doi: https://doi.org/10.5704/MOJ.2607.007

Management of Chronic Pectoralis Major Tears using Suture Anchors: Surgical Techniques and Outcomes

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Date of submission: 08th February 2025
Date of acceptance: 20th July 2025

ABSTRACT

Introduction: Pectoralis major muscle rupture is one of the most infrequently occurring sports/exercise injuries. Among the various techniques described for its repair, three are most commonly used: transosseous (TOS) through drill hole or bone tunnel, suture anchor (SA), and unicortical or bicortical button (UCB and BCB, respectively).

Materials and methods: In this retrospective observational study, we studied the results of ten cases with complete pectoralis major muscle tears from January 2021 to January 2023. All of them underwent repair using suture anchors in a double-row configuration to get a better anatomical footprint at the insertion site on the humerus, along with box-suture bites through the muscle-tendinous unit to provide a better bulk of muscle available for repair in chronic cases. Functional outcomes were assessed over a one-year follow-up period using the ASES score, Penn score, and Bak's criteria.

Results: At one-year follow-up, the American Shoulder and Elbow Surgery score (ASES) improved from 46.33±9.83 pre-operative to 97.5±2.73 post-op for acute cases (p – 0.0001), while for chronic cases it went from 52.33±12.31 to 95.77±3.53 (p – 0.0001). According to the ASES score and Bak's criteria, patients had excellent results with good shoulder ROM without any functional impairment at 12 months post-surgery.

Conclusion: The double row suture anchor technique provides a practical, transosseous equivalent method for repairing pectoralis major ruptures, demonstrating favourable outcomes even in chronic cases. By adapting principles from the familiar rotator cuff repair approach, this technique is particularly relevant in regions where such injuries are infrequently encountered. Nevertheless, the small sample size and lack of objective strength testing in this study highlight the need for further research to validate its efficacy and generalisability.

Keywords:
pectoralis major rupture, suture anchors, chronic injury, double-row repair

INTRODUCTION

Rupture of the pectoralis major muscle was first described in 1822 by Pattisier[1] followed by Lettenneur in 1861[2]. Pectoralis major muscle rupture is one of the most infrequently occurring sport/exercise injuries, not commonly observed by sports surgeons around the globe. Only a limited number of studies in the past have reported this, with around 200 cases reported till 2012[3,4]. Although it is not a commonly encountered sports injury, recent studies report its prevalence has increased in the past decade due to increased popularity and interest in competitive high-impact sports and strenuous exercises[5,6]. This injury results most commonly from violent, eccentric contraction of the muscle, which is seen most commonly in weightlifters while performing a 'bench press'[7,8]. The Tietjen classification[9] is the most widely used system for evaluating pectoralis major tendon (PMT) injuries. In this study, a modified version developed by Bak *et al*[10] was utilised, incorporating additional subclassifications to enhance diagnostic detail. According to this system, pectoralis major injuries are categorised into three types: Type I involves muscle contusions or strains, Type II includes partial tendon tears, and Type III represents complete tendon ruptures. Type III injuries are further subdivided based on the site of the tear: Grade 1 occurs within the muscle belly, Grade 2 at the myotendinous junction, and Grade 3 involves avulsion of the tendon from its insertion. In our study, all cases were classified as Grade 3 tears, specifically tendon avulsions from the humeral insertion. Another way to categorise these injuries is based on timing: acute (<8 weeks) and chronic (>8 weeks). Chronic pectoralis major muscle (PMM) tears, similar to other tendon injuries, are more challenging to repair due to tendon retraction and the presence of adhesions. In such cases, the available tendon length may be insufficient, leaving only the muscle or musculotendinous unit for attachment. When adequate tendon length is lacking, the use of autografts or allografts becomes necessary.[10]

Regarding surgical treatment options for pectoralis major tendon tears, several reconstruction techniques have been

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reported in the literature, all aiming to restore the tendon to its anatomical insertion site on the humerus. Among the various techniques described in the literature, three are most commonly employed for pectoralis major tendon repair: transosseous fixation (TOS) using drill holes or bone tunnels, suture anchors (SA), and unicortical or bicortical button fixation (UCB and BCB, respectively)[3,7,11]. All these methods have shown excellent post-operative outcomes, giving surgeons the flexibility to select the approach they are most comfortable with. However, given the critical role of the pectoralis major in shoulder adduction, internal rotation, and flexion—particularly in athletes where the muscle is subject to high mechanical loads—the chosen fixation must be sufficiently strong. Ensuring a robust repair is essential to minimise the risk of re-rupture and to support a safe and timely return to athletic activity[12].

Building on the importance of achieving a robust fixation, we recognised additional challenges in managing chronic tears, which comprised the majority of cases in our study. In chronic injuries, the tendon is often retracted and scarred, with minimal repairable length available, making secure fixation more difficult and increasing the risk of suture cut through at the musculotendinous junction. To address these limitations, we utilised the standard suture anchor technique but introduced specific modifications to reinforce the repair and enhance its durability. Functional outcomes were then assessed in the months following surgery to evaluate the effectiveness of our modified approach in restoring strength and facilitating return to activity.

MATERIALS AND METHODS

We conducted a retrospective observational study reviewing patients operated on for pectoralis major muscle tendon tears between January 2021 and January 2023 at our institute. The inclusion criteria were all patients who underwent repair for complete PMM tears and had at least one-year of post-operative follow-up. Patients who were lost to follow-up were excluded. Data collected from hospital records included patient demographics (age, sex, side dominance), mechanism of injury, time interval between injury and surgery, clinical presentation, anabolic steroid intake, diagnostic studies, pre-operative findings, surgical procedure details, intra-operative findings, and primary follow-up outcomes.

All patients presented with a similar history of experiencing a sensation of immense pain in the axilla and arm, associated with a loud pop sound at the time of injury. There was a sudden-onset dull-aching pain and swelling around the chest and axillary region following the incident, with reduced strength in the affected arm. The mechanism of injury can be either direct injury or an indirect one caused by extreme muscle tension. Most of the patients presented with a history of indirect injury, ‘bench-press’ being the most common cause of this injury mechanism. On examination, loss of contour of the pectoralis major muscle was observed along with significant weakness of adduction and internal rotation of the arm. Plain radiology generally showed a loss of the pectoralis major shadow and loss of the normal anterior axillary fold. MRI is the investigation of choice to localise the tear and demonstrate its extent. Multi-planar coronal (Fig. 1) and axial (Fig. 2) images (T2-weighted fat-suppressed images) were taken for all patients. It revealed avulsion of the pectoralis major muscle tendon from the bone with retraction and effusion (Grade 3 tears). The sternal head was involved in all cases. Routine haematological investigations (Complete Blood count, INR, Liver and Kidney function tests) were done as a part of pre-anaesthetic check-up.

All tears were treated surgically as elective day case procedures. General anaesthesia combined with a brachial plexus block was administered. For optimal exposure and access to the affected shoulder, patients were positioned in the beach chair position with the arm draped freely. A standard deltopectoral approach was utilised. The incision began at the coracoid process and curved toward the axilla, deviating from a straight longitudinal line along the humerus to enhance visibility and surgical access to the repair site. Upon incision, the deltopectoral interval was clearly identified. The deltoid muscle was retracted laterally, and the overlying fascia was incised. Hematoma within the surgical field was meticulously evacuated to ensure a clear view of the underlying structures. The pectoralis major muscle tendon was then carefully mobilised, allowing it to be repositioned back to its lateral anatomic attachment on the humerus. The insertion site on the humerus was identified (lateral lip of bicipital groove) and a bleeding bone bed was created using a burr and bone rasp. After preparing the bed, two sets of sutures anchors (Y-knot all suture anchors, Conmed) were placed medially (Fig. 3). The suturing was done in a box-like fashion to take suture bites through the bulk of the musculotendinous unit (Fig. 4). After taking bites into the tendon, another anchor was used lateral to the first two (Swivelock, Arthrex), to bring the tendon back to its anatomical footprint and thus, forming a double-row configuration (Fig. 5 and Fig. 6). After completing the suturing and securing the tendon in place, the wound was thoroughly irrigated to remove any debris. The incision was then closed in layers to promote optimal healing. Post-operatively, the shoulder was immobilised with a shoulder immobiliser for six weeks to facilitate proper tendon healing and prevent undue stress on the repair. A follow-up appointment was scheduled for two weeks after surgery for a wound check and the removal of surgical clips. During this visit, the integrity of the repair was assessed, and any early complications were addressed. Post-surgical rehabilitation included a carefully planned physical therapy program to restore shoulder function and strength while accommodating the healing process.

Table I: Bak criteria.

	Excellent	Good	Fair	Poor
Pain	Free	Free	With activity	Persistent
Range of motion	Full	Slight decrease	Slight decrease	Restricted
Cosmesis	No complaints	Minor	Minor	Unsatisfactory
Return to activity	Full function	Slight impairment	Impaired	Complications
Strength	<10% Isokinetic loss	<20% Isokinetic loss	<20% Isokinetic loss	<20% Isokinetic loss

Table II: Patients details.

No	Age/ Sex	Dominant Hand/ Injured Side	Mechanism	Days from injury to surgery	Anabolic steroids	Physical findings		
1	15/M	Left / Right	Bench-Press	74	No	Swelling	Ecchymosis	Deformity
2	42/M	Left / Left	Bench-Press	153	Yes	Yes	No	Yes
3	39/M	Right/ Right	Bench-Press	139	No	No	No	Yes
4	29/M	Right/Left	Bench-Press	42	Yes	No	No	Yes
5	27/M	Right/ Left	Bench-Press	92	No	Yes	Yes	No
6	33/M	Right/ Left	Rugby	63	No	No	No	Yes
7	24/M	Right/ Right	Traction injury while hanging	77	No	No	No	Yes
8	29/M	Right/ Left	Bench-Press	32	Yes	No	No	Yes
9	25/M	Right/ Right	Rugby	41	No	Yes	Yes	No
10	34/M	Right/ Right	Bench-Press	127	No	Yes	No	No

Post-operatively, patients followed a structured physiotherapy protocol adapted from the Massachusetts General Hospital guidelines for pectoralis major repair. Passive range of motion (ROM) exercises were initiated for the first 3 weeks, followed by active-assisted ROM from week 4. Gradual strengthening exercises were introduced during this period, with advanced strengthening between weeks 14 and 20. Physiotherapy was continued for a total of 5–6 months post-surgery, after which patients were typically discharged from formal rehabilitation and progressed to unrestricted activity under supervision. Post-operative outcomes were evaluated using the American Shoulder and Elbow Surgeons (ASES) score[13] and the Penn Shoulder Score[14]. The clinical outcome of treatment at the final follow-up was graded as excellent, good, fair, or poor according to the criteria of Bak *et al*[10] (Table I).

RESULTS

Out of an initial cohort of 13 patients evaluated for pectoralis major tendon (PMT) injuries, three were excluded from the final analysis. Two patients were lost to follow-up and did not complete the required post-operative evaluations. One patient presented 457 days after the initial injury, having been managed non-operatively elsewhere for over a year. Due to extensive tendon retraction and fibrosis, this patient required reconstruction with an artificial ligament (LARS – Ligament Augmentation and Reconstruction System), which involved a different surgical approach and post-operative protocol. As this case represented a significant outlier in terms of chronicity and treatment technique, it was excluded from the outcome analysis to maintain cohort homogeneity.

Therefore, the final study population included 10 patients—all young, active males—with an average age of 29.7 ± 7.78 years (range 15 – 42, median 29) at the time of injury. There was an equal distribution of left- and right-sided tears. The average duration from injury to surgery was 84 days (range 32 – 139, median 75.5), and all patients were followed for a minimum of 1 year post-operatively. Seven of the ten injuries occurred during bench pressing at the gym, and three took place while playing rugby. A history of anabolic steroid use was reported in 3 of the 7 bench-pressing cases (42.9%). Seven of the ten injuries were chronic tears, defined as repairs performed more than eight weeks after injury (Table II).

At the one-year post-operative follow-up, eight patients demonstrated excellent outcomes according to Bak's criteria and had successfully returned to work and their pre-injury level of exercise. On average, return to sports or full training occurred within six to nine months following surgical repair. Two patients who presented late (139 and 153 days post injury) achieved good post-operative results; however, they were unable to resume bench pressing due to reduced muscle strength compared with the contralateral side. All patients were satisfied with the cosmetic results and exhibited full shoulder range of motion at the final follow-up.

The mean Penn score improved significantly from 52.2 ± 1.78 pre-operatively to 96.0 ± 3.49 post-operatively,

Table III: Functional assessment pre-op and at one-year follow-up.

Patient number	Days from injury to surgery	Pre-op ASES	Post-op ASES	Pre-op Penn Score	Post-op Penn Score	Post-op ROM shoulder	Return to activity	Bak's Criteria
1	74	43	100	Pain – 5 Satisfaction – 3 Function – 45	Pain – 10 Satisfaction – 9 Function – 59	Full	Full function	Excellent
2	153	57	92	Pain – 4 Satisfaction – 2 Function – 43	Pain – 8 Satisfaction – 7 Function – 54	Full	Slight impairment	Good
3	139	68	90	Pain – 5 Satisfaction – 2 Function – 44	Pain – 9 Satisfaction – 6 Function – 55	Full	Slight impairment	Good
4	42	38	100	Pain – 5 Satisfaction – 3 Function – 46	Pain – 10 Satisfaction – 9 Function – 58	Full	Full function	Excellent
5	92	63	95	Pain – 4 Satisfaction – 2 Function – 45	Pain – 9 Satisfaction – 8 Function – 59	Full	Full function	Excellent
6	63	43	100	Pain – 5 Satisfaction – 3 Function – 44	Pain – 10 Satisfaction – 9 Function – 60	Full	Full function	Excellent
7	77	53	95	Pain – 6 Satisfaction – 3 Function – 45	Pain –10 Satisfaction – 9 Function – 60	Full	Full function	Excellent
8	32	38	100	Pain – 5 Satisfaction – 2 Function – 43	Pain – 9 Satisfaction – 8 Function – 58	Full	Full function	Excellent
9	41	43	95	Pain – 5 Satisfaction – 3 Function – 46	Pain – 10 Satisfaction – 9 Function – 59	Full	Full function	Excellent
10	127	68	95	Pain – 5 Satisfaction – 4 Function – 45	Pain – 10 Satisfaction – 9 Function – 60	Full	Full function	Excellent
Average/Mean	84	51.4	96.2	52.2	96			

Table IV: Average ASES scores for acute versus delayed repairs.

Time of repair	Pre-op ASES Mean ± SD	Post-op ASES Mean ± SD	T-value / p-value
Acute < 8 weeks	46.33 ± 9.83	97.5 ± 2.73	10.43 / 0.0001
Delayed > 8 weeks	52.33 ± 12.31	95.77 ± 3.53	8.50 / 0.0001

Table V: Summary of key studies on surgical management of pectoralis major ruptures, including techniques, patient demographics, and clinical outcomes.

Author (year)	Number of patients	Patient age (Mean)	Injury Type	Surgical Technique	Outcomes
Cordasco *et al* (2017)[18]	35	34.4 years	Tendon avulsion	UCB	Surgical repair with unicortical buttons resulted in high patient satisfaction, with excellent restoration of function and strength.
de Castro Pochini *et al* (2010)[19]	27	29.9 years	Tendon avulsion	UCB + Graft	Chronic tears with tendon retraction were treated with adjustable cortical button and autologous knee flexor grafts, showed good results.
Garrigues *et al* (2012)[8]	19	34 years	Tendon avulsion + Musculotendinous-junction	TOS (16) and SA (3)	Excellent results with both TOS and SA technique
Joshi *et al* (2016)[20]	11	25.5 years	Tendon avulsion	SA	Excellent results in chronic tears with suture anchors and box-suture sliding technique.
Kakwani *et al* (2007)[21]	13	28.6 years	Tendon avulsion	SA	Early surgical repair and accelerated rehab protocol was important in achieving excellent results.
Merolla *et al* (2015)[22]	12	34.6 years	Tendon avulsion	SA + TFL	Both acute and delayed surgical repairs can lead to successful outcomes; however, acute repairs performed within a shorter time frame are more likely to result in excellent recovery, while delayed repairs tend to yield good rather than excellent results.
Aärimaa *et al* (2004)[17]	22	28 years	Tendon avulsion + Musculotendinous-junction	TOS (12) SA (10)	Strongly advocate for early anatomical surgical repair, which was recommended as the treatment of choice for complete or near-complete pectoralis major ruptures.

reflecting marked improvements in pain reduction, functional recovery, and patient satisfaction (Table III). No complications or re ruptures were observed during the follow-up period.

Three out of the 10 patients (30%) underwent acute repair (<8 weeks), while the remaining 7 (70%) were chronic repairs (>8 weeks). For the acute repairs, the average ASES increased from 46.33±9.83 pre-operatively to 97.5±2.73 at final follow-up, while for the chronic repairs, there was again a substantial jump from 52.33±12.31 at presentation to 95.77±3.53 at final follow-up (Table IV). The Wilcoxon signed rank test was used to assess pre- and post-op ASES scores. The improvement in ASES score following surgery was found to be statistically significant ($p<0.0001$).

DISCUSSION

The first case of pectoralis major muscle tear was reported in 1822[1], and fewer than 90 cases had been documented by 1990. A recent meta-analysis by Bodendorfer *et al* in 2020 reports a total of 693 cases[15]. More than 75% of reported cases have been documented in the last two decades, reflecting both an increased understanding of the injury and advancements in diagnosing soft tissue pathology with high quality MRI scans. The majority of cases described in the literature occur in athletes engaged in weightlifting, wrestling, football, surfing, and rugby.[7,8,10] Bodendorfer *et al* in their meta-analysis reported that weightlifting was the primary reason contributing to 63.2% of cases, with 39.5% documented tears due to bench-press[15]. Cases included in our study presented with similar history and mechanism of

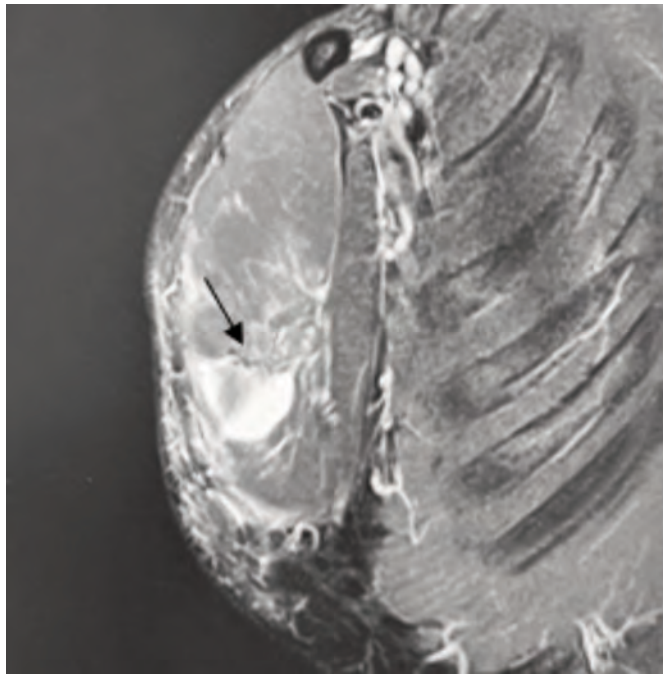

Fig. 1: Coronal magnetic resonance imaging showing a complete rupture of the pectoralis major muscle tendon (indicated by black arrow).

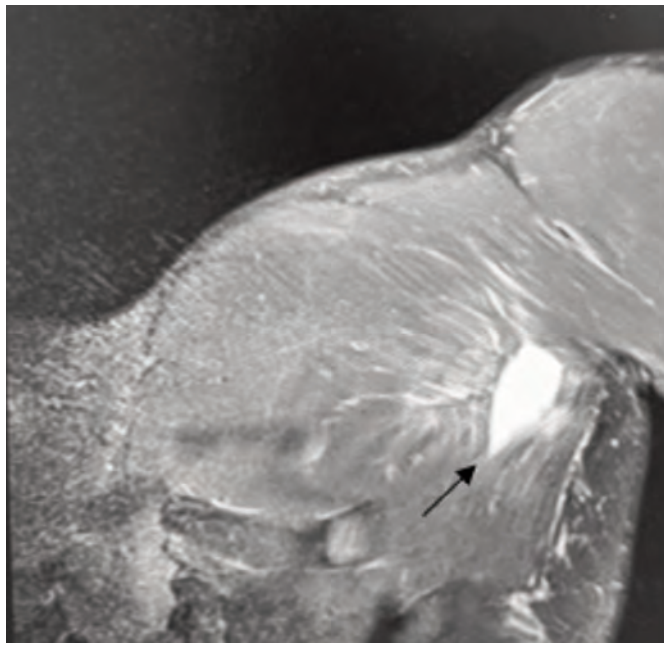

Fig. 2: Axial magnetic resonance imaging illustrating a complete rupture of the pectoralis major muscle tendon (indicated by black arrow).

injury, seven out of the ten cases (70%) tore their tendon while bench-pressing; three out of these seven (42.85%) were on anabolic steroids, which has been reported as a substantial risk factor in previous studies[3,8,16].

A growing body of evidence supports the clear advantage of surgical intervention over non-operative management for pectoralis major (PM) ruptures, particularly in cases involving complete tears. Early influential work by Aärimaa *et al* (2004)[17] highlighted the benefits of surgical repair, noting significantly better functional outcomes and strength restoration compared to conservative treatment. This was further reinforced by Garrigues *et al*[8] in their 2012 study, which reported excellent results with operative management, including high rates of return to pre-injury activity levels. Cordasco *et al* (2017)[18], in their series of 40 surgically managed cases, echoed these findings, documenting favourable outcomes in terms of strength recovery, cosmesis, and patient satisfaction.

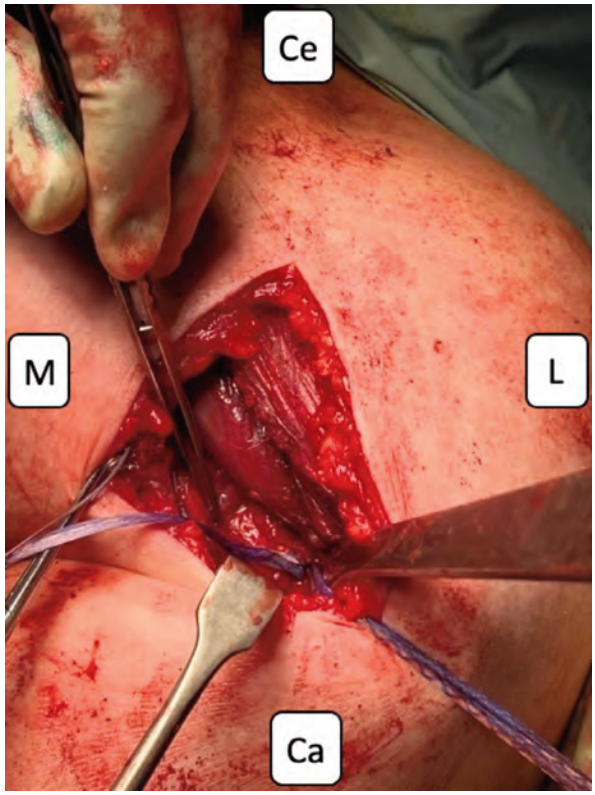

Fig. 3: Intra-operative photograph demonstrating placement of suture anchors. Anatomical directions are marked as CE (cephalic), Ca (caudal), M (medial), and L (lateral).

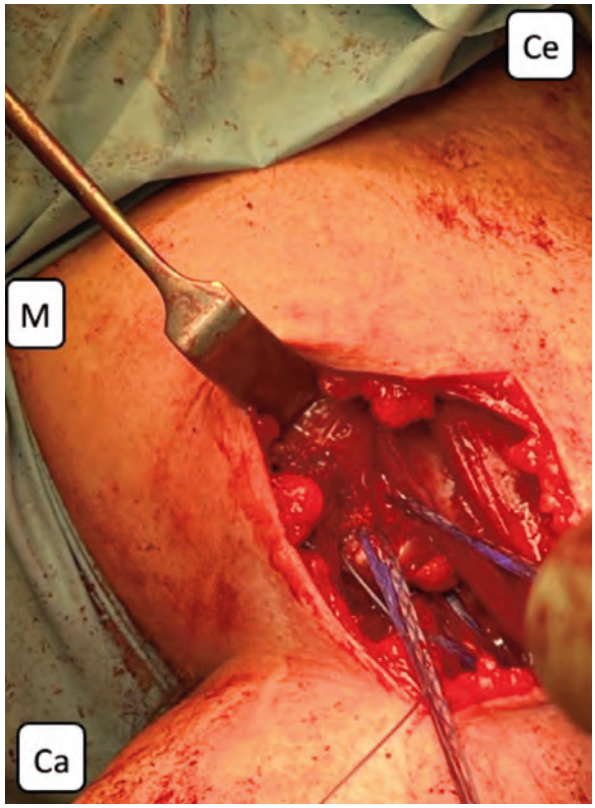

Fig. 4: Suture bites through the bulk of musculotendinous unit.

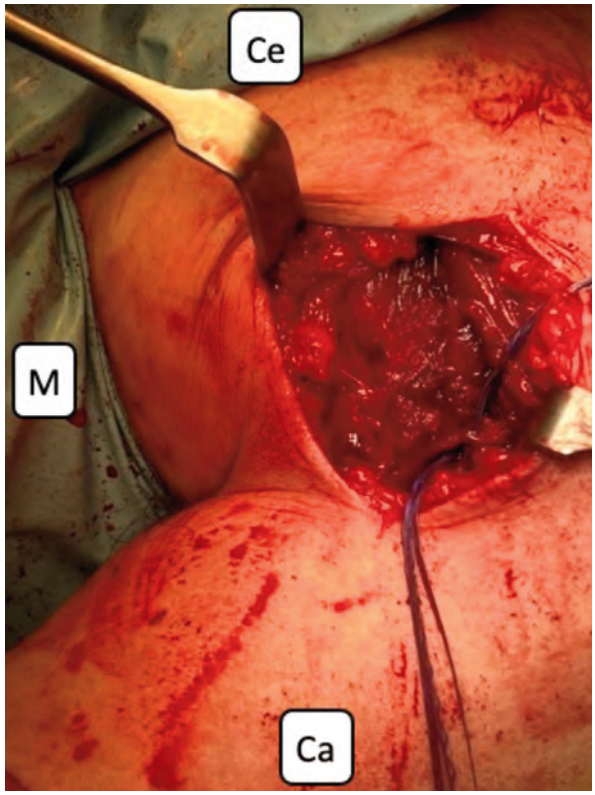

Fig. 5: Intra-operative photograph depicting complete tendon repair after placement of lateral anchor.

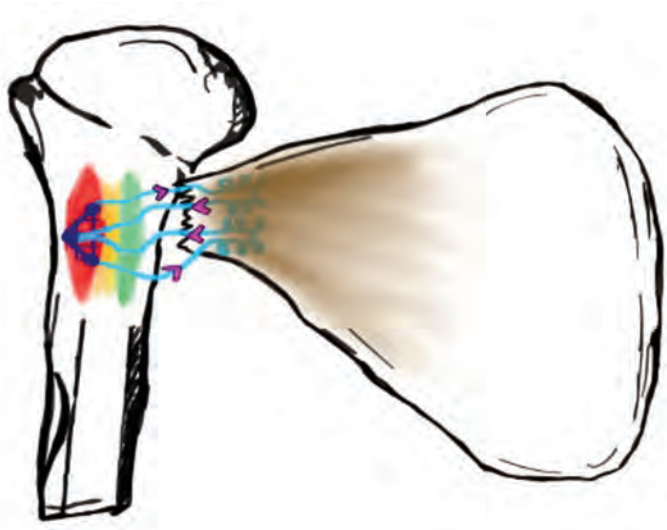

Fig. 6: Schematic diagram illustrating the placement and arrangement of suture anchors, with colour coding used to differentiate the attachment of various muscles: Red (pectoralis major tendon), Yellow (latissimus dorsi), Green (teres major), Brown (pectoralis major muscle bulk). The arrows in the diagram represent the direction of the fibre wire threads connecting the suture anchors to the corresponding muscle attachments.

Perhaps most compelling is the comprehensive systematic review and meta-analysis conducted by Bodendorfer *et al* in 2020[15], which synthesised available data and concluded unequivocally that complete pectoralis major tendon ruptures warrant surgical repair. Their analysis demonstrated superior functional outcomes, reduced complication rates, and a more predictable return to previous levels of performance when surgical management was employed.

The review of published literature demonstrates that, despite the relative rarity of pectoralis major (PM) tendon injuries, several studies with moderate sample sizes have consistently shown favourable outcomes with surgical repair, particularly when anatomical fixation techniques are employed. The majority of cases involved tendon avulsions, and various fixation methods—including suture anchors (SA), unicortical buttons (UCB), transosseous sutures (TOS), and

graft augmentation—have been described. For instance, Garrigues *et al*[8] and Cordasco *et al*[18] highlighted high patient satisfaction and return to pre-injury activity levels with UCB and SA repairs, respectively, while de Castro Pochini *et al*[19], Joshi *et al*[20] and Kakwani *et al*[21] emphasised the efficacy of SA in both acute and chronic cases. Additionally, Merolla *et al*[22] and Aärimaa *et al*[17] pointed out that early repair tends to yield superior results compared to delayed intervention. However, even in chronic tears with tendon retraction, modified techniques involving grafts or cortical buttons have also produced acceptable outcomes (Table V).

These individual findings are well-aligned with the 2019 meta-analysis by Gupton *et al*[23], which evaluated the comparative efficacy of four commonly used fixation techniques. Their results affirmed that while all methods achieved over 80% rates of excellent/good outcomes, the TOS and SA techniques were statistically superior to UCB in terms of clinical results. The TOS technique, in particular, had the highest predicted probability (97%) of achieving an excellent/good outcome, and the lowest complication and poor outcome rates. Nevertheless, the analysis also acknowledged potential technical drawbacks of TOS, such as increased surgical time, risk of proximal humerus weakening, and more invasive dissection—issues that may be mitigated with newer transosseous-equivalent constructs using suture anchors. Importantly, Gupton *et al* also noted that the apparent inferiority of the UCB technique might have been influenced by cosmetic dissatisfaction rather than true functional failure, suggesting a possible overrepresentation of suboptimal outcomes in one large case series. Overall, both the literature review and meta-analytic data reinforce the conclusion that anatomical repair—particularly when performed early and with techniques that maximise tendon-to-bone contact—is associated with superior functional recovery in pectoralis major ruptures.

Given the superior outcomes associated with transosseous suturing (TOS) as highlighted in the meta-analysis by Gupton *et al*[23], and considering its limitations, we aimed to replicate the biomechanical advantages of TOS using a more familiar and technically streamlined approach. Specifically, we employed a double-row suture anchor construct to create a transosseous-equivalent repair, similar to the technique widely used in rotator cuff surgery[24]. This approach is both practical and reproducible, especially in regions like the Indian subcontinent, where upper limb surgeons frequently perform rotator cuff repairs but encounter pectoralis major ruptures far less often. Support for the use of suture anchors in chronic pectoralis major ruptures also comes from the study by Joshi *et al* (2016)[20], which is particularly relevant as it represents one of the few Indian series on this topic. In their cohort of 11 patients, all of whom presented with chronic tears, the authors utilised a suture anchor-based repair combined with box-suture sliding techniques, reporting excellent functional outcomes and satisfactory return to activity levels. Their findings are notable, as chronic cases are generally considered more challenging due to tendon retraction, scarring, and adhesion formation—factors that often compromise optimal tendon mobilisation and anatomic reattachment.

Despite these known challenges, various authors have shown that with thoughtful surgical modifications—such as using grafts, box sutures, or tension-reducing constructs—even chronic ruptures can yield highly favourable results[19,22,23]. In our series, we adopted a similar strategy, employing box sutures combined with a double-row suture anchor technique to reconstruct the tendon footprint in a transosseous-equivalent manner. Importantly, chronic cases in our study performed comparably to acute cases, demonstrating the effectiveness of this method. However, it is worth noting that two patients who presented very late (at 139- and 153-days post-injury) achieved only good outcomes according to Bak's criteria and were unable to return to their full pre-injury level of exercise. These findings underscore the importance of early intervention while also reinforcing that, even in delayed presentations, satisfactory results can be obtained with appropriate technique adaptations.

Our study has certain limitations that must be acknowledged. First, objective strength assessment was not performed during follow-up, such as isokinetic testing or quantitative dynamometry, limiting our ability to provide precise data on muscle strength recovery. Patient outcomes were primarily assessed using clinical examination and functional scores, which, while informative, may not fully capture subtle deficits in power or endurance. Second, the sample size was relatively small, reflecting the inherent rarity of pectoralis major ruptures and the selective surgical indications. As such, while our findings—particularly regarding the favourable outcomes in chronic cases—are encouraging, they may not be sufficiently powered to draw definitive conclusions about the superiority or generalisability of our surgical modification.

CONCLUSION

Our study demonstrates that the double-row suture anchor technique, designed as a transosseous equivalent repair, is a practical and effective method for managing pectoralis major ruptures, including chronic cases. By adapting a technique familiar to most upper limb surgeons—particularly those experienced in rotator cuff repairs—this approach provides a reproducible solution with favourable clinical outcomes. Importantly, our findings suggest that even chronic tears can achieve good to excellent functional recovery using this method. Nevertheless, limitations such as the relatively small sample size and the absence of objective strength assessments warrant cautious interpretation. Further large-scale, prospective studies are required to validate these results and to establish standardised surgical protocols for both acute and chronic pectoralis major injuries.

CONFLICT OF INTEREST

The authors declare that they have no relevant financial or non-financial interests to report.

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Cite this article:

Ratra R, Shetty V. Management of Chronic Pectoralis Major Tears using Suture Anchors: Surgical Techniques and Outcomes. *Malays Orthop J.* 2026; 20(2): 52-62. doi: 10.5704/MOJ.2607.007