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Pectoralis Major Muscle Rupture – Review of Treatment Options

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ABSTRACT

Introduction

In recent decades, the incidence of pectoralis major (PM) ruptures has risen, largely due to the increased popularity of high-intensity weight training and the use of anabolic steroids among athletes. Failing to address a PM rupture can result in permanent physical deformity and long-term functional impairment. While early detection and prompt surgical intervention often

simplify the repair process and improve success rates, modern reconstructive advancements now allow for effective treatment even in chronic cases.

Aim of study

This review aims to evaluate the current state of knowledge regarding the anatomy, diagnostic metrics, and both operative and non-operative treatment options for acute and chronic pectoralis major ruptures.

State of knowledge

Pectoralis major (PM) ruptures primarily affect men between the ages of 20 and 40. Patients often report hearing an audible "pop" or experiencing a distinct tearing sensation at the moment of injury. If left unaddressed, these injuries progress into a chronic state. While the medical literature lacks a single, universal definition for chronic PM ruptures, the typical threshold used is six weeks following the initial trauma. Managing these delayed cases can more challenging due to complications such as muscle atrophy, dense scar tissue, tendon retraction, and a decline in the overall quality and substance of the remaining tendon.

Summary (conclusion)

Conservative, non-surgical treatment of PM ruptures is generally limited to elderly or low-demand individuals, specific partial tears, or patients with medical contraindications to surgery. In contrast, surgical intervention is considered the gold standard, as it consistently produces the most favorable clinical and cosmetic results. While acute injuries typically allow for a straightforward direct repair, chronic cases are more complex and often require surgeons to utilize autografts or allografts to bridge retracted tissue. Despite these technical challenges, surgical treatment for chronic injuries remains highly recommended, as patients can still achieve high levels of satisfaction and functional recovery.

Keywords: pectoralis major rupture, pectoralis major repair, conservative treatment, surgery, review, tendon transfer

INTRODUCTION

Over the last few decades, pectoralis major (PM) ruptures have become increasingly common. This rise is largely driven by the popularity of heavy weight training and, in some instances, the use of anabolic steroids. While these injuries are not frequent, they are most prevalent among active men in their 20s and 30s. The majority of cases are concentrated among athletic and military cohorts. A distinct, smaller group of injuries occurs in older adults, often when weakened muscles are strained during physical labor or transfers. Neglecting a PM rupture can lead to lasting functional deficits and physical deformity. Consequently, surgical methodologies are continually advancing to optimize patient outcomes. Despite the prevalence of acute diagnoses, chronic ruptures frequently remain undetected, necessitating clinical expertise in managing both early-stage and delayed clinical presentations. Failure to promptly recognize these injuries can complicate subsequent clinical management. Specifically, late-stage interventions may necessitate allograft reconstruction instead of direct primary repair, a shift that is often associated with less favorable prognostic outcomes. (Baverel et al. 2017; Butt et al. 2015; Thompson et al. 2020)

Anatomy

The pectoralis major is a triangular muscle originating from the clavicle, sternum, ribs, and abdominal fascia, primarily functioning to adduct, flex, and internally rotate the humerus. It is divided into two distinct sections: the superior clavicular head, which originates from the medial clavicle and drives forward flexion and adduction, and the much larger sternocostal head, which comprises 80% of the muscle's volume across seven overlapping segments to facilitate elevation, internal rotation, and horizontal adduction. These two heads converge into tendons that insert onto the lateral lip of the bicipital groove and the deltoid tuberosity of the humerus. The tendons of the PM exhibit a unique spiraling architecture, twisting to form two distinct layers. The muscle is controlled by the medial (C8-T1) and lateral (C5-C7) pectoral nerves and receives its blood supply from the thoracoacromial artery's pectoral branch. Because activities involving heavy pressing, elbow extension, and arm adduction place disproportionate stress and tension on the sternocostal fibers, this section of the muscle is the most frequent site of rupture. (Aärimaa et al. 2004; Al-Ahaideb 2014; Long et al. 2022; Thompson et al. 2020)

Acute PM rupture

Acute PM ruptures are frequently reported as an audible “pop” or “tearing” sensation, accompanied by a sudden pain in the medial upper arm resulting in resisted adduction and internal rotation of the affected shoulder. Physical examination typically reveals a visible deformity, asymmetry, an inferior displacement of the areola and a vertical orientation of the lateral chest wall. However the deformity may be masked by a local hematoma, an intact fascial sheath, or a preserved clavicular head in cases of partial rupture. Hence, a comparative bilateral examination is essential for a proper evaluation. Exercises such as contraction of the pectoralis major muscle and resisted humeral adduction might make the injury more apparent, allowing the muscle to migrate medially and enhancing diagnostic clarity. The location of ecchymosis and swelling near the anterior chest wall may indicate a proximal PM tendon tear or muscle belly tear, whereas the presence of the same symptoms in the upper arm and axilla suggest a distal tendon tear or tendon avulsion from the humeral insertion. (Bodendorfer et al. 2020; Giordano et al. 2023; Kowalczuk i Elmaraghy 2022; Long et al. 2022)

Diagnostics

The pectoralis major index (PMI) serves straightforward and highly reliable diagnostic metric. It’s calculated by measuring the distance between the most laterally prominent apex of the anterior axillary fold and the ipsilateral nipple, while the patient remains in the “military press” starting position with shoulders in 90° abduction and 90° external rotation. According to the cohort study by ElMaraghy et al. PMI enables clinicians to accurately diagnose majority of significant cases of PM ruptures with specificity of 98% and sensitivity of 79% with overall accuracy of 93%. (ElMaraghy, Rehsia, i Pennings 2013; Kowalczuk i Elmaraghy 2022)

Although ultrasound is valued for being easily accessible and inexpensive and may be used for initial screening of PM rupture, magnetic resonance imaging (MRI) of the chest wall remains the gold standard for diagnosis. A retrospective study performed by Chang et al. in 2016 demonstrated that MRI exhibits greater sensitivity in diagnosing acute PM ruptures compared to chronic presentations. A standard shoulder MRI is not recommended in diagnosing PM ruptures because of its lack of sufficient distal inclusion, which may make a definitive diagnosis impossible. (Chang et al. 2016; Lake et al. 2025; Thompson et al. 2020)

Non-operative treatment

Conservative, non-operative treatment is typically reserved for specific clinical scenarios: proximal or partial tears, injuries within the muscle belly that cannot be sutured, or low-demand patients who are comfortable with the resulting cosmetic changes. It is also the preferred path for individuals whose age, underlying medical conditions, or inability to follow a strict rehabilitation program makes a surgery too risky. For sedentary or older populations, non-surgical management is often adequate, as the pectoralis major is not essential for completing standard daily activities. However, in cases of complete or high-grade partial ruptures, choosing not to operate results in a permanent, visible chest deformity and a loss of strength. Furthermore, patients receiving non-surgical treatment generally report lower satisfaction with the results compared to those who undergo repair. (Haley i Zacchilli 2014; Petilon et al. 2005; Thompson et al. 2020)

Non-operative management consists of rest, cryotherapy, control of hematoma, and analgesia. The affected limb is typically immobilized in a sling in an adducted and internally rotated position for a duration of three weeks. Rehabilitation initiates with passive and active range of motion exercises within the first 14 days, progressing to full mobility over a six-week period. Light resistance training may be introduced after six weeks with gradual progression. Participation in contact sports is deferred for 5–6 months post-injury, when the full strength and range of motion return. Permanent adjustments to lifting habits are often necessary, particularly the elimination of high-intensity, low-repetition bench pressing. If conservative treatments fail to produce results within 3 to 4 months, surgical options should be considered. (Haley i Zacchilli 2014; Kircher et al. 2010; Petilon et al. 2005; Thompson et al. 2020)

Operative treatment techniques

Numerous techniques have been described for pectoralis major repair such as bone through technique, the use of unicortical buttons and suture anchors, each designed to the pectoralis major to its natural footprint. In the bone through technique the process begins by carving a 5-cm vertical through into the proximal humerus, positioned just lateral to the biceps tendon. To ensure the muscle reaches this site without tension, it is meticulously detached from the medial chest wall and mobilized on all sides. Once the muscle is flexible enough to reach its anatomical home, four 2-mm drill holes are placed roughly 1 cm lateral to the trough. The

repair is finalized by weaving sutures through the tendon in a secure, locking pattern, which are then anchored through the drill holes and tied to seat the tendon firmly within the trough. (Belk et al. 2023; Haley i Zacchilli 2014; Rabuck et al. 2012; Schepsis et al. 2000)

The unicortical button technique utilizes a 4.5- to 5-cm incision along the axillary crease, extending 2 to 3 cm distal to the coracoid process. After developing the tissue planes and removing the clavipectoral fascia, the surgeon identifies and mobilizes the ruptured pectoralis tendon. The humeral insertion site is then prepared through careful dissection. To promote biological healing, the anterior humerus is decorticated using an acorn-tip burr, creating a raw bony platform. Fixation is achieved by drilling two 3.2-mm spade-tipped pins into the cortex. It is vital that these pins are placed precisely at the anatomical footprint; if positioned too medially, the biceps tendon could be trapped or damaged, leading to chronic pain. Finally, unicortical buttons are used to anchor the tendon securely to the prepared bone. (Haley i Zacchilli 2014; Metzger et al. 2012; Rabuck et al. 2012; Sanchez et al. 2017)

In the suture anchor technique, the humeral footprint is first cleared of soft tissue and lightly abraded to create an optimal surface for healing. The surgeon then inserts two or three high-strength suture anchors similar in size to those used in rotator cuff repairs directly into the bone at the anatomical insertion site. Each anchor comes pre-loaded with non-absorbable sutures. One strand from each anchor is woven through the pectoralis tendon using a locking stitch for a secure grip. Finally, the passed strand is tied to its corresponding free strand, cinching the tendon down firmly against the prepared bone. (Haley i Zacchilli 2014; Rabuck et al. 2012)

Comparison of the surgical techniques

Each fixation method involves a trade-off between surgical efficiency, cost-effectiveness, and patient safety. The bone trough technique is the most economical option because it avoids the expense of specialized hardware, requiring only standard sutures. However, it is the most time-consuming approach and carries a higher risk of iatrogenic humeral fractures because the trough creates a "stress riser" in the bone. It also requires more extensive tissue dissection for proper exposure. In contrast, suture anchors and unicortical buttons are faster to implant but may increase procedural costs. These metal implants can also create magnetic resonance

imaging artifacts, which may obscure views in future diagnostic imaging. A distinct safety advantage of the unicortical button is its shallow placement, because it does not penetrate the far side of the bone, it minimizes the risk of damaging posterior neurovascular structures like the radial nerve. (Kang, Mahony, i Cordasco 2014; Metzger et al. 2012; Saito, Panwar, i Huish 2024)

Regardless of the specific surgical approach chosen, operative repair of pectoralis major tendon tears reliably yields high patient satisfaction, effective pain relief, and a swift return to professional or athletic activities. When compared to non-surgical management, surgical intervention is demonstrably superior, offering statistically significant gains in both isokinetic and isometric strength, as well as better cosmetic results and the correction of resting chest wall deformities. While biomechanical studies show that various techniques are effective, the overarching goal of restoring function and strength is consistently met across the board. However, patients should be counseled that they may experience a notable decrease in their maximum weightlifting capacity post-surgery. This limitation can stem from either physiological changes in the muscle-tendon unit or psychological factors, such as a fear of re-injury. (Bodendorfer et al. 2020; de Castro Pochini et al. 2014; Sherman et al. 2012; Waldron et al. 2025; Zhiti et al. 2025)

Tabl. 1 Comparison of treatment methods of acute PM ruptures (Belk et al. 2023; Haley i Zacchilli 2014; Kang et al. 2014; Kircher et al. 2010; Metzger et al. 2012; Petilon et al. 2005; Rabuck et al. 2012; Sanchez et al. 2017; Schepsis et al. 2000; Thompson et al. 2020; Saito et al. 2024; Bodendorfer et al. 2020; de Castro Pochini et al. 2014; Sherman et al. 2012; Waldron et al. 2025; Zhiti et al. 2025)

METHOD	INFORMATION	ADVANTAGES	DISADVANTAGES
Non-operative treatment	Consists of immobilization of the affected limb, rest, cryotherapy, control of hematoma, analgesia and physiotherapy	- Allows the patients to avoid undergoing surgery - Preferred path for older	- Restricted to limited clinical scenarios - Visible chest deformity - Loss of

		patients with underlying conditions	strength - Patients report lower satisfaction
Bone-through technique	The ruptured tendon is secured to its natural footprint using the bone through	- Most economical out of all surgical techniques - Superior outcomes to non-surgical treatment	- Most time consuming approach - Risk of iatrogenic humeral fractures - Requires more extensive tissue dissection
Unicortical buttons	The ruptured tendon is secured to its natural footprint using unicortical buttons	- Increased procedural costs - Minimized risk of damaging posterior neurovascular structures like the radial nerve - Superior outcomes to non-surgical treatment	- Magnetic resonance imaging artifacts
Suture anchor	The ruptured tendon is secured to its natural footprint	- Increased procedural costs	- Magnetic resonance imaging

	using suture anchors	- Superior outcomes to non-surgical treatment	artifacts

Chronic PM rupture

In the medical literature, there is no single consensus on what constitutes a "chronic" pectoralis major (PM) rupture. While the standard threshold is typically six weeks post-injury, a degree of muscle belly retraction can begin as early as three weeks. Delayed identification of a rupture may introduce several challenges in proper treatment, such as muscle athrophy, the presence of scar tissue, altered anatomy, tendon retraction and poor tendinous substance and quality, increasing the complexity of the repair. While postponing treatment during the acute phase raises the likelihood of permanent strength deficits and difficulty returning to sports, a "chronic" status isn't a dead end. Even years after the initial trauma, surgical intervention can still yield successful outcomes and should remain a viable option for the patient. (Butt et al. 2015; Giordano et al. 2023; Zhiti et al. 2025)

Non-operative treatment

If diagnosis is delayed, similarly to acute cases non-operative treatment is typically preferred for patients with partial or intramuscular tears, those with an intact sternocostal head, or individuals with lower physical demands. It is also the preferred route for elderly patients or those with significant medical comorbidities. Therapy consists of physical therapy of deltoid and trapezius muscles in order to increase range of motion. Additionally, activity modification may be necessary. (Thompson et al. 2020)

Operative treatment

Chronic PM repairs are often significantly more complex than acute cases due to muscle atrophy, tendon retraction, altered anatomy and the presence of dense scar tissue that can obscure the injury and increase tension on the repair. To address these challenges, surgeons must use larger incisions to meticulously dissect scar tissue and mobilize the muscle, while taking extreme care to protect the medial and lateral pectoral nerves located on the muscle's

deep surface. If the surgeon is able to adequately mobilize the muscle the tendon can be repaired directly. Unfortunately it is not always possible and the use of an autograft or an allograft may be necessary to successfully reconstruct the musculotendinous unit. Because of this it is recommended to have a back-up plan in case of a failure of a standard end-to-end repair. Various methods can be used to secure the graft during stabilization, such as transosseous sutures, suture anchors, bone troughs, unicortical buttons, or screws and washers. However, because there is currently a lack of comprehensive clinical data, a "gold standard" or single superior fixation technique has not yet been established for this reconstruction. (Giordano et al. 2023; Gouk et al. 2021; Petilon et al. 2005; Thompson et al. 2020)

Autografts

While both hamstring and bone-patellar tendons are used as autografts for pectoralis major reconstruction, the hamstring is more commonly chosen. Using a patient's own tissue ensures total biocompatibility and eliminates the risk of disease transmission, while providing a versatile material that can be customized to bridge large gaps and replicate the muscle's natural shape. However, these benefits come with the downside of donor site pain and complications, along with the risk of nerve injury during the harvest. Furthermore, because the native tissue must be pulled to the humerus to create a solid attachment, larger bone sockets are required. This can theoretically weaken the bone and increase the risk of a fracture. (Thompson et al. 2020)

Allografts

Allografts are a popular choice for reconstruction because they eliminate the pain and complications associated with a secondary donor site while providing impressive structural strength. They offer the surgeon flexibility, as they are easily tailored to bridge the specific gap created by the injury. However, these benefits are balanced against potential drawbacks, such as the risk of disease transmission, slower integration into the patient's natural tissue, and a higher possibility of future tears. Common techniques used for this purpose include the Achilles tendon allografts, dermal allografts and fascia lata allografts. (Giordano et al. 2023; Thompson et al. 2020; Zhiti et al. 2025)

The Achilles allograft is a versatile option for reconstruction, compatible with various fixation methods and offering a broad surface area that naturally mimics the thin, flat anatomy of the pectoralis major. When addressing delayed ruptures, this graft can be applied to both the sternal and clavicular heads. The process involves tubularizing the graft and attaching it circumferentially to the existing tendon stump, which extends the tissue by roughly 3–4 cm. The repair is finalized by securing the graft directly to the humerus using metal suture anchors. (Thompson et al. 2020; Zhiti et al. 2025)

Dermal allograft augmentation is one of the most thoroughly researched techniques for surgically repairing pectoralis major tears. Although primarily used in rotator cuff surgeries, these grafts have gained recommendation for pectoralis repairs due to their successful clinical results. In situations involving significant tissue retraction or weak tendon quality, acellular dermal allografts function effectively for both reinforcing the repair (augmentation) and bridging gaps (interposition). Because these grafts are acellular, they offer improved biocompatibility and a lower risk of immune rejection. Additionally, their naturally thin profile closely resembles the pectoralis major's anatomy, which simplifies the surgical process by reducing the time needed for graft preparation. (Giordano et al. 2023; Thompson et al. 2020; Zhiti et al. 2025)

Research on using fascia lata allografts for PM repairs remains limited. However, a case study by Sikka et al. highlighted its effectiveness in a chronic injury five years post-trauma. Despite aggressive efforts to mobilize the tissue, the surgeon was left with a 1.5-cm gap and 7 cm of retraction, necessitating a fascia lata graft to bridge the defect. During the procedure, the graft allowed the shoulder to reach 70° of external rotation before tension became a concern. By the 18-month mark, the patient had regained full strength and stability, returning to all activities without restrictions. (Sikka, Neault, i A Guanche 2005)

CONCLUSION

The rising incidence of PM ruptures among young, active men driven largely by heavy weight training and anabolic steroid use underscores the importance of clinical awareness and prompt diagnosis. While conservative management is suitable for low-demand patients or specific partial tears, surgical intervention remains the gold standard for restoring strength, function,

and aesthetics. Acute repairs using techniques like bone troughs, suture anchors, or unicortical buttons offer reliable pathways to recovery, though each method involves specific trade-offs regarding cost, surgical time, and potential bone stress. Chronic ruptures, while more complex due to tissue retraction and scarring, should not be viewed as untreatable. Modern reconstructive options using autografts or allografts allow for successful functional restoration even years after the initial injury. Ultimately, the goal of treatment is to return the patient to their baseline activity level, and while some reduction in maximum lifting capacity may occur, surgical repair consistently yields high patient satisfaction and effective long-term outcomes.

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Authors contribution

Conceptualization –

Methodology –

Software –

Check –

Formal Analysis –

Investigation –

Resources –

Data curation –

Writing – rough preparation –

Writing – review –

Editing –

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