Reconstruction of the Pectoralis Major Tendon with Fascia Lata Allograft

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Orthopedics

October 2005 - Volume 28 · Issue 10:

The rupture of the pectoralis major muscle is relatively uncommon. In 1822 Patissier[1] first described disruption of the muscle in a French butcher who sustained the injury while lifting a large piece of meat. Over the next 180 years, approximately 150 cases of ruptures of the pectoralis major muscle were reported.[2]

Not uncommonly, partial or complete tears may be misdiagnosed as muscle strains. The consequent delay in diagnosis in some cases may lead to complicated delayed repairs. Several cases of delayed repair, ranging from 3 months to 13 years, have been reported. Delayed repair may result in functional deficit or cosmetic defect.[3-11]

This article presents a case of a pectoralis major rupture that was successfully repaired with fascia lata allograft augmentation five years after initial injury with minimal cosmetic defect and no functional deficit.

Case Report

A 43-year-old right hand dominant man, sustained a left pectoralis major rupture while performing bench press exercises five years prior to presentation. At the time of the injury, he was treated conservatively with physical therapy including progressive strengthening exercises.

At the time of presentation to our center, he was a self-employed mason who had been having difficulty engaging in physical labor. His main problems were weakness with overhead activities as well as subjective feelings of instability in the shoulder.

Physical examination revealed a muscular, well-developed male. His left axillary

fold, however, appeared asymmetric. The pectoralis major tendon was not palpable on that side. The rest of his shoulder examination revealed full active and passive range of shoulder motion (symmetrical with the contralateral side) with mild anterior apprehension on abduction/external rotation. There was a positive relocation sign, with no excessive anterior, posterior, or inferior motion.

Strength in adduction and internal rotation of the shoulder was 4/5. Plain radiographs showed no bony injury. A magnetic resonance image (MRI) confirmed the diagnosis of a pectoralis major tendon rupture with retraction and mild atrophy of the muscle.

Based on his medical history and attempted rehabilitation with no significant resolution of his symptomatology, a decision was made to attempt surgical repair of the tendon. Surgical exploration revealed the tendinous insertion to be completely avulsed from the humerus and retracted approximately 7 cm. With the tendon of the pectoralis major mobilized, a 1.5 cm gap was still present from the area where a repair with mild tension would be possible at the humeral shaft insertion site.

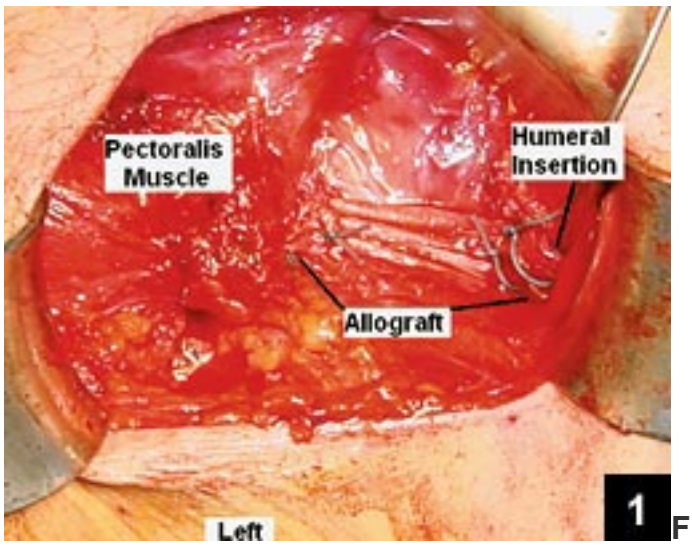

Figure 1: The allograft is seen woven through the pectoralis tendon and anchored to the humerus. The tendinous portion was attached using a Pulvertaft stitch, and the humeral attachment was made using a running Krackow stitch.

Given the length of time from injury and the preoperative MRI, it was apparent that some form of allograft augmentation would be necessary to reattach the tendon to the humerus. As such, a freeze-dried fascia lata allograft was used in the reconstruction and allowed for a tension free repair. The tissue was wove using a Pulvertaft stitch through the tendinous portion of the pectoralis major.

Three suture anchors were then inserted into the humerus lateral to the latissimus dorsi insertion. The allograft was then approximated to the humerus and a running Krackow stitch was used on both sides of the tissue by using one limb from each of the proximal and distal anchors (Figure 1). The remaining free limbs of these two anchors were then passed through the tissue in a simple fashion. The third anchor's sutures (the central anchor) were then passed in a simple fashion through the central portion of the allograft. This configuration allowed for tensioning of the repair as the simple sutures were pulled down to their woven counterpart. A solid repair was evident at this time. Significant tension developed only with external rotation past 70° of abduction and external rotation.

The patient was kept in a sling for four weeks, with pendulum exercises begun on the second postoperative day. The pendulums were limited to 90° forward flexion and abduction for four weeks. At four weeks, progressive stretching was begun in a formal therapy program, including passive and active motions. At eight weeks, complete range of motion was present. The patient was allowed to return to gradually increasing lifting and activities, and at 10 weeks he was allowed to resume unlimited activity and weightlifting.

Follow-up at 18 months revealed a clinically satisfying appearance of the patient's chest both at the side and with abduction (Figures 2 and 3). He had returned to full unrestricted activities and reported no instability. Strength in adduction and internal rotation of the shoulder was 5/5 and symmetric with the right shoulder.

Figure 2: Normal contour and bulk of pectoralis major muscle was noted post-operatively in both shoulders.

Figure 3: A close-up view of the left shoulder showing no cosmetic defect and normal contour.

Discussion

The pectoralis major is a thick triangular muscle that originates from the anterior

thorax to the clavicle. The fibers converge like a fan and twist 90° before coalescing and inserting into the intertubercular groove of the humerus just lateral to the biceps tendon. The fibers of the anterior lamina arise from the clavicle and remain parallel as they insert into the humerus. The manubrial portion of the sternal head comprises the majority of the pectoralis muscle and arises from the midportion of the sternum and the costal cartilage of ribs one through five. The fibers of the lower, or abdominal, portion of the sternal head arise from ribs five and six and the fascia of the external oblique and transversalis muscles.[9,12] The clavicular and upper sternal fibers attach inferiorly on the humerus and the lower sternal and abdominal fibers cross above the upper fibers before inserting superiorly. Because of this division, complete rupture of the tendon is infrequent.[13]

The fibers of the abdominal portion of the sternal head are disproportionately stretched during terminal humeral extension.[2,12] This can occur during the bench press maneuver, which subjects the lower sternal abdominal fibers to an inordinate amount of stress. As a result, these fibers are often the first to rupture. This rupture can propagate to the remaining sternal head and finally to the clavicular head.[4,7]

The function of the pectoralis major muscle is in adduction of the humerus, and in internal rotation and forward flexion. Rupture of the pectoralis major muscle most often occurs in the weight lifters, body-builders, wrestlers, and individuals involved in weight training. Most injuries occur during the bench press. With this maneuver, excessive force occurs on the pectoral muscles, because the arms are abducted and externally rotated, thus functioning in an eccentric fashion. The pectoralis major muscle is under tension and contracts during the lift. The muscle then helps in “braking” as the weight is lowered back down to the chest. Fatigue or uncoordinated movements can cause the weight lifter to let the weights slip to one side, causing a sudden contraction in the muscle while it is under tension, thereby potentially leading to rupture.[2,11,14,15] Wolfe et al[12] showed that in the final 30° of humeral extension, the inferior fibers of the muscle respond disproportionately to the tension.[12]

Ruptures can occur within the muscle belly, at the musculotendinous junction, or at the point of insertion of the tendon.[15] Occasionally, the sternocostal portion, which is deep in the uninjured clavicular portion, may rupture, thereby, obscuring diagnosis. When complete disruption occurs, avulsion type injuries at the enthesis are common.[16] Traditionally, musculotendinous ruptures have been treated conservatively.

Clinical symptoms include sudden severe pain in the arm and shoulder at the time of injury, sensation of tearing, painful and limited motion, swelling, and ecchymosis. Swelling and ecchymosis usually subside after the first month. Later in the process, a thin anterior axillary fold, or sulcus, muscle bulging, and

weakening in adduction and internal rotation, are also signs of a pectoralis major avulsion.[11] In the acute phase of the injury, it may be difficult to differentiate between complete and partial tears because of swelling, an intact clavicular portion, and pain.[10] In these cases, use of MRI can be used to confirm the diagnosis and extent of the injury, thereby allowing more effective treatment.[16] Associated injuries are rare. Only one case reported a rupture with an anterior dislocation of the glenohumeral joint, and another, a rerupture of the pectoralis muscle with an associated rotator cuff injury.[2,7] Yet, while most pectoralis major injuries are not associated with dislocation, in our case, the patient felt relatively unstable with higher level activities.[2]

The most frequent site of tendon rupture is at the insertion on the humerus, which accounts for 58% of those confirmed at surgery, whereas 31% are reported to be at the musculotendinous junction.[2] This is in sharp contrast to the study reported by a cadaveric study, which showed the most frequent location of rupture to be the musculotendinous junction. This was explained by the old age of the cadavers used, with the ruptures more likely to occur in the weakened tissues.[2,12] Ruptures have been reported exclusively in males, although with the rise in weight training among women, the likelihood of pectoralis ruptures in women is an increasing possibility.[16] Additionally, the use of anabolic steroids with vigorous training increases muscle strength disproportionately to the strength of the tendon, making the tendon more susceptible to injury. Biochemical and biomechanical analysis showed that anabolic steroids produce a stiffer tendon that absorbs less energy and is more likely to fail.[17] This is especially important to consider in body builders and those participating in heavy weight training.[18]

Normal shoulder function for most activities is possible without the intervention of the pectoralis major muscle. As a result, nonoperative treatment may be preferred if the patient is willing to accept reduced strength or if the rupture occurs at the musculotendinous junction. Surgical repair is needed to restore full strength and for continuation of strenuous athletic activity such as weight lifting. In patients with no repair, internal rotation and adduction decrease significantly. However, those patients who had delayed repair still had some limited mobility, strength, and possibly cosmetic defect.[11-13,19]

Repair is recommended for patients with acute complete tears who require use of their upper extremity for strenuous activity or sports. Zeman et al[20] showed full return to performance in nine professional athletes treated surgically. However, these patients were treated soon after the initial injury.[20] In contrast, conservative management, which is indicated in older and inactive patients, will not result in significant functional deficit in that population.[21]

In our case, there was significant retraction of the pectoralis tendon. Consequently, the allograft was used to approximate the tendon to the humerus.

There is only one other reported case demonstrating use of an allograft to reattach a chronically retracted pectoralis tendon to the humerus. Joseph et al[7] described a patient with a chronically retracted pectoralis tendon, which was repaired eight weeks from the time of injury with an Achilles tendon allograft.[7] Additionally, Alho[3] reported a case of repair three months after injury. He described a technique of fascial release through a separate incision that enabled direct repair of the tendon to the humerus. By advancing the tendon to overcome a 2-cm deficit, immobilization in an adducted position was avoided and the patient was able to return to activity.[3]

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