Suture Anchor Technique for Muscle Belly Repair

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ABSTRACT

Upper extremity lacerations occur frequently throughout the United States leading to a number of hospital visits. While surgical indications for repair of the muscle tendon are widely accepted, indications for repair of the muscle mid-substance are not. As the standard of care for muscle repair techniques is absent, there are a variety of techniques available for the treating surgeon. In this paper, we describe a technique used on several patients seen in our orthopedic hand clinic. The use of orthogonally placed suture anchors allows for more reliable suture passes and superior purchase in the muscle belly compared to simple end-to-end approximation. As more research is conducted in this field, we believe this technique will gain more recognition as a method of treating muscle lacerations.

INTRODUCTION

Lacerations of the upper extremity are frequent causes of hospital visits across the United States.[1] Knife wounds, broken glasses and motor vehicle related injuries often penetrate not only the skin but the soft tissue and muscle substance at the site of injury. This often results in disruption in the lengthening and contraction of the muscle-tendon unit.[2-10] Surgical indications for repair of muscle bellies include any substantial transection of the muscle belly which may be associated with either a weakness or loss of function in the affected musculature. However, there is no consensus regarding the optimal technique by which to repair muscle belly lacerations. It is accepted that difficulties in muscle belly repairs is due to their high incidence of suture pull-out.[11-13] In an animal model, it was shown that a modified Mason-Allen stitch supported by a running interrupted locking stitch in the epimysium of pig rectus femoris muscles is a viable option.[11] However, its use in the forearm has yet to be investigated. Tendon grafts using a Pulvertaft side-weave technique have been used in human flexor digitorum superficialis (FDS) laceration repairs.[10] These repairs however, require a donor tendon, usually a palmaris longus or extensor hallicus longus (EHL). The drawbacks of this technique include donor site morbidity should a distant tendon be harvested. The technique described in this paper is based on a simple end-to-end primary muscle repair that is technically simple to perform and is free from donor graft morbidity.

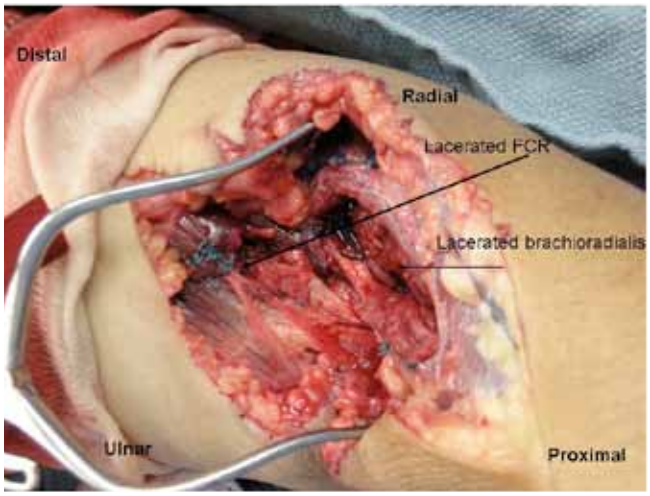

Figure 1. Lacerated flexor tendon belly (brachioradialis) with anchor sutures in place.

SURGICAL TECHNIQUE

The majority of forearm lacerations involve the volar surface. In the forearm, most of the neurovascular structures lie on the ulnar or radial aspect of the forearm or deep to the superficial muscle flexors. Figure 1 shows a lacerated flexor muscle belly on the volar aspect of the right arm of a patient.

In the case of volar wrist lacerations, the wrist is partially flexed to take tension off the flexor muscle bellies. A thorough debridement is performed. Prior to irrigating, exploring and debridement of the area, it is best to approximate the two ends of the lacerated muscle by flexing the forearm to ensure that there is not an extensive amount of tissue loss. Following this, anchor sutures are thrown perpendicular to the muscle fibers in both the proximal and distal fragments (Fig. 2). For the muscle bellies, 2-0 absorbable sutures are used to construct the anchors. The key technique is to place the open hole of the anchor within the belly of the muscle about 0.5-1.0 cm away from the lacerated edge. In figure 1, three anchor sutures are

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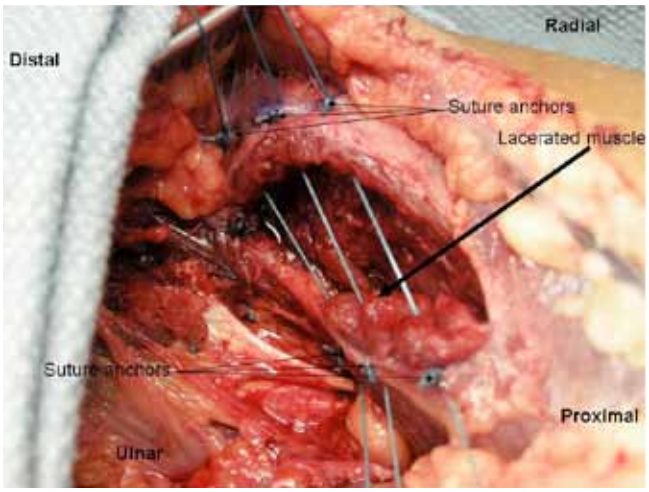

Figure 2. Lacerated flexor tendon belly (brachioradialis) with anchor sutures and approximating sutures passed through the anchors.

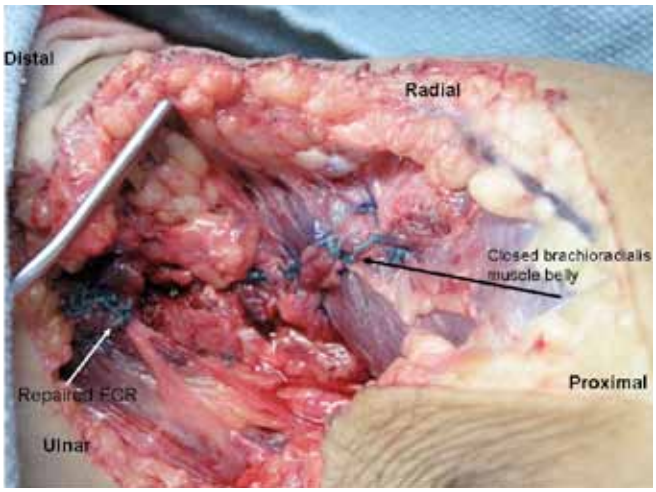

Figure 3. Final repair of the muscle belly.

placed in the proximal and distal ends of the lacerated muscle belly. This allows for greater purchase in the muscle and helps prevent pull-out. The final step is to pass a suture through the loop in the anchor, through the muscle bellies in both the proximal and distal fragments, and to secure the two ends of the muscle (Fig. 3).

Following routine closure, the wrist is immobilized in a dorsal blocking splint with the wrist in 20 degrees of flexion until stability of the wound is confirmed during the first post-operative week. Thereafter, the patient's wrist is placed in a long arm cast with the elbow flexed to 90 degrees, the forearm pronated and the wrist flexed at 20 degrees for three weeks. This positioning ensures muscle healing in a position with the least tension on the repair site. Following this, the patient can begin gentle range of motion exercises. Strengthening is initiated six weeks after surgery.

DISCUSSION

Repair of upper extremity muscle belly lacerations is traditionally reserved for complete tears or tears over 50% of the muscle width. Failure to treat these injuries can lead to deformity and loss of function. While smaller lacerations can heal by scarring, larger defects require direct repair. There is a paucity of literature supporting an optimal repair technique. The method described above is simple to perform and allows for a shorter rehabilitation period than immobilization without direct repair.

Due to the simplicity of this technique, we recommend that this be used to treat partial lacerations less than 50% of the width of the muscle as well as other defects.

References

1. **Garrett, W.E., Jr., et al.,** *Recovery of skeletal muscle after laceration and repair.* J Hand Surg Am, 1984. **9**(5): p. 683-92.
2. **Orava, S., et al.,** *Total rupture of pectoralis major muscle in athletes.* Int J Sports Med, 1984. **5**(5): p. 272-4.
3. **Chekofsky, K.M., C.R. Spero, and W.N. Scott,** *A method of repair of late quadriceps rupture.* Clin Orthop Relat Res, 1980(147): p. 190-1.
4. **Heckman, J.D. and M.I. Levine,** *Traumatic closed transection of the biceps brachii in the military parachutist.* J Bone Joint Surg Am, 1978. **60**(3): p. 369-72.
5. **Kawashima, M., et al.,** *Rupture of the pectoralis major. Report of 2 cases.* Clin Orthop Relat Res, 1975(109): p. 115-9.
6. **Berson, B.L.,** *Surgical repair of pectoralis major rupture in an athlete. Case report of an unusual injury in a wrestler.* Am J Sports Med, 1979. **7**(6): p. 348-51.
7. **Urs, N.D. and D.M. Jani,** *Surgical repair of rupture of the pectoralis major muscle: a case report.* J Trauma, 1976. **16**(9): p. 749-50.
8. **McEntire, J.E., W.E. Hess, and S.S. Coleman,** *Rupture of the pectoralis major muscle. A report of eleven injuries and review of fifty-six.* J Bone Joint Surg Am, 1972. **54**(5): p. 1040-6.
9. **Miller, W.A.,** *Rupture of the musculotendinous juncture of the medial head of the gastrocnemius muscle.* Am J Sports Med, 1977. **5**(5): p. 191-3.
10. **Botte, M.J., et al.,** *Repair of severe muscle belly lacerations using a tendon graft.* J Hand Surg Am, 1987. **12**(3): p. 406-12.
11. **Kragh, J.F., Jr., et al.,** *Suturing of lacerations of skeletal muscle.* J Bone Joint Surg Br, 2005. **87**(9): p. 1303-5.
12. **Faibisoff, B. and R.K. Daniel,** *Management of severe forearm injuries.* Surg Clin North Am, 1981. **61**(2): p. 287-301.
13. **Phillips, L.G. and J.P. Heggers,** *Layered closure of lacerations.* Postgrad Med, 1988. **83**(8): p. 142-8.