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Case Report

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Effect of Early or Delayed Rehabilitation on Massive Rotator Cuff Tear: A Review of Literature

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ABSTRACT

Introduction: The commonest cause of shoulder pain is rotator cuff pathology that will lead to so many problems such as weakness, shoulder instability and limitation of daily activities (work and sports). Symptomatic disease affects 4% to 32% of the rotator cuff tear population of patients. Surgical management is preferred in full thickness rotator cuff tear. In present days the arthroscopic repair management is spreading widely as a least invasive method. This procedure is increasingly used for the proper fixation and early starting of range of motion even in full thickness tear. The first one is the early or the accelerated rehabilitation.

Objective: Is to reduce the stiffness after the surgery whereas the other one is the traditional form of physiotherapy in which there is slow rehabilitation with more immobilization period after the surgery the main purpose of this is to protect the tendon integrity and provide information about which rehabilitation protocol is effective after massive rotator cuff tear.

Design: This is a comprehensive review, data was extracted from the search-based engines such as Google Scholar, PubMed, Web of Science, Scopus using the keywords.

Result: This has been concluded that early rehabilitation on massive rotator cuff tear has better effect when compared with delayed rehabilitation.

Keywords: Rotator Cuff Tear, Early Rehabilitation, Delayed Rehabilitation, Physiotherapy, Physical Rehabilitation, Partial Rotator Cuff Tear, Complete Rotator Cuff Tear

Introduction

The commonest cause of shoulder pain is rotator cuff pathology that will lead to so many problems such as weakness, shoulder instability and limitation of daily activities (work and sports). symptomatic disease affects 4% to 32% of the rotator cuff tear population of patients [1].

Age of the patient level of activity by patient or the patient performance the severity or the tear of the size and some personal habits such as smoking status influences the decision of managing the pathology usually the initial management is conservative management when this, management is unsuccessful then the surgical management is used for the improvement in patient function in more than 90% of patients [2].

Surgical management is preferred in full thickness rotator cuff tear. The main aim behind the surgical repair management after the rotator cuff repair is to maintain the disturbed anatomy by positioning the tendon to their insertion i.e., greater tuberosity. There has been a drastic change in surgical management of rotator cuff tear in the past decades. In the early 20th century open repair techniques were the main choice of treatment whereas later on time the mini open repair techniques show their advantage and became the alternative and less invasive gold standard method of treatment [3].

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In present days the arthroscopic repair management is spreading widely as a least invasive method. This procedure is increasingly used for the proper fixation and early starting of range of motion even in full thickness tear [3,4].

Now a days the standard method use for the repair of rotator cuff tears is arthroscopic management whereas mini open rotator cuff tear repair is still being use and according to researchers had a similar clinical result.

The choice of technique is the decision taken by the surgeons. After using the exact technique for the treatment of the tear physiotherapy play a very important role in the complete recovery of the patients. Postoperative rehabilitations technique can be different for different individuals and can vary from one patient to another patient outcome [5].

In the proper algorithm of rehabilitation two main purposed approaches are there after the full thickness rotator cuff repair surgery.

Functional Anatomy and Biomechanics

The rotator cuff had the tendons of subscapularis, supraspinatus, infraspinatus and teres minor muscles. The main purpose of the rotator cuff is to give dynamic stability to the joint while performing the movement. It also provides internal and external rotation at the shoulder joint and prevents the upward migration of the humeral head in the initial phase of the shoulder abduction [3,4].

It is very important to know the biology and the biomechanics of the injured as well as the repaired rotator cuff tendon for an effective rehabilitation protocol. According to the histological studies it has been seen that the healing of rotator cuff take place in three phases immediately after the surgical repair.: inflammatory phase (7 days), proliferative phase (2 to 3 weeks) and maturation or remodeling phase (12 to 26 weeks) [6].

For providing a safe and individualized rehabilitation programme is necessary to know and understand the duration and biology of healing [7].

During first week the inflammatory cells platelets and fibroblast comes to the repair site in tendon to bone fixation and then in the next 2-3 weeks the proliferation of these cells occurs. This cellular proliferation and deposition of cell is mediated by several growth factors11after the duration of three to four weeks of repair the remodeling of scar begins in which the tissue organizes themselves.in the initial stage the type 3 collagen turns into collagen type 1 till the formation of mature scar tissue [8,1]. This remodeling process reaches to its maximal tensile strength after 12-16 weeks post repair. Generally, it has been seen that we cannot create the normal tendon to bone transition as it was earlier. The repaired RC tendon heals to the greater tuberosity via fibrocartilage /scar tissue [5].

In the normal anatomy the insertion of the rotator cuff is in four different zones: tendon, unmineralized fibrocartilage, mineralized fibrocartilage and bone. But after the operative repair of the tendon, it heals with an interposed layer of fibrocartilage on to the bone. the mechanical properties are weaker than the earlier tissue and this kind of repair is very much prone to failure [3].

Methodology

Protocol

The primary research question that was studied is 'early or delayed which rehabilitation is better in treating massive rotator cuff tear' Various different databases were used to search relevant articles using different keywords. Articles were collected altogether to and selected on basis on eligibility criteria and removal of duplicates. The final sets of articles were selected after complete screening.

Search Strategy

Electronic data-based searches were performed under PubMed, Pedro and Google Scholar until March 2021.

A basic search strategy was used with the help of following keywords: early rehabilitation OR delayed rehabilitation OR rotator cuff tear OR massive rotator cuff tear OR conservative management OR early rehabilitation and rotator cuff tear OR delayed rehabilitation and rotator cuff tear.

Selection of Studies and Data Extraction

The studies were evaluated on the basis of their eligibility criteria. The inclusion criteria for choosing the study were (1) only English language articles (2) studies should be categorized under RCT's (3) subjects enrolled in the studies were irrespective of age and gender (4) treatment used in the studies should be early and delayed rehabilitation in the massive rotator cuff tear. Exclusion criteria were (1) unpublished articles (2) research abstract from a meeting proceeding, PhD thesis.

The first step was the identification of the articles through data-based search and references list. Abstract and titles which were full filling the eligibility criteria were selected for full text reading. Articles were screened on the basis of inclusion and exclusion criteria and articles which satisfied the eligibility criteria were selected.

Study Assessment

Before being submitted, data was analyzed by Zotero which is the corporation for digital scholarship project to remove the duplicates. Following those records were screened by separate researches (SS, IA) using the eligibility criteria applied.

Factors effecting rehabilitation in full thickness rotator cuff tear

Patients' demographic

All the demographic details of patients are listed in table 1. All the studies include comparison in early vs delayed mobilization only two studies are included in which there is comparison of continuous passive motion and manual therapy along with delayed and early mobilization

Table 1: Level of Evidence of the included studies

Study	Level of evidence	Study type	Patient enrolled	Pt. at final follow up	Pt. at mean follow up	Average age	Men	women	tear
DerekJ. cuff et al.,	1	Early vs. delayed physiotherapy	68	68	68	63.2	38	30	Full thickness supraspinatus tear
Lee et al.,	2	Aggressive vs. limited early passive rehabilitation	85	64	25	55	41	23	Full thickness RCT
Duzgun et al.,	1	Slow vs. accelerated rehabilitation	29	29	6	56	3	26	Full thickness RCT
Keener et al.,	1	Early vs. late mobilization	145	114	24	55	73a	51a	Full thickness tear of rotator cuff
Duzgun et al.,		Slow vs accelerated rehabilitation	42	40		57	6	34	Full thickness RCT
Sheps et al.,		Early and slow mobilization	189	165		55.1	115	74	Full thickness RCT
Sheps et al.,	1	Early motion vs. immobilization	211	206		55	65%		Full thicknessRCT
Kim et al.,	1	Early vs late mobilization	117	105	12	60	44	61	Full thickness RCT
Gorafalo et al.,	1	CPM vs manual therapy	100	100	12	60	47	53	Full thickness RCT
Mazzocca et al.,	2	Early vs delayed motion	73	58		54	18	40	Full thickness tear of supraspinatus
Koh et al.,	1	Early and late mobilisation	100	88		59.9	44	44	Full thickness postero superior tear

a=Reflects patients who underwent surgery; RCT=rotator cuff tear

Rotator Cuff Tear Classification

Full thickness rotator cuff tear patients are only included in this review. Patient having partial or incomplete tear of rotator cuff are being excluded from the review. (Table 1)

Surgical Technique and Concomitant Procedure

All studies included in this review had arthroscopic rotator cuff repair whereas the exact method may vary according to the patients factor and surgeon choice. (Table 2)

Table 2: Surgical Technique used in Included Studies

Study	Arthroscopic technique	Concomitant procedure	Re tear rate (%)	Modality used to determine re tear
DerekJ. cuff et al.,	Transosseous equivalent suture bridge (100%)	Subacromial decompression (100%)	12	ultrasound
Lee et al.,	Single-row fixation (100%); 1 or 2 anchors (64%), 3 or 4 anchors (36%)	Subacromial decompression (100%)	16	Magnetic resonance imaging
DUZGUN et al.,	1 anchor (76%), 2 anchors (24%); Side-to-side technique: 1 (38%), 2 (14%), 3 (3%)	NR	NR	NR

Keener et al.,	Modified doublerow transosseus technique (100% acromioplasty (100%)	Subacromial decompression (100%)	16	Ultrasound
Duzgun et al.,	1 anchor (76%), 2 anchors (24%); Side-to-side technique: 1 (38%), 2 (14%), 3 (3%)	NR	NR	NR
Sheps et al.,	Mini open rotator cuff repair	NR	NR	NR
Sheps et al.,	Single row (11%), double row transosseous equivalent or transosseous approaches (92%)	Subacromial bursectomy and acromioplasty	NR	NR
Kim et al.,	Single-row fixation (16%), double-row fixation (2%), suture bridge (82%)	Subacromial decompression (100%), acromioplasty (100%)	NR	NR
Gorafalo et al.,	Double-loaded titanium suture anchor (100%)	NR	NR	NR
Mozzocca et al.,	Transosseous equivalent technique with peek anchors	NR		MRI
Koh et al.,	Single row rotator cuff repair with double suture	NR	14.3%*	MRI

AC joint, acromioclavicular joint; NR, not reported, *full re tear percentage

Rehabilitation Protocol

Table 3: Rehabilitation programme that is being used in the included studies.

	Early group	Late group
Derek J. cuff et al.,	3 physical therapy sessions per week starting on postoperative day 2 (stressing pendulum exercise and graduated passive ROM) for 6 weeks	Sling immobilization for 6 weeks postoperatively, but pendulum exercises (3 times daily for 5 min/ session) during this time period
	Active assisted ROM at weeks 6-10 Active ROM to tolerance at weeks 10-12 Rotator cuff muscle strengthening at week 12	Passive ROM at week 6; then started same protocol that "Early Group" started at week 6
Lee et al.,	Starting on day of surgery, pendulum and progressive passive ROM ×6 weeks	Starting on day of surgery, CPM machine with stretching limited to 90° ×3 weeks Progressive increases in passive ROM for next 3 weeks
Duzgun et al.,	In both groups, active ROM started at 6 weeks postoperatively	
	Reached final stage (active ROM against resistance and rotator cuff muscle strengthening) at week 7	Reached final stage at week 18
Keener et al.,	Initial 6 weeks of passive ROM, progressive active ROM in subsequent 6 weeks, and rotator cuff strengthening 3-4 months postoperatively	
	Protocol started at first postoperative visit (10-14 days)	Protocol started 6 weeks Postoperatively
Duzgun et al.,	Start from 2nd postoperative week Soft tissue mobilization for St and GH joint, active rom in scapular plane at 3rd week	Soft tissue mobilization for St and GH joint at 4th week, active rom in scapular plane at 3rd week, light resistance exs. at 8 week
Sheps et al.,	sling for 6 week (no active shoulder rom	Sling as needed; pain free active rom for ADL
Sheps et al.,	sling for 6 week (no active shoulder rom	Sling as needed; pain free active rom for ADL
Kim et al.,	Passive shoulder ROM initiated on postoperative day 1	Shoulders immobilized for 4 or 5 weeks postoperatively (based on tear size)
	At 4-5 weeks postoperatively, identical progressive increases in active ROM and rotator cuff muscle, strengthening at 9-12 weeks postoperatively	
Gorafalo et al.,	Shoulders immobilized 4 weeks in both groups	
	Progressive pendulum and passive ROM exercises for the next 4 weeks	CPM regimen in addition to progressive pendulum and passive ROM exercises for the next 4 weeks
	Starting at 8 weeks postoperatively, both groups stress identical increases in passive and active ROM	
Mozzocca et al.,	Sling for 6 weeks except during elf care activities during performance of home exercise and during formal physical therapy	

	Exercises started at post-operative day 2	Rom exercises at post-operative day 28
Koh et al.,	Immobilization for 4 weeks	Immobilization for 8 weeks
	During immobilization period no passive as well as active ROM exercise is involved not even pendulum exs.	

Functional Scores

Table 4: Functional score of the included studies

study	Mean follow up	Constant score		ASES Score		VAS pain score at rest	
		early	Late	early	late	early	late
DerekJ. cuff et al.,	12	NR	NR	91.1	92.8	NR	NR
Duzgun et al.,	6	NR	NR	NR	NR	-------a	-------a
Keener et al.,	24	83.2 ± 11.5	84.3 ± 10.8	91.0 ± 15.3	93.3 ± 10.6	0.9 ± 1.7	0.6 ± 1.1
Duzgun et al.,	NR	NR	NR	NR	NR	NR	NR
Sheps et al.,	……a	……a	…….a	……..a	…….a	……..a	……a
Sheps et al.,	NR	NR	NR	NR	NR	NR	NR
Kim et al.,	12	69.81	69.83	73.29	82.90	2.8	1.8
Mazzocca et al.,		82 ± 15	75±19	90±15	84 ± 19	7 ± 15	9±15
Koh et al.,		85.6±15.6	88.7±9.7	88.9 ± 16.2	92.1 ± 10.2	1.3±1.8	0.8 ± 1.0

--------a= no numeric data available. Data available in graph format or in words

All studies include early versus late mobilization reported functional outcome scores (Table 4). Only 2 studies include CPM versus manual therapy reported functional scores (Table 5).

Table 5: Functional score of the included studies

Study	Mean follow up	UCLA score		VAS pain score at rest	
		CPM	Manual	CPM	Manual
Garofalo et al	12	NR	NR	0.2 ± 0.1	0.2 ± 0.2
Lee et al	12	31.8	32.3	0.15	0.23

CPM, continuous passive mobilization; NR, not reported; UCLA, University of California Los Angeles; VAS, visual analog scale.

Pain

Pain data are summarized in Tables 4 and 5 for early versus late mobilization and CPM versus manual therapy, respectively.

Range of Motion

Range of motion data are summarized in Tables 6 and 7 for early versus late mobilization and CPM versus manual therapy, respectively.

Table 6: ROM of patients included in the studies

Study	Mean follow up	Forward flexion		External rotation		External rotation with abduction to 90		Internal rotation	
		early	late	early	late	early	Late	early	late
DerekJ. cuff et al.,	12	174	NR	46	45	NR	NR	94	91
Duzgun et al.,	6	NR	NR	NR	NR	NR	NR	NR	NR
Keener et al.,	24	164 ± 13.4	163 ± 15.8	62.0 ± 16.4	66.2 ± 14.0	90.0 ± 10.3	87.7 ± 11.9	NR	NR
Duzgun et al.,		175.6±1.8	174.2±1.6	86.3 ±2.4	84.1±2.2	NR	NR	88.2±2.1	86.5±1.9
Sheps et al.,		149.9±12.4	149.6±17.8	NR	NR	34.9±9.7	35.7±10.2	NR	NR
Sheps et al.,		155.5±12.7	152.2±18.5	NR	NR	76.0±14.8	71.5±17.8	NR	NR
Kim et al.,	12	159.75	153.67	78.50	81.33	NR	NR	T10.0	T9.9
Mazzocca et al.,		NR	NR	58±17	61±18	NR	NR	NR	NR
Koh et al.,		NR	NR	33.1	29.5	NR	NR	NR	NR

NR=not reported

Table 7: ROM of the patients included studies

Study	Mean follow up	Forward flexion		External rotation		ER at 90 of abduction 90° of Abduction		abduction	
		CPM	manual	CPM	manual	CPM	manual	CPM	manual
Gorafalo et al.,	12	174	NR	46	45	NR	NR	94	91
Lee et al.,	12	164 ± 13.4	163 ± 15.8	62.0 ± 16.4	66.2 ± 14.0	90.0 ± 10.3	87.7 ± 11.9	NR	NR

Tendon Re tear Rate

For studies comparing early and late mobilization, 2 studies used ultrasound and 3 study used arthro–computed tomography to evaluate tendon re tear rates. All 5 studies found a higher tendon re tear rate in the early mobilization group relative to the late mobilization group, but none of the differences were statistically significant (Table 8)

Lee using magnetic resonance imaging, found a statistically no significant higher tendon re tear rate in the Manual therapy group relative to the CPM group at final 24-month follow-up (Table 8)

Table 8: Re-tear Rate incidence of the included studies.

Study	Mean follow up	Early	Late	P value
DerekJ. cuff et al.,	68	15	9	0.47
Lee et al.,	25	8.8%a	23.2%b	0.106
Duzgun et al.,	6	NR	NR	NR
Keener et al.,	24	10	6	0.46
Duzgun et al.,		NR	NR	NR
Sheps et al.,		NR	NR	NR
Sheps et al.,		NR	NR	NR
Kim et al.,	12	NR	NR	NR
Gorafalo et al.,	12	NR	NR	NR
Mazzocca et al.,		11	9	
Koh et al.,		5	4	0.726

a=CPM; b=manual therapy

Discussion

This study compares the early mobilization in patients receiving rotator cuff repair with those received delayed mobilization protocol on pain, range of motion, functional score and chance of re-tear.

Range of Motion

Maintaining or regaining glenohumeral range of motion while creating the perfect environment for the repaired tendon to heal is the aim of rehabilitation. Compared to patients who are immobilized for at least six weeks after rotator cuff surgery, early mobilization does offer the benefit of enhanced range of motion, as explained and demonstrated by the evidence above. Pendulous shoulder mobility and subsequent problems like fibrosis and capsular contracture are avoided by early passive mobilization. Research has also indicated that patients who are moved earlier after surgery recover at faster rates [9]. These findings are supported by above mentioned studies that demonstrated early motion protocols prevent postoperative shoulder stiffness in patients after rotator cuff repair. Another rationale could be that early motion promotes the circulation of blood and lymph which decreases the future risk for adhesion formation [10].

Functional scores

CS and ASES were used in the above-mentioned studies which shows a better outcome result for patients who received early mobilization when compared to delayed mobilization. Similarly, Chen at al shows ASES has significant improvement with a possible reason for better quality of the healing tendon. Primarily above-mentioned studies used two functional score scale that i.e., CS and ASES whereas other studies used manual techniques to criticize functional score. Both the techniques are reliable and show results as per the improvement despite the size of the muscle tear and time of mobilization [6].

According to Cronin for patients who had shoulder arthroplasty, the University of California at Los Angeles (UCLA) score was the most responsive, followed by the Adjusted CMS. Consequently, because there were more reported data, CMS and SST were chosen for additional examination. The benefits of CMS include larger weighting of ROM that may be used to assign postoperative evaluation for rotator cuff repair and established population normative value that is useful in subsequent score interpretation. However, inconsistent patient assessments and objective shoulder measurements may result in lower CMS reliability, which could account for our finding that EAM enhanced ROM but had no effect on CMS.

Pain

Regarding pain, the above literature generally shows no significant difference between early and late rehabilitation in terms of pain when measured by VAS pain scores. Only 1 study found a lower VAS pain score in the early mobilization group at initial weeks of follow-up, but not at final 6-month follow-up. Therefore, this is one of the prime limitations and required more studies to focus on pain also.

CPM V/S Manual Therapy

The limitation of studies comparing CPM versus manual therapy made it difficult to understand any meaningful conclusion regarding the efficacy of CPM. The literature shows significant results in terms of functional scores, during early 3-month follow-up only, whereas, for the manual therapy group relative to the CPM group. However, patients undergoing CPM had lower pain levels at early 2.5-month follow-up only. When re-tear was assessed using imaging techniques manual therapy shows negative significance when compared with CPM [5].

Re-tear Rate and Integrity

In our study, CT, MRI and Ultrasound was used to investigate the re-tear integrity after surgery, the percentage of RCR was 15% at 3 months follow-up, 21% at 3–6 months follow-up, 16% at

6–12 months follow up, 21% at 12–24 months follow-up, 16% at follow-up longer than 24 months. These findings would suggest more frequent time points for diagnostic imaging between 3 and 6 months and 12–24 months after RC surgery.

Possible reasons could be the biomechanics of the repaired tendons and patient-related factors such as smoking, diabetes, osteoporosis, hyperlipidemia. During the recovery phase following surgery, patients could encounter pain and restricted functionality. Widespread discussions around the best rehabilitation programme in this regard, with the goal of minimizing the chance of healing failure and ensuring a successful return to normal activities.

We propose that early motion be advised for smaller tears and delayed motion for larger ones, in light of our observation that bigger RC tears may heal at a slower rate. As previously mentioned, the healing of tendons is closely linked to factors such as age, extent of tears, atrophy, and fatty degeneration of the muscles that surgeons cannot fully control due to the patients' biological characteristics [11].

Limitation and Future Scope

The majority of the studies were considered of high or unclear overall risk of bias and their definition of early and delayed rehabilitation were not consistent.

Studies related to Pain were limited.

For future scope, studies should use imaging techniques during the mid-treatment session to check prevalence of re-tear.

Conflict of Interest

I affirm that I have no financial affiliation or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript.

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Key points

- Both early and delayed rehabilitation have significant effect on pain, range of motion and functional score in long duration.
- Both have no difference in outcome for long duration whereas in early rehabilitation, ROM has improved in only short duration.

Implications

The study will help in selecting a better rehabilitation programme after massive rotator cuff tear. This literature review is not implacable to all population and to all age group further scope for research is still there in this aspect.

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