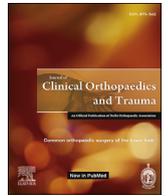




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Review article

Early versus delayed mobilization following rotator cuff repair

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ABSTRACT

Rotator cuff tears are a common cause for pain and reduced function. Tears of the tendons of the cuff can be a result of a degenerative process or as a consequence of trauma. Management of cuff tears are surrounded by controversy from indications for surgical management to rehabilitation protocol post-surgical repair. The aim of post surgical rehabilitation is to improve functional outcome, reduce pain and promote tendon healing. In the case of rotator cuff repair, rehabilitation can be broadly divided into early passive range of motion (EPM) and delayed range of motion (DRM).

The EPM regime is defined by minimal immobilisation of the shoulder and passive mobilisation of the joint within the first post-operative period. In contrast, DRM immobilises the shoulder joint up to six weeks post-operatively. Proponents of EPM state various advantages of their rehabilitation protocol including improved range of motion and earlier return to normal activities of daily living. However, there has also been concern that this rehabilitation regime may result in an increased rate of re-rupture.

Since this is a highly controversial issue, various high quality literature have been published looking to clarify which regime is best following rotator cuff surgery. Reviewing these articles, it appears that there is an increase rate of re-tear of the repaired rotator cuff tendon when the EPM regime is employed. Statistical significance however was limited by small sample sizes. Range of motion post-repair also appears to be associated with post-operative rehabilitation regime. As expected, the EPM regime has been shown to improve range of motion post-repair. Despite this, literature reports patients managed with the DPM showed a statistically better patient reported outcome measure.

We conclude that based on the evidence we currently have, early range of motion post rotator cuff repair is related with an increase risk of re-tear. The DPM regime reduces this risk with the possible complication of reduced range of shoulder movement. This problem is thought to be an easier clinical issue to deal with compared to re-rupture of the repaired rotator cuff tendon. There is however lack of data to achieve statistical significance in most of these analysis. There is a definite need for a large, multi-centre single blinded randomised controlled trial to further shed light on this controversial topic.

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1. Introduction

Rotator cuff tears are a common cause for presentation to a shoulder surgeon secondary to pain and reduced function. Tears can be a result of a degenerative process such as subacromial impingement syndrome or a result of a traumatic incident.¹ Surgical treatment is indicated for traumatic rotator cuff tears and degenerative tears that fail conservative treatment. Chronic rotator cuff tears may go on to progress to superior migration of the humeral head and glenohumeral joint osteoarthritis.² The aim of

surgical intervention is to improve functional outcome, reduce pain and promote tendon to bone healing of rotator cuff tear.³

Various surgical treatments have been described to repair a torn rotator cuff including the all-open technique, arthroscopic assisted mini open technique and all arthroscopic technique.⁴ Due to advances in surgical techniques, arthroscopic approach has become the mainstay in approach of rotator cuff tears despite no evidence showing one method is superior to the other in terms of pain, complications and long term results.⁵ In addition to this, the repair technique can also differ from surgeon to surgeon depending on personal preference, experience and nature or size of the cuff tear.⁶ Options for surgical repair of the cuff include transosseous repair (TO), single anchor (SA), double anchor (DA) and double row suture bridge (SB) technique.

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Healing of the repaired tendon is dependent on various factors. This includes the aetiology of the injury being traumatic or degenerative, age of patient, associated patient co-morbidities, surgical technique and rehabilitation regime.^{7–10} Recently, there has been significant debate and discussion with regards to which is the optimal post-operative rehabilitation regime for patients following rotator cuff repairs.

This article aims to summarise current evidence looking into the post-operative rehabilitation regimes following rotator cuff repair.

2. Early versus delayed mobilisation program following rotator cuff repair

The primary goal of rehabilitation following rotator cuff repair is to minimise stress on the repair and improve tissue healing while preventing stiffness and atrophy to the muscle.¹¹ Post-operatively, rehabilitation of the shoulder can be divided into two broad categories; early passive motion (EPM) regime and immobilisation with delayed range of motion (DRM).

EPM rehabilitation protocol is considered to be undertaken when the shoulder is minimally immobilised following surgery. Pendular and passive range of motion such as external rotation of the glenohumeral joint, forward elevation is allowed to take place normally within the first week but can be as soon as day one post-operatively.¹² This rehabilitation regime was traditionally enforced post rotator cuff repair due to concerns regarding shoulder stiffness.¹³ DRM rehabilitation protocol was developed due to the concerns increase rates of re-tears of the repaired rotator cuff tendon.¹⁴ In this protocol, the shoulder is immobilised in a sling and no passive range of motion of the shoulder is allowed apart from pendulous motion of the shoulder joint under gravity. This continues for up to six weeks post-operatively and only then both passive and active range of motion is commenced.¹¹

Proponents of the EPM regime states that the benefits of improved range of motion are reduce pain secondary to stiffness and improved quality of the healed tendon due to improved orientation of the collagen fibres.¹⁵ There is however a fear that the EPM regime results in an increase risk of cuff tear recurrence of the repaired tendon. A similar conundrum encapsulates the dilemma of early versus delayed mobilisation following anterior cruciate ligament reconstruction.¹⁶

On the other extreme of rehabilitation protocol, delayed mobilisation, both passive and active post rotator cuff repair may result in reduced range of motion post-operatively but this is thought to be a smaller issue to manage compared to cuff tear recurrence in an unfavourable surgical environment.^{12,17}

3. What does the evidence show?

Over the last twenty years, numerous studies have been conducted to improve our understanding on this controversial topic. This has resulted in several systematic reviews and meta-analysis on this specific question.^{3,12,18–20} Several factors have been identified as being a potential to influence patients' outcome following EPM or DPM rehabilitation protocols. Cuff re-tear rates and post-operative range of motion is thought to be the two most important factors directly influenced by the rehabilitation post rotator cuff surgery.

3.1. Re-tear rates

Cuff re-tear is defined as defect in the repaired tendon which is symptomatic and confirmed with imaging (CT, MRI or USS).²¹ Kluczynski, in his study, showed that there is an increased risk of cuff tear recurrence in patients with large tears between 3 cm and

5 cm who underwent EPM rehabilitation protocol.²⁰ Chen et al. showed a similar increased risk of cuff tear recurrence in patients in the EPM group.¹⁹ Their study however, did not stratify the risk based on the size of the tear.

Riboh and Garrigues compared EPM and DPM rehabilitation protocol and concluded that there was no difference in cuff re-tears rates at one year for patients with tears less than 1 cm and medium sized tears of between 1 and 3 cm.²² Several studies have echoed similar results.^{3,23} However, Riboh and Garrigues had several deficiencies in their work. The article only looked at cuff tears up to 3 cm in size and they did not take into account the type of tendon repair and how it affects rates of recurrence with early or delayed mobilisation.

In 2015, Kluczynski and his team set out to answer these questions and find the effect of tear size, repair technique and the rates of recurrence with early and delayed mobilisation.²⁰ Their findings are summarised in the table below.

Tear size	Repair Tech	Risk of Re-tear		Relative Risk
		EPM	Delayed	
<1 cm	TO + SA	0%	13.1%	0.24 (95% CI 0.01–3.98)
	DA	0%	15.8%	0.11 (95% CI 0.01–1.94)
	SB	n/a	n/a	n/a
	All combined	0%	13.8%	0.09 (95% CI 0.01–1.42)
1 cm–3 cm	TO + SA	22%	24%	1.03 (95% CI 0.62–1.73)
	DA	7.1%	7%	1.02(95% CI 0.29–3.61)
	SB	10.5%	12%	0.88 (95% CI 0.32–2.38)
	All combined	15.9%	12.7%	1.25 (95% CI 0.82–1.92)
<3 cm	TO + SA	39.7%	24.3%	1.63 (95% CI 1.28–2.08)
	DA	5.5%	6.5%	0.85 (95% CI 0.36–1.99)
	SB	14.5%	10.4%	1.39 (95% CI 0.74–2.63)
	All combined	21.2%	17.1%	1.24 (95% CI 0.99–1.56)
3 cm–5 cm	TO + SA	28.6%	22.2%	1.29 (95% CI 0.33–5.05)
	DA	30.3%	22.2%	1.36 (95% CI 0.71–2.60)
	SB	34.8%	18.6%	1.87 (95% CI 0.95–3.69)
	All combined	31.8%	20.4%	1.55 (95% CI 1.00–2.42)
≥3 cm	TO + SA	39.6%	34.8%	1.14 (95% CI 0.77–1.68)
	DA	36.8%	27.4%	1.43 (95% CI 0.89–2.31)
	SB	48%	17.5%	2.74 (95% CI 1.59–4.73)
	All combined	40.5%	26.7	1.52 (95% CI 1.17–1.97)
≥5 cm	TO + SA	0%	35%	n/a
	DA	50%	39.3	1.27 (95% CI 0.59–2.72)
	SB	100%	16.7%	6.00 (95% CI 1.69–21.26)
	All combined	55.6%	35.1%	1.58 (95% CI 0.87–2.88)

Their meta-analysis combined samples from thirty-four studies to give a total sample size of 2251 of which 649 were mobilised early and 1502 were mobilized six weeks after their surgery. Despite these large numbers, there were small numbers for early mobilisers for tears under 1 cm. Analysis was only meaningful when tears were grouped as tears under the size of 3 cm. This showed a small and statistically significant increased risk of cuff tear recurrence in patients with rotator cuff under the size of 3 cm undergoing transosseous/single anchor repair and early mobilisation. No other repair technique seemed to show any statistical difference.

In the cohort of cuff tears above 3 cm or more, again EPM was related to increased risk of recurrent cuff tears and this was also true for tears repaired using the double row suture bridge technique. This pattern was also observed in patients with tears above the size of 5 cm.

3.2. Range of motion and functional recovery

As expected, several studies have shown early active mobilisation results in better range of motion of the glenohumeral joint

at three, six and twelve month intervals post-operatively.^{24,25} As a result of this, it was no surprise studies such as Shen et al. showed EPM resulted in improved speed of recovery.²³ Increased range of motion however may not translate to better patients' satisfaction. A study by Chen et al. showed a significantly better American Society of Shoulder and Elbow Surgeons (ASES) scores in patients with delayed rehabilitation following their operation.¹⁹ This is could be due to better quality of the healing tendon in patients following six weeks of immobilization.

4. Discussion

Rotator cuff tears are a problem that affects both the active young and the elderly population through degenerative disease. In the United Kingdom, it is estimated that the rotator cuff disorders accounts for 30%–70% of shoulder pain cases.^{26,27} Clearly this is a surgical procedure that is becoming a staple for an orthopaedic surgeon specialising in shoulder surgery or sports surgery.

Rotator cuff repairs can be performed as an open or an arthroscopic procedure. Arthroscopic options have now become the preferred approach as in addition to preserving the deltoid muscles, it allows better visualisation of the tendon including the subscapularis tendon, infraspinatus and supraspinatus tendon through small incisions. The glenohumeral joint can also be assessed for concurrent injuries via this technique which was not previously possible using the more traditional open repair technique. These advantages however do not translate to better clinical outcomes.⁵

The topic of surgical management of rotator cuff tears itself has been a subject of heated debate. This however is outside the scope of this review article. Once surgical management has been decided upon, there are various options for repair techniques including transosseous, single anchor, double anchor or double anchor suture bridge. Choice of surgical technique is again a subject of debate and can be influenced by surgeon training, preferences, tear configuration and tear size.

The goal of rehabilitation is to provide an ideal environment for the repaired tendon to heal while maintaining or restoring glenohumeral range of motion.¹¹ As described and illustrated by the evidence above, early mobilisation does confer the advantage of improved range of motion compared to patients who are immobilised at least six weeks following their rotator cuff surgery. Early passive mobilisation not limited to pendulous movement prevents shoulder joint stiffness secondary to fibrosis and capsular contracture. Studies have also showed improved rates of recovery in patients mobilised earlier post-operatively.¹⁸ This term represents the time interval between surgical intervention and return to normal activities of daily living. Despite this, ASES scores in patients in the DRM group was found to be statistically better compared to patients undergoing EPM.¹⁹

Current evidence suggests patients who are allowed EPM has a statistically increased risk of recurrent cuff re-tear and this is particularly true for tears smaller than 3 cm repaired using the transosseous or single anchor technique.^{19,20} Early mobilisers in patients with large tears repaired using the double row suture bridge technique are also at particular risk of repair defects.²⁰ Although the other techniques did not achieve statistical significance, this could be secondary to a type 1 error. Based on the evidence available at present, the theoretical advantage of early mobilization to allow better orientation of collagen type III fibres has not substantiated by its clinical advantage. The suboptimal healing of the tendon due to early mobilisation may be the cause of poorer outcome measures reported in the ASES scores.

Economically, earlier recovery in patients with early passive range of motion will allow earlier return to work. However, this

may be offset by secondary procedures due to higher rates of cuff tear recurrence. Time taken off work from the revision operation and post-operative rehabilitation in patients with clinically symptomatic defects in their repair would result in not only a heavier burden to the healthcare system but will also translate to more non-contributing days as a working individual. Clinically, there is an argument that shoulder stiffness secondary to prolonged immobilization is an easier problem to manage compared to symptomatic repair and a significant secondary procedure is more likely to relate to poorer outcomes.

5. Conclusion

In summary, it appears that DPM following rotator cuff repair will result in reduced risk of cuff tear recurrence and improved patient reported outcome measures. There is an increased risk of stiffness if this rehabilitation regime is employed but this is a less complex clinical and surgical issue to manage compared to a revision surgery to repair the rotator cuff complex.

This conclusion however has been made with the best possible information and evidence we have currently. The scarcity of data especially patients with small sized tears, under 1 cm and between 1 and 3 cm in size, means we are still unsure on how best to rehabilitate these tears once they are repaired. In order to arrive to a concrete conclusion for this cohort of patients, a large multicentre randomised control trial is necessary. This may highlight the benefit of early mobilisation in patients with small tear sizes.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jcot.2019.01.016>.

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