atrophy, degeneration of the tendon end, and the inability to mobilize the tendon to the biceps tuberosity are a few of these concerns that must be addressed surgically. Strong consideration should be made for a pre-operative MRI to learn the location of the tendon retraction as well as to evaluate for muscle atrophy.

One surgical option in chronic injuries includes nonanatomically attaching the biceps to the underlying brachialis, but this technique is not favored by many due to the failure to restore supination strength by as much as 50% [Klonz *et al.* 2003]. A meta-analysis of 147 patients demonstrated 90% good–excellent outcomes after anatomic reattachment and 60% after nonanatomic reattachment [Rantanen and Orava, 1999]. It is for this reason and the reasons mentioned previously regarding chronic injuries, that many surgeons use allograft or autograft to reconstruct the tendon. Surgical anatomic reconstruction options involve the use of fascia lata, palmaris longus, Achilles tendon (with or without a bone block), flexor carpi radialis, and semitendinosus. Currently, there is no consensus as to the optimal graft, and it remains surgeon dependent. An additional controversy includes using a one *versus* two incision technique, and there is no definitive evidence to support one over the other. The single incision approach has a higher rate of nerve injury, and the double incision has a higher prevalence of heterotopic ossification [Miyamoto *et al.* 2010].

Darlis and Sotereanos retrospectively reviewed 7 chronic distal biceps reconstructions using Achilles allografts and suture anchors through a single volar incision [Darlis and Sotereanos, 2006]. These patients presented a mean of 28 weeks after their

injury and, using the Mayo elbow performance score at a mean of 29 months post-operatively, 6 rated their elbow as excellent and 1 as good. All patients demonstrated 5/5 strength with elbow flexion and supination, and each returned to their pre-injury employment. Another reconstruction option investigated by Hallam and Bain uses a hamstring autograft woven through the biceps tendon and attached anatomically to the radius through a single incision with an Endobutton (Smith and Nephew, London) [Hallam and Bain, 2004]. Their 9 patients underwent surgery a mean of 4.1 months post-injury, and the mean Mayo elbow performance score was 96.3 (range 85–100). All patients returned to work and were satisfied with their outcomes. Small case series, as in the two seen above, have shown that patients do well after reconstructive procedures with a variety of grafts and fixation techniques.

In this case report, we have briefly described the operative technique and post-operative functional outcome in a surgically treated chronic distal biceps rupture. Our preferred surgical strategy in such cases involves two incisions and an Achilles allograft with an intact bone block. When appropriate fixation technique is chosen, we feel that we can create an anatomic and robust reconstructed tendon. Such fixation is important in order to allow for early elbow mobilization to prevent post-operative scarring of the graft around the antecubital fossa.

This rupture occurred 13 years prior to treatment, and, as far as we can ascertain, there is no reported successfully surgically treated case of this chronicity. This patient regained the pre-injury function of his dominant extremity with no residual pain or limitations. This case report shows that proper operative technique coupled with structured post-operative therapy can offer patients with chronic distal biceps injuries a full, meaningful recovery and highlights that not all chronic injuries are destined to have a poor outcome.

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Conflict of interest statement

The authors declare that there is no conflict of interest.

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