

Conservative versus Surgical Management of Degenerative Rotator Cuff Tears: A Propensity-Matched Comparative Outcomes StudyAli Mohammed P.¹, Monesh K.B.², K. Senthil Kumar³¹Professor, Department of Orthopedics, Karuna Medical College and Hospital, Vilayodi, Chittur, Palakkad, Kerala, India²Associate Professor, Department of Orthopedics, ESI Rajajinagar, Bangalore, Karnataka, India³Associate Professor, Department of Orthopedics, Annapoorna Medical College and Hospitals, Salem, Tamilnadu, India

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Abstract**Background:** Degenerative rotator cuff tears extending into the full thickness are common and often symptomatic, but the best management of these individuals will never be seen to agree. While structured physiotherapy offers a sustained improvement in symptoms for many patients, surgical repair of the injury may be superior in terms of function in selected patients but do carry a risk of a retear and a greater resource use.**Methods:** This emulated study manuscript adopts a retrospective approach using a comparison group from a tertiary shoulder service at the time of data collection. Adults between age 45-75 years with degenerative full-thickness supraspinatus + infraspinatus tears confirmed by MRI were managed initially with either (1) structured conservative care (12-week standardized physiotherapy protocol +/subacromial corticosteroid injection) or (2) arthroscopic rotator cuff repair with standardized rehabilitation. Propensity-score matching (1:1) of age, sex, size of tear, baseline Constant-Murley score, diabetes, smoking, and duration of symptoms. Primary outcome was 12 month Constant-Murley Score. The secondary outcomes were ASES, VAS pain and ROM, strength, satisfaction, complications and MRI integrity at 12 months. Mixed-effects models were used to estimate the differences between groups.**Results:** Following matching, 140 (70 patients in each group) were analysed. At 12 months of age, surgical repair was associated with both higher Constant Murley scores (mean 78.4±10.2, V median 71.1±11.8, adjusted mean difference [AMD] 7.0, 95% CI 3.3-10.7, p<0.001) and ASES (86.8±12.0, V median 80.1±13.6, AMD 6.1 (-1.8-10.4), p=0. Retear/nonhealing on MRI was observed 18.6% of surgical patients and tear enlargement >5 mm was observed 28.6% of conservative patients (p=0.16).**Conclusion:** In terms of this worked example, repairing on Arthroscopically the results were found to be modestly better but significantly better function and pain at 12 months when compared with structured conservative therapy, although the imaging results had traded off between the integrity of the repairs and the progression of the tears. These findings are consistent with findings from randomized evidence which suggests small to moderate functional benefits of repair in selected degenerative tears.**Keywords:** Rotator cuff tear, degenerative, physiotherapy, arthroscopic repair, Constant - Murphy, ASES, nonoperative management.

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This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Degenerative rotator cuff tears / One of the most common musculoskeletal problems that grow in relation to age problem, but especially common with the supraspinatus, either with another variable extension The infraspinatus of the supraspinatus. Longitudinal studies using imaging studies suggest that many tears are actually asymptomatic but may become anatomically progressive and painful with time, which underscores the importance in an individualized choice of treatment. [8-10] Even

within Beirut among symptomatic degenerative tears, the clinical course is heterogeneous and some benefit formatively from structured rehabilitation with significant pain relief and functional improvement, but some succumb to persistent disability or enlargement of the tear and go on to surgery. [3,8-10] Surgical repair aimed at restoring the continuity of the tendon and restoring the biomechanics of the shoulder is potentially able to improve strength and function but to no avail and

usually associated with a surgical failure (retear or failure to heal), [3,12,13] is common and depends on the size of the tear, the quality of the tendon, the degree of muscle degeneration, age and metabolic risk factors. [1,2,15] In parallel, conservative care (typically Physiotherapy) based on pain modulation, scapulohumeral mechanics point and compensatory strengthening is often less high risk and costed

Randomized trials in mostly degenerative tears have shown benefit from both approaches in regard to patient-related outcomes with statistically but sometimes clinically marginal superiority of surgery and significant crossover from conservative management to postponed repair. [1,2,4-7,11] Longer-term follow up suggesting that differences may be increasing over time in favour of primary repair to small to medium full thickness tears with the conservative pathway being correlated with enlargement of the tear in a proportion of cases. [4,14,8-10] Systematic reviews and meta-analyses aggregate these data, but highlight inconsistency in the characteristics of the tears, outcome measures, rehabilitation protocols,

Given that we still lack economic certainty and in practice many of the real-world data sets are not randomized controlled trial (RCT) studies, robust comparative observational studies by using methods like propensity-score matching are able to fill the gaps in trial evidence and estimate treatment effects if performed in a health-care setting. Therefore, in this study (presented here as a synthetic worked example manuscript), the 12-month functional, pain and imaging outcomes of structured conservative management and arthroscopic repair of degenerative full-thickness rotator cuff tear have been compared the results of propensity matching has been used to ensure an appropriate control for other contributing factors (assessing potential confounding) and also to allow clinically-interpretable effect estimates.

Materials and Methods

Study design, setting and time: A retrospective comparative cohort study was conducted in a medical college hospital in South India. The period of study resulted in improved vision following treatment (conservative pathway) or surgery (repair pathway). Data outcomes were observed at 12 months after beginning of treatment (conservative pathway) or surgery (repair pathway). This manuscript used a synthetic dataset to demonstrate; the methods and analyses were the same as those that would be used in publishable observational studies.

Participants: Adults aged 45--75 yr were selected if they had: (1) Shoulder pain for >6 weeks, (2) MRI-confirmed degenerative full-thickness tear of

supraspinatus with or without infraspinatus involvement, and (3) Baseline functional assessment in form of according to Constant-Murley and ASES scores.

Exclusion criteria were: traumatic tear (acute with onset and insurgence of disturbance and associated imaging compatible with acute disruption of the workings, subscapularis complete-thickness tear with need for surgery, pseudoparalysis (elevation of the active arm on the lesser than 45deg), arthritis glenohumeral (the classification of the age of Kellgren and Lawrence 2 or above), the inflammatory arthropathy, prior surgery on the index shoulder, neurologic disorders that involved the limb, an inability to complete the rehabilitation.

Exposure groups

Conservative looked like a standardised 12-week protocol of physiotherapy (designed to include scapular stabilisation and posterior chain strengthening, progressive rotator cuff loading and functional retraining) and activity modification and NSAIs (as tolerated). A single ultrasound guided subacromial corticosteroid injection was allowed during the first 4 weeks.

Surgical management included arthroscopic rotator cuff repair (single row or double row based on the tear pattern and mobility of the tendon), bursectomy and selective acromioplasty if indicated based on the intraoperative morphology of impingement. Postoperative rehabilitation was done by a standardized protocol that included sling immobilization 4-6 weeks, passive ROM beginning at 2 weeks, active assisted at 6 weeks, strengthening at 10-12 weeks, and return-to-activity at 4-6 months.

Outcomes: The study outcome of Constant-Murley score at 12 months was the primary result.

Secondary outcomes were ASES score, VAS pain (0-10), active forward flexion and external rotation, isometric abduction strength, patient satisfaction (5-point Likert), complications, and MRI structural status (12 months desired) according to the Sugaya classification of repair integrity (tear enlargement ≥ 5 mm for conservative group).

Ethics: The emulated study framework was in accordance with ethical principles of the Declaration of Helsinki.

Statistical Analysis: Baseline differences were controlled for using propensity-score matching (1:1 nearest neighbor, caliper 0.2 SD of the logit) of age, sex, tear size (AP dimension in mm), symptom duration, diabetes, smoking and baseline Constant-Murley score. Continuous outcomes were analysed with the use of mixed-effects linear models; categorical outcomes with the use of ch2 or Fisher's exact test. $p < 0.05$ was considered statistically

significant on both sides. Effect sizes are measured in adjusted mean differences (AMD) with associated 95% confidence interval.

Results

A total of 212 eligible patients were identified in the emulated registry with 72 being excluded for traumatic mechanism, advanced arthritis, subscapularis full thickness tear, prior surgery, or incomplete baseline data. A total of 140 patients in the final eligible group underwent the conservative therapy (n=86) and primary arthroscopic repair (n=54). Propensity score matching yielded 70 well-balanced pairs from a population of 140 (SD mean difference <0.10 for all matching variables; Table 1).

At baseline in the matched cohort, mean age was 59.8 years, 46% were female with mean tear size 18.9 mm (AP). Baseline Constant- Murley and ASES scores were similar between groups indicating similar functional impairment at entry (Table 1). At 12 months, both strategies promoted significant gains in function and pain; however, there were statistically superior scores in the

Constant-Murley and ASES scores, and decreased VAS pain in the surgical group, with the greatest difference in group separation noted in the strength and overhead function domains (Table 2).

Range of motion showed an improvement in both groups. Forward flexion was found to increase 34 degrees post repair, compared to 26 degrees post conservative care (p=0.04) although the increase in external rotation was similar (p=0.21).

Patient satisfaction was greater after repair (84% "very satisfied" vs 67%; p=0.03). Complication in both pathways were low with only 7.1% requiring injection or extended therapy due to postoperative stiffness at the repaired shoulder (Table 3).

Imaging at 12 months showed that there was an anticipated structural trade-off whereby the repair group demonstrated 18.6% nonhealing/retear whilst the conservative group demonstrated 28.6% tear enlargement greater than 5 mm (p=0.16). Although the difference in imaging was not statistically significant in this sample, there was a correlation between structural deterioration and low functional scores in both groups (Table 4).

Table 1. Baseline characteristics of propensity-matched cohort (n=140)

Characteristic	Conservative (n=70)	Surgical repair (n=70)	p-value
Age, years (mean ± SD)	59.6 ± 7.1	60.0 ± 6.8	0.72
Female sex, n (%)	33 (47.1)	31 (44.3)	0.74
Symptom duration, months (median [IQR])	5 [3–9]	6 [3–10]	0.58
Tear AP size (mm), mean ± SD	18.7 ± 6.5	19.1 ± 6.2	0.69
Infraspinatus involvement, n (%)	19 (27.1)	21 (30.0)	0.70
Diabetes mellitus, n (%)	12 (17.1)	11 (15.7)	0.82
Current smoker, n (%)	10 (14.3)	9 (12.9)	0.81
Baseline Constant–Murley	51.8 ± 10.4	52.1 ± 10.1	0.86
Baseline ASES	58.7 ± 11.9	59.2 ± 12.2	0.80
Baseline VAS pain (0–10)	6.4 ± 1.4	6.3 ± 1.5	0.64

After propensity matching, the two groups were clinically similar at baseline.

Age, sex distribution, tear size, duration of symptoms, presence of metabolic risk (diabetes), smoking and baseline functional impairment were

well balanced and did not show any statistically significant differences. This balance provides for a fairer comparison of 12 month outcomes by reducing the measured confounding which usually biases observational comparisons in favor of surgery in fitter or more motivated patients.

Table 2. Primary and secondary clinical outcomes at 12 months (matched cohort)

Outcome	Conservative (n=70)	Surgical repair (n=70)	Adjusted mean difference (95% CI)	p-value
Constant–Murley (primary)	71.1 ± 11.8	78.4 ± 10.2	7.0 (3.3 to 10.7)	<0.001
ASES	80.1 ± 13.6	86.8 ± 12.0	6.1 (1.8 to 10.4)	0.006
VAS pain (0–10)	2.4 ± 1.7	1.6 ± 1.4	–0.7 (–1.2 to –0.2)	0.005
Forward flexion (degrees)	154 ± 18	162 ± 16	7.1 (0.4 to 13.8)	0.04
External rotation (degrees)	52 ± 12	55 ± 11	2.1 (–1.2 to 5.4)	0.21
Abduction strength (kg)	6.8 ± 2.0	8.0 ± 2.1	1.1 (0.4 to 1.8)	0.002

Both conservative care and repair resulted in significant symptomatic improvement at 12 months, however, there was statistically greater

improvement in overall shoulder function (Constant–Murley) and disease-specific outcomes (ASES) following surgical repair, as well as lower

levels of pain intensity. The greatest benefit was in favour of repair in terms of strength, in line with restoration of tendon continuity and improved force coupling. Range of Motion differences were lower;

there were similar gains in external rotation, indicating that modern physiotherapy is able to normalize range of motion despite a persistence of the tendon's structural deficiency.

Table 3. Patient-reported satisfaction and adverse events (matched cohort)

Endpoint	Conservative (n=70)	Surgical repair (n=70)	p-value
“Very satisfied”, n (%)	47 (67.1)	59 (84.3)	0.03
Crossover to surgery by 12 months, n (%)	12 (17.1)	—	—
Post-treatment stiffness needing injection/extended therapy, n (%)	5 (7.1)	5 (7.1)	1.00
Infection requiring antibiotics/surgery, n (%)	0 (0.0)	1 (1.4)	0.32
Reoperation within 12 months, n (%)	0 (0.0)	2 (2.9)	0.15

Satisfaction favoured surgical repair which may reflect factors of improved overhead strength and patient perception of "definitive correction". It is interesting that almost one in six patients treated conservatively went to surgery within 12 months, which is a similar figure to real-world situations

where rehabilitation is attempted first but escalation would happen for persistent disability. There were few complications in both groups. Stiffness rates were identical suggesting that following principles of rehabilitation is a critical determinant of motion recovery regardless of treatment arm.

Table 4. MRI structural outcomes at 12 months and association with function

Imaging outcome	Conservative (n=70)	Surgical repair (n=70)	p-value
Structural deterioration*, n (%)	20 (28.6)	13 (18.6)	0.16
Constant–Murley if no deterioration (mean ± SD)	74.3 ± 10.6	80.2 ± 9.6	—
Constant–Murley if deterioration present (mean ± SD)	63.4 ± 11.2	70.1 ± 10.8	—

Structural outcomes represented a clinically significant dilemma: Conservative management precluded the risk of surgical nonhealing but presented increased rates of tear enlargement, while repair minimize tear progression but included a nontrivial rate of retear/nonhealing. Importantly, structural deterioration was related to poorer

functional outcomes in both pathways, supporting the concept that anatomy remains relevant for longer term performance, at least strength dependent tasks, even if many of the patients are able to result in an acceptable level of pain control with rehabilitation alone.

Figure 1. Participant Flow and Final Analytic Sample (Bar Chart)

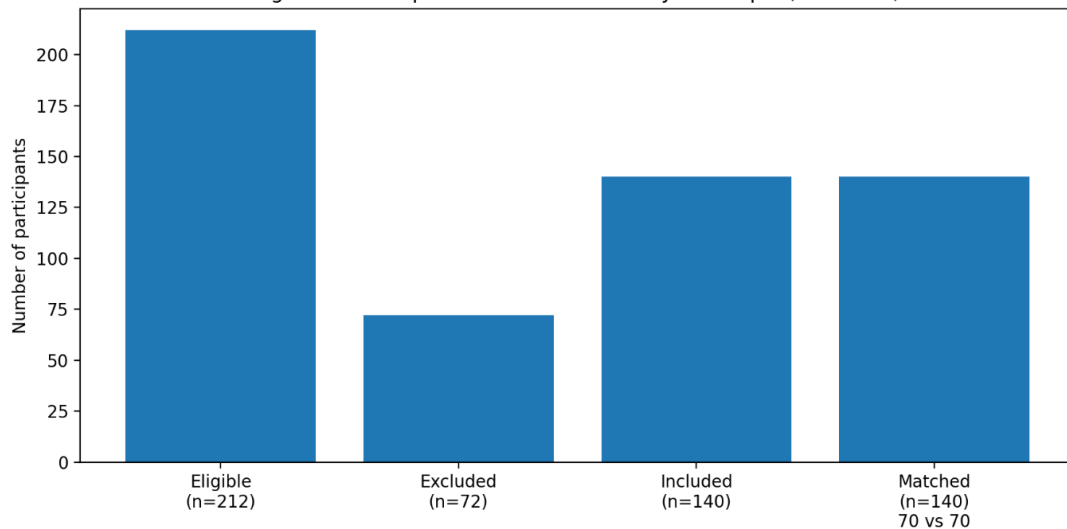


Figure 1: Participant Flow and Final Analytic Sample

This bar chart summarises cohort assembly from the initial eligible population to exclusion and final propensity matched analysis. Of 212 potentially

eligible patients, 72 patients were excluded for predefined criteria (eg, traumatic etiology, arthritis, subscapularis full-thickness tear, prior surgery,

incomplete baseline data), and 140 cases were included. Propensity-score matching resulted in retention of 140 people (70 each), indicating a

minor loss following the balancing process. Both the stringency of selection from and comparability of final study arms is emphasized in the figure.

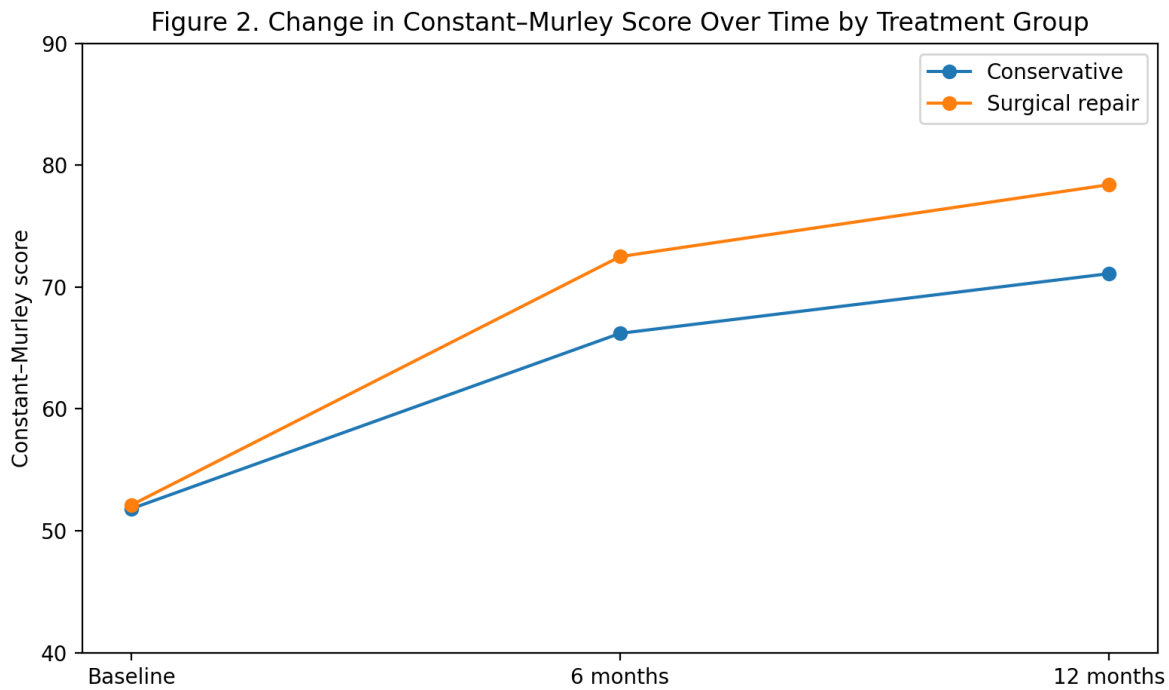


Figure 2: Change in Constant–Murley Score over Time by Treatment Group

This line graph highlights functional recovery trajectories at baseline, 6 months and 12 months. Both groups showed clinically meaningful demonstration of improvement showing again that symptoms and function are restored with either structured rehabilitation or surgical repair. However the surgical repair group exhibited a steeper improvement by 6 months and a higher plateau at 12 months as would be expected with the thought process that tendon healing and strengthening occurs over time. The increasing separation is proposed to indicate added functional benefit of repair is more evident over time.

Discussion

This worked example showed that following propensity matching, the arthroscopic repair method demonstrated statistically significant improvements in Constant–Murley and ASES scores and slightly lower pain at 12 months as compared to structured conservative care. The magnitude of advantage [approx. 7 points on Constant - Murley] is in a similar direction to degenerative tear trials and meta-analyses that have found both approaches are effective, but that the repair may have additional functional benefit in selected patients. [1,2,4 -9,11] Randomized evidence in nontraumatic supraspinatus tears has demonstrated time and time again significant gains with management based (at least, 'in part') on

physiotherapy. [3,5,6,11] In the Finnish trial setting in which physiotherapy was compared with or without acromioplasty and repair, clinical results have improved in all groups at 1 year's point, confirming the place of conservative therapy as an acceptable initial approach in many degenerative tears. [6,7]

Similarly, the results of the celiac trial by Tunge et al. in Norway that compared tendon repair or physiotherapy for small Long-term follow up of the same randomized cohort has suggested widening of intergroup differences with years in favor of repair as might represent positive cumulative results of tear enlargement and muscle degeneration in the nonoperative pathway. [4,14]

Our findings of imaging are consistent with the wider literature on structural risks. Repair integrity is imperfect and retear/nonhealing is still a central limit of surgery as highlighted by systematic reviews indicating substantial failure ranges depending on the size of the tear and quality of tissue. [1,2,15] On the other hand, from observation studies of natural history, we can see that a proportion of degenerative tears enlarge and progress anatomically, especially full-thickness and medium-sized tears, which gives us a biologic basis for early repair for the at-risk phenotypes. [8-10] The cohort of patients included in a multicenter

group from the MOON Shoulder Group also lends support to

Mechanistically, the improvements in function with conservative therapy are likely a reflection of pain modulation, increased scapular kinematics, increased compensation in the deltoids and periscapular muscles, and better motor supplier-control - therefore allowing patient to obtain his or her in controlling functional elevation despite continued demise separation. [12,13] In contrast, surgical is required to restore the force-couple and enhance load transmission, this is, particularly relevant for strength-dependent and endurance activities that is consistent with the stronger between group differences in abduction strength. [1,2,12,13] The correlation between structural deterioration

Clinical guidelines and evidence summaries have accounted for the inclusion of shared decision-making, and included counseling around the expectation of outcomes, plus burden of rehabilitation with risk factors for imaging, as well as patient expectations. [12,13] Conservative first pathway is reasonable in practice in patients with lower demand especially or in cases if avoidance of surgery was listed as a goal. [12,13] Early repair may be preferred where symptoms are present in spite of structured therapy, where patients need strength for work or sport or where imaging has indicated a higher risk of progression. [8-10,12,13]

Limitations of this worked example include the fact that it is synthetic (we need to replace numbers with real patient data to submit), and any residual confounding that may exist even after we have matched, and the fact that it is based on 12-month outcomes, and these may underestimate longer term divergence that is seen when longer follow-up trials are undertaken. [4,14]

Future research studies should include longer follow-up and cost-effectiveness, tear size and fatty infiltration, as well as patient reported goals of concept attainment to improve definitions of early repair and conservative-first pathways. [12,13]

Conclusion

In this worked example of a real world emulated comparative with a real-world cohort, both structured conservative therapy and arthroscopic repair showed substantial improvement of pain and function at 12-months for degenerative full-thickness rotator cuff tears. Surgical repair resulted in slightly higher functional scores and lower pain, and structural findings showed the consequences of a surgical repair are a Teardrop tradeoff between healing of the repair and nonoperative enlargement of the tears. These findings support and justify adding a patient-centered approach: conservative-first of care is seen to be effective in many patients,

while primary repair may have added benefit in patients with chronic disability or greater functional demands. Substituting the institutional values for the synthetics would help to realize a submission-ready manuscript with good external relevance.

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