Pectoralis Major Rupture

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Abstract

Injuries to the pectoralis major muscle range in severity from mild strains and contusions to complete ruptures. Careful physical examination and a high level of suspicion based on history are keys to accurate and timely diagnosis. Injuries are most common in males in the 20s and 30s and occur when load is applied to an eccentrically contracting muscle. In the pectoralis major, this situation frequently occurs when the arm is maximally loaded in a position of forward flexion, abduction, and external rotation. Injuries are classified based on tear location and severity. Physical examination of an acute rupture typically reveals significant bruising of the chest, axilla, and arm, along with loss of the axillary fold. The diagnosis can be confirmed with ultrasound or MRI. While contusions and partial tears can often be managed nonoperatively, complete ruptures near the distal insertion are generally treated surgically. A variety of repair techniques have been described.

7.1 Introduction

Injuries to the pectoralis major muscle range in severity from mild strains and contusions to complete ruptures. Injuries typically result from eccentric contraction of the muscle with the arm in an extended and externally rotated position [31]. The initial description of the injury dates from 1822 and occurred in a butcher attempting to lift a large piece of beef [28]. The injury remained primarily occupational and quite rare until recent years, when sporting activities have become the most common etiology [21, 31].

Although acute complete ruptures are generally associated with significant bruising and swelling, presentation can be more subtle in more chronic cases and in the elderly. Careful physical examination and a high level of suspicion based on history are keys to accurate and timely diagnosis.

7.2 Definition of the Injury

7.2.1 Anatomy

The pectoralis major is a triangular-shaped muscle overlying the rib cage and pectoralis minor muscle on the superolateral chest. The muscle can be divided into two distinct portions based on their origins: the clavicular head and the sternocostal head, both of which insert on the anterior humerus just lateral to the bicipital groove (Fig. 7.1) [12, 31]. The clavicular fibers attach distally and laterally in the insertion site, while fibers from the manubrium and second through fourth ribs attach in the central portion. Inferior fibers originating from the fifth and sixth ribs and external oblique aponeurosis are multipennate and are noted to twist 180° prior to their insertion proximally and medially in the footprint [41]. With humeral abduction, these fibers undergo significantly more stretch than those originating more superiorly,

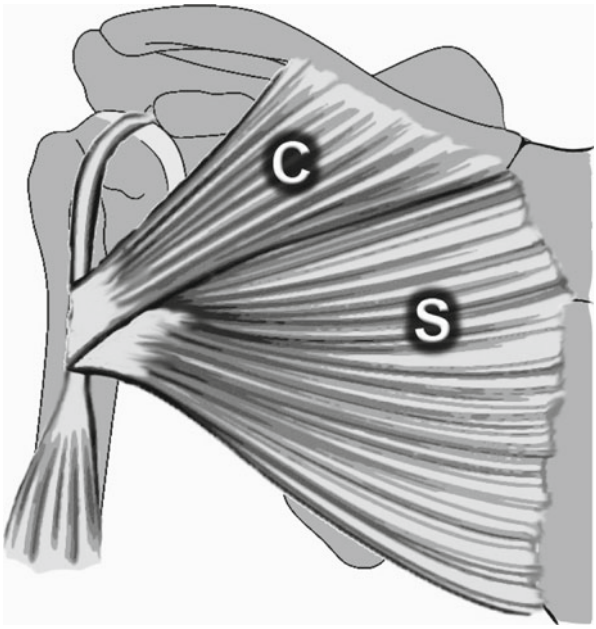

Fig. 7.1 Drawing of pectoralis major origin and insertion on a right upper extremity. The clavicular head (*C*) takes origin on the clavicle and inserts on the humerus just lateral to the bicipital groove. The sternocostal head (*S*) takes origin from the sternum and inserts on the humerus just lateral to the bicipital groove, medial and proximal to the fibers of the clavicular head

which may be related to the propensity of partial tears to involve these inferior fibers [41]. The insertion site measures approximately 5.4 cm in length and 3–4 mm in width with its widest portion located distally [15].

The pectoralis major is innervated by the medial and lateral pectoral nerves, which are named for the respective cords of the brachial plexus from which they originate. The lateral pectoral nerve innervates the majority of the muscle, with the medial pectoral nerve supplying much of the innervation to the pectoralis minor and the inferior portion of the pectoralis major [5, 19, 31]. Its primary blood supply is from the pectoral branch of the thoracoacromial artery, with smaller contributions from the clavicular branch and internal mammary arteries [9].

7.2.2 Injury Mechanism

Injuries to the pectoralis major can occur from several mechanisms. First, a direct blow to the muscle belly can lead to disruption of the fibers and formation of a large hematoma [12]. Traction injury to the muscle is more common and can lead to injury at the muscle's origin on the chest wall, at the myotendinous junction, or near its insertion [6, 25, 41]. The highest forces occur when load is applied to an eccentrically contracting muscle. In the pectoralis major, this situation frequently occurs when the arm is maximally loaded in a position of forward flexion, abduction, and external rotation. This arm position places the inferior fibers of the muscle in a position of mechanical disadvantage and leads to very high forces in this region [41]. Tears frequently begin in this inferior region and progress superiorly if loads persist [41].

Pectoralis major ruptures have traditionally been described as occurring almost exclusively in men in their 20s and 30s, likely related to their involvement in activities that place them at risk [1, 31]. A recent prospective cohort study in a military population confirmed that the injury typically affects males and noted a significantly increased risk in black soldiers relative to white soldiers [40]. By far the most common activity leading to injury of the pectoralis major muscle is weightlifting. The bench press in particular places the muscle at high risk for injury, especially as the muscle contracts eccentrically while lowering the weight to the chest [21]. Anabolic steroid use in such athletes has been noted to predispose to pectoralis major rupture [11, 18]. Pectoralis major rupture has also been reported in football players [27], windsurfers [13], water-skiers [22], elderly [8], and in association with shoulder dislocations [4] and seatbelt injuries [16]. Bilateral ruptures have also been reported [29, 38].

7.3 Symptoms and Signs

Patients suffering a muscle contusion report typical symptoms of pain and discoloration with short-term limitation of function secondary to pain. Patients suffering an acute complete rupture typically describe a sensation of tearing in their axilla or hear a "pop" followed by a significant loss of strength in the affected extremity [3]. Patients presenting with chronic injuries may report weakness in the affected extremity and muscular asymmetry.

7.3.1 Physical Examination

Physical examination of an acute rupture typically reveals significant bruising of the chest, axilla, and arm depending on the location of rupture (Fig. 7.2a). Pain on palpation as well as with motion of the shoulder is to be expected. Weakness in shoulder adduction, internal rotation, and to a lesser extent forward flexion are also common. Unfortunately these signs are common to numerous injuries in this region.

A more specific sign of pectoralis major rupture is loss or thinning of the axillary fold (Fig. 7.2b) [31]. This finding is best noted in comparison with the contralateral side and may be accentuated by abduction [22] or resisted adduction [20] of the shoulder. Additionally, one may note a bulge on the chest wall in cases of more distal rupture or in the axilla in cases of proximal rupture associated with palpable gaps in the tendon or muscle tissue. One should note that associated swelling and pain may limit the effectiveness of physical examination in diagnosing this injury and localizing the tear [41].

Chronic ruptures may present with atrophy of the pectoralis major muscle on the affected side and possibly dimpling of the skin due to an underlying scar tissue in the region [31]. A careful physical exam is often quite successful in making the diagnosis if one maintains a high index of suspicion.

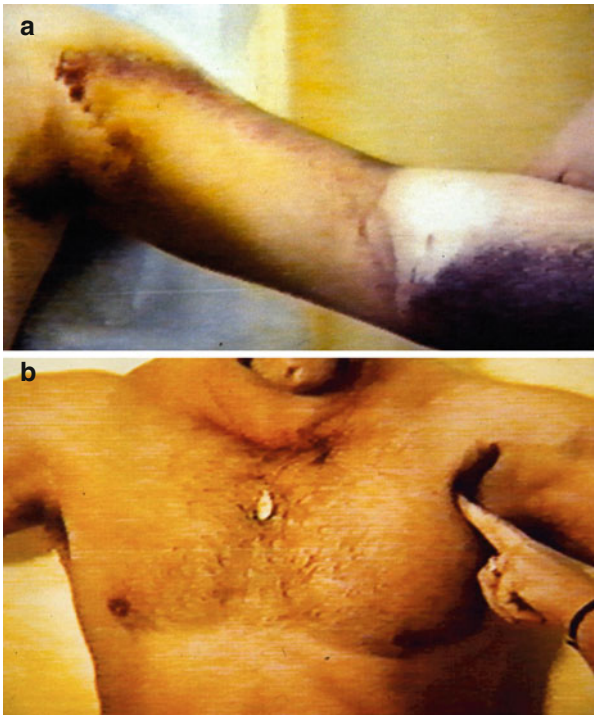

Fig. 7.2 Clinical photographs following pectoralis major rupture. Bruising can be severe, extending from the axilla into the forearm (**a**). Bruising associated with loss or thinning of the axillary fold relative to the contralateral side is also a common finding (**b**) (Image courtesy of Jean-François Luciani)

Table 7.1 Tietjen's [37] classification of pectoralis major injuries as modified by Bak et al. [6]

	Description	Relative incidence
Type I	Contusion	Unknown
Type II	Partial rupture	9 %
Type III	Complete rupture	91 %
A	Muscle origin rupture	1 %[a]
B	Muscle belly rupture	1 %[a]
C	Musculotendinous junction rupture	27 %[a]
D	Muscle tendon avulsion	62 %[a]
E	Bony avulsion of the insertion	5 %[a]
F	Intratendinous rupture	1 %[a]

[a]Represents the percentage of type III Injuries (complete ruptures)

7.3.2 Clinical Classification

Pectoralis major injuries are typically classified according to the system described by Tietjen [37] and modified by Bak et al. [6], in which muscle contusions are classified as type I injuries, partial tears as type II injuries, and complete ruptures as type III injuries. Type III injuries are further classified as type IIIA to IIIF depending on the specific location of the tear (Table 7.1). Complete ruptures are more common than partial ruptures, with avulsion of the tendon insertion (type IIID) representing the majority of injuries (Table 7.1) [6].

7.4 Imaging

Although physical examination is often sufficient for diagnosis, imaging provides additional useful information regarding tear extent and location and allows the physician to rule out associated injuries.

7.4.1 Plain Radiographs

Plain radiographs are generally normal (with the exception of soft tissue swelling) in cases of isolated pectoralis major muscle injuries. Rarely, one can visualize a bony avulsion injury at the humeral insertion [6, 39], which is more common in the skeletally immature [36]. The greatest value of plain radiographs probably lies in ruling out associated injuries. Pectoralis major ruptures have been reported in association with both anterior shoulder dislocations and proximal humerus fractures [23].

7.4.2 Ultrasound

Ultrasound imaging has proven to be an efficient and cost-effective means of evaluating injuries to the pectoralis major muscle and tendon. It is effective in confirming ruptures in the acute setting (particularly when the comparison to the opposite side is performed) and in localizing tear location [7, 31].

7.4.3 MRI

MRI is generally the most useful imaging modality in assessing pectoralis major injuries (Fig. 7.3). In addition to confirming tear location (which significantly impacts treatment strategy), MRI has been shown effective in differentiating partial and complete tears as well as acute versus chronic injuries [10].

7.5 Treatment

7.5.1 Nonoperative

Pectoralis major contusions and other minor injuries are best treated with rest, ice, and anti-inflammatory medication. If a partial tear is confirmed with MRI or ultrasound, some authors recommend a trial of conservative management [6, 33]. Treatment consists of brief immobilization in adduction and internal rotation followed by gradual restoration of motion following resolution of pain from the initial injury. Gradual strengthening then proceeds after full painless range of motion has been restored. Nonoperative management of complete ruptures generally yields poorer functional outcome [6, 12, 35, 41] and is limited to the elderly and those with low functional demands [8, 17].

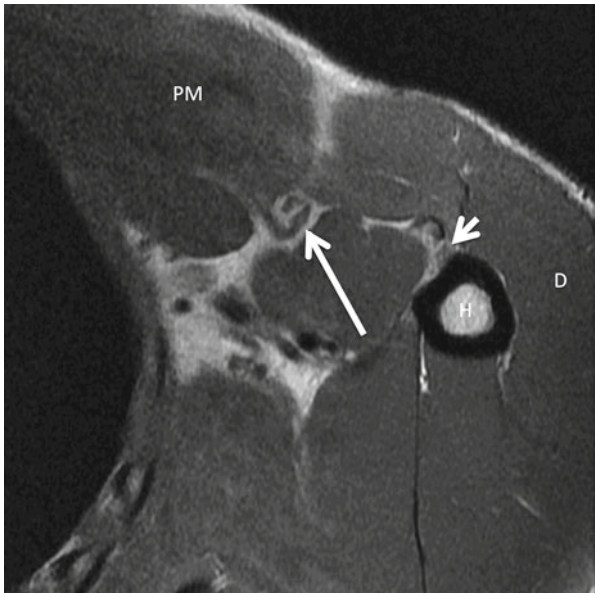

Fig. 7.3 An axial T1-weighted MRI image of a left shoulder of a patient with a complete tear of the pectoralis major (*PM*). The tendon of the pectoralis major has avulsed from the humerus (*H*), where periosteal stripping can be visualized (*short arrow*). The tendon has retracted medially and curled (*large arrow*). The deltoid (*D*) has been labeled (Image courtesy of Ryan L. Hartman)

7.5.2 Operative

Surgical repair is the treatment of choice for complete ruptures of the pectoralis major in active patients. A recent meta-analysis demonstrated that surgical repair yielded less pain and improved function when compared with nonoperative management [6].

Following surgical repair of complete ruptures, the arm should be placed in a sling for 3–6 weeks. Passive range of motion exercises are then initiated and transitioned to light resistance at about 8 weeks postoperative [4, 14, 16, 27, 30, 35, 41]. Full abduction and external rotation should be avoided until at least 6 weeks postoperative [24, 30, 34]. More aggressive strengthening can be initiated 3–4 months postoperative, with an expected return to unrestricted activity at about 6 months [31].

7.5.3 Surgical Technique

Following an approach through the deltopectoral interval and identification of the location of the rupture, the tendon is mobilized to restore its native insertion site. This mobilization can be accomplished through releasing scar around the tendon and muscle belly in all directions. If sufficient length cannot be gained in this manner, one can consider a relaxing incision in the inferomedial portion of the muscle belly to facilitate lateralization [2]. Alternatively, an Achilles allograft can be used to lengthen the pectoralis tendon [20].

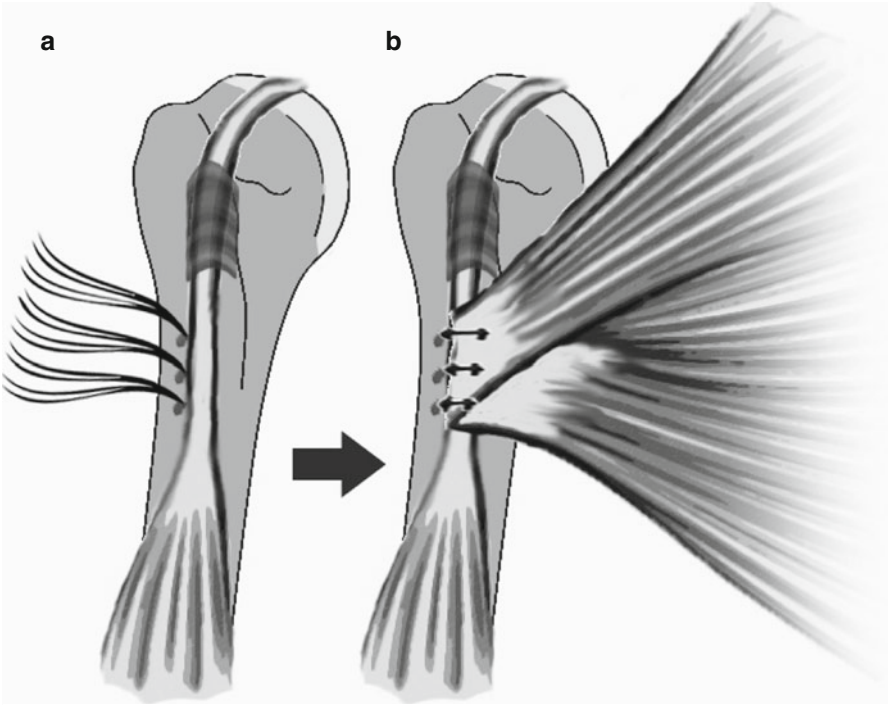

Fig. 7.4 A schematic of the suture anchor technique for repair of a complete pectoralis major tendon avulsion. Suture anchors are first placed in the pectoralis major footprint, just lateral to the bicipital groove (**a**). The sutures are then passed through the tendon and tied, reattaching the tendon to its native position (**b**)

After sufficient tendon length and mobility have been established to restore the humeral insertion of the tendon, a fixation method must be selected. Numerous methods have been described with excellent results including suture anchors (Fig. 7.4) [1, 26], bone tunnels (Fig. 7.5) [31], staples [14], and screws and washers [32].

7.5.4 Findings at Surgery

Ruptures treated acutely are frequently associated with formation of a large hematoma that is encountered following skin incision in the deltopectoral interval. Although tear location varies (Table 7.1), the most common surgical finding is avulsion of the tendon from its humeral attachment with medial retraction [6]. The tendon is generally freely mobile and can easily be reattached to its insertion.

Chronic cases can be significantly more difficult. The formation of fibrous tissue in the gap between the retracted tendon and its insertion may give the false impression that the tendon is intact [35]. Additionally, scarring of the tendon into the muscle belly as well as numerous adhesions to the skin and chest may complicate

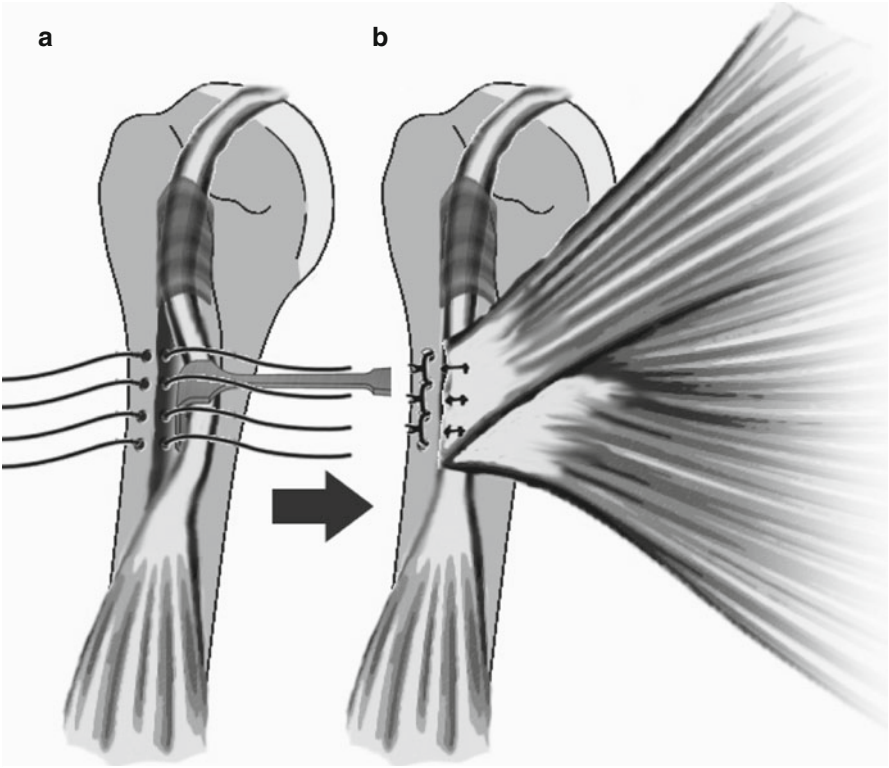

Fig. 7.5 A schematic of the bone tunnel technique for repair of a complete pectoralis major tendon avulsion. Drill holes are created through the pectoralis major footprint, just lateral to the bicipital groove and sutures passed through the holes (**a**). The sutures are then passed through the tendon and tied, reattaching the tendon to its native position (**b**)

identification and mobilization of the tendon prior to reattachment to the humeral insertion [31].

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