Case Report

Pectoralis Major Tear with Retracted Tendon: How to Fill the Gap? Reconstruction with Hamstring Autograft and Fixation with an Interference Screw

L. Baverel,1 K. Messedi,1 G. Piétu,1 V. Crenn,1 and F. Gouin1,2

1CHU de Nantes, Clinique Chirurgicale Orthopédique et Traumatologique, Hôtel-Dieu, Place A. Ricordeau, 44093 Nantes Cedex, France
2LPRO, Inserm U1957, Laboratoire de la Résorption Osseuse et des Tumeurs Osseuses Primitives, Faculté de Médecine, Université de Nantes, 44000 Nantes, France

Correspondence should be addressed to L. Baverel; l.baverel@gmail.com

Received 21 September 2016; Revised 5 December 2016; Accepted 9 January 2017; Published 30 January 2017

Academic Editor: Kaan Erler

Copyright © 2017 L. Baverel et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Rupture of the pectoralis major tendon is considered an uncommon injury and a significant number of ruptures are missed or diagnosed late, leading to a chronic tear. We report an open reconstruction technique and its outcomes in a case of chronic and retracted PM tear. At the last follow-up (12 months), the patient was pain-free, with a visual analogic scale at 0 all the time. He was very satisfied concerning the cosmetic and clinical results. The constant score was 93%, the SST value 95%, and the Quick DASH score 4.5. MRI performed one year postoperatively confirmed the continuity between PM tendon and graft, even if the aspect of the distal tendon seemed to be thinner than normal PM tendon. The excellent clinical outcomes at one-year follow-up suggest that PM tear with major tendon retraction can be reliably reconstructed with hamstring autograft, using a bioabsorbable screw to optimize the fixation device. This technique has proven its simplicity and efficiency to fill the gap.

1. Introduction

Rupture of the pectoralis major (PM) tendon is considered an uncommon injury occurring in male patients between 20 and 40, most being of military population and athletes [1, 2]. The incidence seems to increase with both weight lifting practice and use of anabolic steroids [3]. Nonspecific clinical signs are ecchymosis and pain, but more specific is a loss or thinning of the anterior axillary fold [4]. Magnetic resonance imaging (MRI) is the gold standard to confirm diagnosis, localize and grade the tear, and measure the stump retraction and the muscle fatty degeneration [5]. Surgical repair during the acute phase is recommended, regarding excellent outcomes and low number of operative complications [6–12].

Pectoralis Major is well described as a two-head muscle, according to its clavicular and sternocostal heads [13]. Its humeral tendon insertion is just lateral to the bicipital groove and measures approximately 5 centimeters in length and 3 to 4 millimeters in width, with U-shape (anterior and posterior layers inferiorly continuous) [14]. According to Bak, complete tears are more common than partial tears, with, respectively, reported rates of 91% and 9%. However, significant number of PM injuries are missed or diagnosed late, leading to a chronic tear [4, 15, 16]. Some authors reported good clinical outcomes after direct sutures of chronic PM tears, once tendon was released and mobilized [12].

Otherwise, tendon graft is necessary in presence of chronic tear with significant tendon retraction and altered tissue quality [17]. Various graft techniques have been described: hamstrings autograft [16], bone-patellar bone-tendon autograft [18], fascia lata allograft [19], Achilles tendon allograft [4], and dermal allograft [15]. In the literature, numerous fixation devices have been reported and compared, as suture anchor [4], unicortical button [20, 21], bone trough [12], or transosseous suture [6]. Authors found no significant biomechanical difference between these fixation devices [22–24]. However, interference screw seems to be equal or superior to these other modes of fixation for subpectoral tenodesis of the long head of the biceps [25–29].
Figure 1: MRI axial T1 showing full-thickness PM tear at the humeral tendon-bone junction.

Figure 2: MRI axial T1 showing tendon retracted medial to the anterior chest wall and absence of any muscle fatty infiltration.

Figure 3: MRI axial T1 showing calcification inside the conjoint tendon immediately under its coracoid insertion.

Figure 4: Intraoperative photograph demonstrating the gap between the footprint and the stump.

We report an open reconstruction technique and its outcomes in a case of chronic and retracted PM tendon tear. The tendon reconstruction was performed with hamstrings autograft fixed with a humeral interference screw. To the best of our knowledge, this technique has not been reported in the literature.

2. Case Report

A 30-year-old male, street-cleaner-worker, sustained a right (dominant) shoulder injury in a motorcycle accident. He was heavy manual worker and did not practice any sport. In the emergency department, an acromioclavicular joint dislocation was initially diagnosed, and the patient was treated in a conservative manner. One year later he presented to the senior author (LB) with complaints of pectoral pain and cramps and deformity of the chest. He had significant functional limitations; mainly return to work was impossible. Physical exam revealed an abnormal anterior axillary contour and reduced adduction and internal rotation strength. The shoulder range of motion was however complete. The constant shoulder score was 51 [30], the simple shoulder test 30% [31], and the quick DASH score 52.3 [32].

Standard shoulder X-ray did not reveal any abnormality. MRI identified (1) full-thickness PM tear at the humeral tendon-bone junction including both pectoral heads (Figure 1), (2) tendon retracted medial to the anterior chest wall (Figure 2), (3) absence of any muscle fatty infiltration, and (4) a calcification inside the conjoint tendon immediately under its coracoid insertion (Figure 3). The lesion corresponded to C2/F/C after ElMaraghy and Devereaux [33]. Surgical management was considered regarding major daily activity impairment. The patient consented to surgical procedure once detailed explications were given about PM repair with autograft hamstring tendon to fill the gap.

3. Operative Technique

An interscalene block was performed before surgery, and the patient was operated under general anaesthesia in the beach-chair position. Ipsilateral knee was positioned in 90° flexion with an air tourniquet applied to the limb and draped free. A deltopectoral approach was first performed. The proximal part of the incision was more medial than the standard approach to ease pectoral muscle release. The distal part of the incision was enlarged to the PM footprint. The operative findings confirmed both the full-thickness PM tendon tear and the retraction of the tendon that was positioned more medial than the anterior chest wall. Despite extensive muscle release, the tendon could not be approximated to its anatomic insertion. The gap between the footprint and the stump was more than 5 cm (Figure 4).

Tendon reconstruction with hamstrings was confirmed. Semitendinosus and Gracilis tendon were harvested through an oblique anteromedial approach, [34] using a tendon stripper (Smith & Nephew). The tendons were cleaned of soft tissue and folded to form 7 cm length 6 strands. It was stitched along its distal part to obtain a fan-shape tendon. The diameter at the distal part of the graft was calibrated
Figure 5: Intraoperative photograph, with the free border of the graft sutured at the PM.

Figure 6: Intraoperative photograph with Vicryl plate wrapped around the graft.

at 9 mm. The lateral aspect of the bicipital groove was exposed, while the biceps tendon was carefully protected. The humeral tunnel was performed at the PM center footprint. The humeral tunnel was matched size for size with the graft diameter and had a depth of 25 mm to be bicortical. Two centimeters of hamstring graft was fixed within the bone tunnel with a 9 mm × 25 mm bioabsorbable screw (Biosure, Smith & Nephew). The fan-shaped free border of the graft was sutured into the muscle belly with Mason-Allen and Krachow stitches using nonabsorbable suture (Ultrabraid, Smith & Nephew) arm in neutral rotation (Figure 5). A Vicryl plate (Ethicon) was wrapped around the graft, in order to secure the sutures (Figure 6). The calcification in the conjoint tendon was removed.

4. Postoperative Care and Rehabilitation

The arm was immobilized postoperatively in a sling for 6 weeks. Passive closed chain pendulum exercises were initiated immediately after the surgical procedure, until 45° of abduction during 21 days and 90° for the three weeks later. No external rotation was allowed for six weeks. Active range of motion, stretching exercises, and external rotation were then initiated. Dynamic strengthening was delayed past three months, once complete range of motion was obtained. Return to heavily activities at work was allowed after 6 months.

5. Results

The drain was removed 2 days after surgery and then the patient was discharged. There was no early complication regarding the PM reconstruction and no morbidity at the donor site. At two months postoperatively, the anterior axillary contour was restored (Figure 7(a)), and the shoulder range of motion was 130° in anterior elevation, 110° in lateral elevation, 10° in external rotation, and 5° in internal rotation at 90° of abduction (Figure 7(b)). X-ray confirmed the correct position of the screw and the absence of osteolysis around it. Six months after surgical reconstruction, the patient was pain-free. The axillary anatomy was restituted and shoulder range of motion was complete. Therefore, return to work was authorized.

At the last follow-up (12 months), the patient was pain-free, with a visual analogic scale at 0 all the time. He was very satisfied concerning the cosmetic and clinical results (Figures 8(a)–8(c)). The constant score was 93%, the SST value 95%, and the Quick DASH score 4.5. After Bak’s criteria [7], the patient was classified as excellent: no symptoms, normal range of motion, no cosmetic modifications, no adduction weakness, and work without restriction. MRI performed one year postoperatively confirmed the continuity between PM tendon and graft, even if the aspect of the distal tendon seemed to be thinner than normal PM tendon.

6. Discussion

To our knowledge, this is the first description of a full-thickness PM tendon tear with gap, successfully filled with hamstring autograft fixed with interference screw. PM tears are uncommon and can be easily missed during initial presentation, leading to delayed diagnosis and treatment [4, 15, 16]. In a meta-analysis of 112 cases, Bak et al. reported that acute tears were consensually repaired, and the earlier the surgery was performed, the better the clinical outcomes were observed [7]. In contrast, chronic tears are more difficult to manage, regarding alteration of tissue quality and tendon retraction [17]. However, surgical repair seems to be the preferred option as excellent or good outcomes occur in more than 90% of operated patients, versus 17% of conservatively treated patients (best choice for elderly/sedentary patients or in muscle belly tears) [9, 11, 35].

Previous studies reported that patients with chronic PM tears managed with direct repair obtain similar clinical outcomes than acute repairs [6, 9, 12]. However, a graft is required when extensive surgical release of the PM belly muscle does not allow direct repair [15]. Fascia lata or Achilles tendon allografts are widely used for reconstruction of PM tendon [10, 19, 35, 36]. Allografts avoid donor-site morbidity and can be easily tailored to fill the gap. Drawbacks are disease transmission, delayed graft incorporation, and increased risk of retear [37]. Previous studies reported that sterilization with gamma irradiation could result in impaired biomechanical properties [38]. Thus, recent publications do not advocate irradiated tendon allograft for anterior cruciate ligament reconstruction [39, 40]. Sherman et al. demonstrated the high load to which PM tendon is exposed [23]. As for
biomechanical properties, autograft seems therefore to be more adapted for PM reconstruction.

Dehler et al. reported a reconstruction technique with Human extracellular matrix scaffold device [15]. The use of dermal allograft has been successfully reported in rotator cuff augmentation [41], arthroscopic superior capsule reconstruction [42], and open revision repair [43] in patients with irreparable rotator cuff tears. This graft eliminates donor-site morbidity and the time to prepare the autograft and could have a better biologic incorporation than tendon allograft. However, studies reporting this technique have short clinical follow-up and indication being limited to rotator cuff repair. A graft thickness of 1 mm could be insufficient for PM tendon reconstruction.

For the tendon reconstruction and to fill the gap, ipsilateral hamstrings autograft was our graft choice. The advantages of this technique are (1) using autograft leads to both complete biocompatibility and safety regarding diseases transmission, (2) hamstring graft allows filling a significant gap, and (3) it is tailored to restore the anatomy of the PM tendon (fan-shape). The drawbacks are donor-site morbidity including injuries of the saphenous nerve [44]. A recent systematic review seems to suggest lower rate of neurological impairment adopting an oblique incision [45], which corresponded to our harvesting method.

The success of PM tendon reconstruction requires solid incorporation of the tendon graft within the bone tunnel to enable its histological remodeling. Numerous graft fixation devices are reported in the literature. To optimize graft incorporation, interference screw was our choice, with 2 cm autograft driven in the bone tunnel. This fixation technique was easy to perform, resulting in a solid fixation of the graft in tubular bone of the humerus, as described in subpectoral tenodesis of the long head of the biceps. Drawbacks using an interference screw could be the risk of humeral fracture [46, 47], screw migration, and cyst formation [48] as described with anterior cruciate ligament reconstruction. Furthermore, this tendon reconstruction was not anatomical, the native humeral insertion of the PM measuring near 5 cm. In our case, regarding the gap, there was no possibility of using a superior second screw to perform a more anatomical double bundle tendon reconstruction with hamstring autograft.

Pectoral Major tears are mainly described in young male weight lifters and in high-performance athletes. We recognize that this profile did not correspond entirely to our case, who did not practice sport. However, this young patient had to be considered as a heavy manual worker who had a high demand corresponding to his return to work. The excellent clinical outcomes at one-year follow-up suggest that PM tear with major tendon retraction can be reliably managed with
hamster autograft reconstruction, using an interference screw for fixation device. This technique has proven its simplicity and efficiency to fill the gap. Biomechanical studies, although already validated for subpectoral tenodesis, could be considered for this technique.

Consent

The authors declare that they obtained the patient's written consent for the inclusion of his photo in the manuscript.

Competing Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] G. C. Balazs, A. M. Brelin, M. A. Donohue et al., “Incidence rate and results of the surgical treatment of pectoralis major tendon ruptures in active-duty military personnel,” American Journal of Sports Medicine, vol. 44, no. 7, pp. 1837–1843, 2016.

[2] A. De Castro Pochini, B. Ejnisman, C. V. Andreoli et al., “Pectoralis major muscle rupture in athletes: A Prospective Study,” American Journal of Sports Medicine, vol. 38, no. 1, pp. 92–98, 2010.

[3] P. D. Inhofe, W. A. Grana, D. Egle, K. W. Min, and J. Tomasek, “The effects of anabolic steroids on rat tendon: an ultrastructural, biomechanical, and biochemical analysis,” The American Journal of Sports Medicine, vol. 23, no. 2, pp. 227–232, 1995.

[4] T. A. Joseph, M. J. DeFranco, and G. G. Weiker, “Delayed repair of a pectoral major tendon rupture with allograft: a case report,” Journal of Shoulder and Elbow Surgery, vol. 12, no. 1, pp. 101–104, 2003.

[5] J. A. Carrino, V. P. Chandnann, D. B. Mitchell, K. Choi-Chinn, T. M. DeBerardino, and M. D. Miller, “Pectoralis major muscle and tendon tears: diagnosis and grading using magnetic resonance imaging,” Skeletal Radiology, vol. 29, no. 6, pp. 305–313, 2000.

[6] V. Aärmaa, J. Rantanen, J. Heikkilä, I. Helttula, and S. Orava, “Rupture of the pectoralis major muscle,” The American Journal of Sports Medicine, vol. 32, no. 5, pp. 1256–1262, 2004.

[7] K. Bak, E. A. Cameron, and I. J. P. Henderson, “Rupture of the pectoralis major: a meta-analysis of 112 cases,” Knee Surgery, Sports Traumatology, Arthroscopy, vol. 8, no. 2, pp. 113–119, 2000.

[8] A. De Castro Pochini, C. V. Andreoli, P. S. Belangero et al., “Clinical considerations for the surgical treatment of pectoralis major muscle ruptures based on 60 cases: a prospective study and literature review,” American Journal of Sports Medicine, vol. 42, no. 1, pp. 95–102, 2014.

[9] C. M. Hanna, A. B. Ghinny, S. N. Stanley, and M. A. Caughey, “Pectoralis major tears: comparison of surgical and conservative treatment,” British Journal of Sports Medicine, vol. 35, no. 3, pp. 202–206, 2001.

[10] G. Merolla, P. Paladini, S. Artiaco, P. Tos, N. Lollino, and G. Porcellini, “Surgical repair of acute and chronic pectoralis major tendon rupture: clinical and ultrasound outcomes at a mean follow-up of 5 years,” European Journal of Orthopaedic Surgery and Traumatology, vol. 25, no. 1, pp. 91–98, 2014.

[11] J. Petillon, D. R. Carr, J. K. Sekiya, and D. V. Unger, “Pectoralis major muscle injuries: evaluation and management,” Journal of the American Academy of Orthopaedic Surgeons, vol. 13, no. 1, pp. 59–68, 2005.

[12] A. A. Schepsis, M. W. Grafe, H. P. Jones, and M. J. Lemos, “Rupture of the pectoralis major muscle. Outcome after repair of acute and chronic injuries,” The American Journal of Sports Medicine, vol. 28, no. 1, pp. 9–15, 2000.

[13] M. T. Provencher, K. Handfield, N. T. Boniquit, S. N. Reiff, J. K. Sekiya, and A. A. Romeo, “Injuries to the pectoralis major muscle: diagnosis and management,” The American Journal of Sports Medicine, vol. 38, no. 8, pp. 1693–1705, 2010.

[14] L. Fung, B. Wong, K. Ravichandiran, A. Agur, T. Rindlisbacher, and A. Elmaraghy, “Three-dimensional study of pectoralis major muscle and tendon architecture,” Clinical Anatomy, vol. 22, no. 4, pp. 500–508, 2009.

[15] T. Dehler, A. L. Pennings, and A. W. ElMaraghy, “Dermal allograft reconstruction of a chronic pectoralis major tear,” Journal of Shoulder and Elbow Surgery, vol. 22, no. 10, pp. e18–e22, 2013.

[16] A. K. Schachter, B. J. White, S. Namkoong, and O. Sherman, “Revision reconstruction of a pectoralis major tendon rupture using hamstring autograft: a case report,” American Journal of Sports Medicine, vol. 34, no. 2, pp. 295–298, 2006.

[17] J. H. Flint, A. M. Wade, J. Giuliani, and J.-P. Rue, “Defining the terms acute and chronic in orthopaedic sports injuries: a systematic review,” American Journal of Sports Medicine, vol. 42, no. 1, pp. 235–241, 2014.

[18] M. Zafra, F. Muñoz, and P. Carpentero, “Chronic rupture of the pectoralis major muscle: report of two cases,” Acta Orthopaedica Belgica, vol. 71, no. 1, pp. 107–110, 2005.

[19] R. S. Sikka, M. Neault, and C. A. Guanche, “Reconstruction of the pectoralis major tendon with fascia lata allograft,” Orthopedics, vol. 28, no. 10, pp. 1199–1201, 2005.

[20] Y. Uchiyama, S. Miyazaki, T. Tamaki et al., “Clinical results of a surgical technique using endobuttons for complete tendon tear of pectoralis major muscle: report of five cases,” Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology, vol. 3, article no. 20, 2011.

[21] M. J. Wheat Hozack, B. Bugg, K. Lemay, and J. Reed, “Tears of pectoralis major in steer wrestlers: a novel repair technique using the endobutton,” Clinical Journal of Sport Medicine, vol. 23, no. 1, pp. 80–82, 2013.

[22] S. I. Rabuck, J. L. Lynch, X. Guo et al., “Biomechanical comparison of 3 methods to repair pectoralis major ruptures,” American Journal of Sports Medicine, vol. 40, no. 7, pp. 1635–1640, 2012.

[23] S. L. Sherman, E. C. Lin, N. N. Verma et al., “Biomechanical analysis of the pectoralis major tendon and comparison of techniques for tendo-osseous repair,” The American Journal of Sports Medicine, vol. 40, no. 8, pp. 1887–1894, 2012.

[24] W. Thomas, S. Gheduzzi, and I. Packham, “Pectoralis major tendon repair: a biomechanical study of suture button versus transosseous suture techniques,” Knee Surgery, Sports Traumatology, Arthroscopy, vol. 23, no. 9, pp. 2617–2623, 2014.

[25] A. S. Arora, A. Singh, and R. C. Koonce, “Biomechanical evaluation of a unicortical button versus interference screw for subpectoral biceps tenodesis,” Arthroscopy, vol. 29, no. 4, pp. 638–644, 2013.

[26] A. D. Mazzocca, J. Bicos, S. Santangelo, A. A. Romeo, and R. A. Arciero, “The biomechanical evaluation of four fixation techniques for proximal biceps tenodesis,” Arthroscopy, vol. 21, no. 11, pp. 1296–1306, 2005.
[27] A. D. Mazzocca, M. P. Cote, C. L. Arciero, A. A. Romeo, and R. A. Arciero, “Clinical outcomes after subpectoral biceps tenodesis with an interference screw,” The American Journal of Sports Medicine, vol. 36, no. 10, pp. 1922–1929, 2008.

[28] A. D. Mazzocca, C. G. Rios, A. A. Romeo, and R. A. Arciero, “Subpectoral biceps tenodesis with interference screw fixation,” Arthroscopy—Journal of Arthroscopic and Related Surgery, vol. 21, no. 7, pp. 896.e1–896.e7, 2005.

[29] P. M. Sethi, A. Rajaram, K. Beitzel, T. R. Hackett, D. M. Chowni, and A. D. Mazzocca, “Biomechanical performance of subpectoral biceps tenodesis: a comparison of interference screw fixation, cortical button fixation, and interference screw diameter,” Journal of Shoulder and Elbow Surgery, vol. 22, no. 4, pp. 451–457, 2013.

[30] C. R. Constant, C. Gerber, R. J. H. Emery, J. O. Søjbjerg, F. Gohlke, and P. Boileau, “A review of the Constant score: modifications and guidelines for its use,” Journal of Shoulder and Elbow Surgery, vol. 17, no. 2, pp. 355–361, 2008.

[31] T. S. Roddey, S. L. Olson, K. F. Cook, G. M. Gartsman, and W. Hanten, “Comparison of the University of California—Los Angeles Shoulder Scale and the Simple Shoulder Test with the shoulder pain and disability index: single-administration reliability and validity,” Physical Therapy, vol. 80, no. 8, pp. 759–768, 2000.

[32] D. E. Beaton, J. N. Katz, A. H. Fossel, J. G. Wright, V. Tarasuk, and C. Bombardier, “Measuring the whole or the parts? Validity, reliability, and responsiveness of the disabilities of the arm, shoulder and hand outcome measure in different regions of the upper extremity,” Journal of Hand Therapy, vol. 14, no. 2, pp. 128–146, 2001.

[33] A. W. ElMaraghy and M. W. Devereaux, “A systematic review and comprehensive classification of pectoralis major tears,” Journal of Shoulder and Elbow Surgery, vol. 21, no. 3, pp. 412–422, 2012.

[34] H. Lanternier, J. B. de Cussac, and T. Collet, “Short medial approach harvesting of hamstring tendons,” Orthopaedics and Traumatology: Surgery and Research, vol. 102, no. 2, pp. 269–272, 2016.

[35] U. Butt, S. Mehta, L. Funk, and P. Monga, “Pectoralis major ruptures: a review of current management,” Journal of Shoulder and Elbow Surgery, vol. 24, no. 4, pp. 655–662, 2015.

[36] M. A. Zacchilli, J. T. Fowler, and B. D. Owens, “Allograft reconstruction of chronic pectoralis major tendon ruptures,” Journal of Surgical Orthopaedic Advances, vol. 22, no. 1, pp. 95–102, 2013.

[37] S. A. Euler, S. D. Smith, B. T. Williams, G. J. Dornan, P. J. Millett, “Histologic evaluation of a biopsy specimen obtained 3 months after rotator cuff augmentation with GraftJacket Matrix,” Arthroscopy, vol. 25, no. 3, pp. 329–333, 2009.

[38] J. M. Tokish and C. Beicker, “Superior capsule reconstruction technique using an acellular dermal allograft,” Arthroscopy Techniques, vol. 4, no. 6, pp. e833–e839, 2015.

[39] S. A. Barbour and W. King, “The safe and effective use of allograft tissue—an update,” American Journal of Sports Medicine, vol. 31, no. 5, pp. 791–797, 2003.

[40] T. A. Grieb, R.-Y. Forng, S. Bogdansky et al., “High-dose gamma irradiation for soft tissue allografts: high margin of safety with biomechanical integrity,” Journal of Orthopaedic Research, vol. 24, no. 5, pp. 1011–1018, 2006.

[41] K. Sun, J. Zhang, Y. Wang et al., “Arthroscopic anterior cruciate ligament reconstruction with at least 2.5 years’ follow-up comparing hamstring tendon allograft and irradiated allograft,” Arthroscopy—Journal of Arthroscopic and Related Surgery, vol. 27, no. 9, pp. 1195–1202, 2011.

[42] S. Tian, B. Wang, L. Liu et al., “Irradiated hamstring tendon allograft versus autograft for anatomic double-bundle anterior cruciate ligament reconstruction: midterm clinical outcomes,” The American Journal of Sports Medicine, vol. 44, no. 10, pp. 2579–2588, 2016.