Injuries to the distal biceps brachialis muscle and tendon are relatively uncommon. Distal tendon avulsions usually occur in active 40- to 60-year-old men by forced extension of a partially flexed elbow.\(^1\)

While still an uncommon injury, distal tendon avulsions are now recognized and reported more frequently. Closed, traumatic, intrasubstance biceps muscle belly disruptions are rare and reported in large numbers only in series involving military parachutists.\(^2,3\) The mechanism of injury in paratroopers involves a combination of direct blow and forced abduction. A static line, used to automatically deploy the parachute, strikes the anterior brachium and the arm is forced into abduction as the jumper leaves the plane.\(^2,3\)

This article presents a case of an intrasubstance biceps muscle tear in a young male sustained during water skiing.

**CASE REPORT**

A healthy 17-year-old male sustained an unusual injury to his left upper extremity while water skiing. The injury occurred during a sudden acceleration of the boat. While doing tricks the patient had the toe-ropes held in his cubital fossa with his elbow flexed to secure the rope. He was not holding the rope with his other hand. During the sudden acceleration his arm was jerked by the rope, and he immediately felt pain and a burning sensation in his arm. A large swelling appeared on his arm and he was unable to continue skiing. The toe-ropes did not strike his arm and no abrasion was present to suggest the rope had hit his brachium.

The patient presented to the emergency department within 2 hours of his injury. Examination demonstrated a large tender mass on his anterior arm. He had no

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**Figure 1:** MRI showing intact facertus fibrosis and biceps tendon (arrows) with large intra-muscular tear (open arrow). This correlates well with the intra-operative findings noted in Figure 3.

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Rupture of the biceps muscle is an unusual injury; however, it should be considered in the differential diagnosis of a distal tendon rupture.
shoulder pain and full active range of motion of both his shoulder, elbow, and wrist. Pain was present on full extension of his elbow. Manual strength testing revealed 4/5 strength of elbow flexion and supination. The remaining muscles of the left upper extremity had 5/5 strength and he was otherwise neurovascularly intact. Plain radiographs revealed anterior arm soft-tissue swelling but were otherwise normal. He was discharged from the emergency department with a diagnosis of a biceps tendon avulsion.

The patient presented to the orthopedic clinic 2 days post injury. Additional testing revealed his lacertus fibrosis was palpable and ecchymosis was present from near his axilla to his mid-forearm. An ultrasound showed an intramuscular biceps hematoma but could not confirm if the distal biceps tendon was intact. A magnetic resonance imaging (MRI) scan showed the medial portion of the biceps muscle was disrupted. The distal biceps tendon insertion had increased signal; however, it could not be confirmed that the tendon was intact (Figure 1).

The patient and his parents were informed of the findings and the likelihood of at least a partial tear of the distal biceps tendon and an intra-substance tear. They were given options and elected to proceed with operative exploration and repair of the tendon if needed.

Operative intervention was undertaken five days post injury. An anterior approach to the cubital fossa was used. A “boat race” or lazy “S” incision was used with a proximal medial limb on the medial side of the biceps muscle, curving across the elbow crease and ending with a distal midline limb. During the surgery the biceps tendon was explored and found to be intact with mild edema present in the tendon. The medial 40%-50% of the biceps muscle was torn distally and had retracted proximally (Figure 2). The torn portion of the biceps muscle was dusky and non-contractile without any bleeding. The muscle was debrided back to healthy bleeding, contractile muscle leaving approximately 50%-60% of the muscle (Figure 3).

Postoperatively the patient was immobilized in a posterior splint with the elbow at 90° of flexion and neutral rotation. One week postoperatively, his active range of motion was 85°-135° at the elbow in flexion-extension. By the postoperative week 2, his motion had improved to 30°-135°. By week 3, he had full flexion and lacked only 5° of terminal extension. The last 5° of extension was regained in physical therapy and he now has full range of motion.

At 8-month follow-up, the patient had full elbow range of motion and 5/5 strength to manual testing. The incision is well healed with a slight loss of anterior contour compared to his contralateral extremity. He has resumed skiing and other sports and has no functional limitations.

**DISCUSSION**

No report of biceps muscle injury by this mechanism has been reported. Intra-substance biceps disruptions are reported in military paratroopers. The injuries sustained by paratroopers are common or nearly
complete disruptions of the entire biceps brachii.2,3 In one series, >50 injuries were sustained during a 2-year period.2 In this series, 28 patients went without any treatment with resultant loss of strength, easy fatigability, pain, or cosmetically unacceptable appearance. Lesions treated with late surgical repair had some improvement in strength and appearance. Ten patients had acute surgical repair and another nine had aspiration of hematoma and splinting to bring the transected ends of the biceps closer together. Both the surgical group and the aspiration/splinting group had improved function over the group who received no treatment. The authors conclude that aspiration and splinting yields acceptable results and improves strength, function, and cosmesis when compared to no active treatment.2

In another series of 13 military paratroopers, surgical repair of the muscle led to improvements in strength, appearance, and patient satisfaction over those treated nonoperatively with a sling.3 The patient presented in the case report underwent excision of muscle instead of repair for two reasons: the remaining muscle was devoid of blood supply and innervation and >50% of his muscle belly was intact. The injuries sustained by parachutists usually involved the entire muscle belly with at least some of the musculocutaneous nerve present although contused.3

Rupture of the distal biceps tendon occurs at a rate of about 1.2 per 10,000 patients, the majority involving the dominant elbow of male smokers in their fourth decade.4 Both operative and nonoperative treatments have been described for distal tendon avulsions.5 Results are usually improved by operative management of acute distal biceps tendon avulsions.1 Partial biceps tendon ruptures have been reported and can be treated with operative repairs of the partial laceration in patients failing nonoperative therapy.1,6

Functional studies with electromyography (EMG) distinguish the biceps brachii as an elbow flexor and forearm supinator. It is inactive in shoulder motion when the forearm and elbow are controlled.7-8 This has been further supported by EMG studies in patients with documented rotator cuff disease.9 Injuries to the distal muscle or tendon therefore result in functional problems with elbow flexion and supination.

The present case report occurred in a skeletally mature 17-year-old male by unusual means. The mechanism of injury causing a distal biceps tendon rupture occurs by opposed elbow flexion and is most common in older patients who are 40-60 years old.1,4,7,9 Direct blows to the anterior brachium account for the usual mechanism of injury in muscle belly disruptions with nearly all cases occurring during parachuting. By history this muscle belly disruption occurred by indirect force similar to that noted to cause distal biceps tendon avulsion. Physical exam supports the indirect mechanism of forced extension of the elbow as no rope marks were noted. Another unusual finding is that the muscle disruption involved only about 40%-50% of the muscle whereas the majority of parachutists had complete disruption of the muscle.

Imaging studies and preoperative physical exam in this case did not provide a definitive diagnosis. A partial muscle tear was suspected and confirmed by MRI. The distal biceps tendon continuity could not be confirmed by physical examination or MRI. The amount of swelling present in the arm made the usual clinical deformity of biceps disruption difficult to appreciate. The edema and hemorrhage present around the biceps tendon made confirmation of its continuity difficult.

Rupture of the biceps muscle is unusual but should be considered in the differential diagnosis of a distal tendon rupture. Imaging may not be diagnostic but advances are being made in both ultrasound and MRI.10 Clinical deformity may not be apparent secondary to swelling, making the diagnosis difficult.11 Surgical treatment is available and may improve outcome over those managed nonoperatively.3 This patient had good functional and cosmetic results. He has returned to water skiing with the recommendation to hold the tow-rope in the cubital fossa only after the boat has reached a constant speed.

**REFERENCES**