

Obere Extremität 2021 · 16:298–301
<https://doi.org/10.1007/s11678-021-00663-8>
Received: 4 March 2021
Accepted: 30 April 2021
Published online: 29 September 2021
© The Author(s) 2021



Barbara Wirth¹ · Leonie Weinhold² · Ralf Müller-Rath³

¹ Department for Shoulder and Elbow Surgery, Gelenkzentrum Zürich, Zürich, Switzerland

² Institut für Medizinische Biometrie und Epidemiologie (IMBIE), University Hospital Bonn, Bonn, Germany

³ Orthopädische Praxisklinik Neuss, Neuss, Germany

Surgical reconstruction of small and medium rotator cuff tears shows superior long-term results

Introduction

One of the most frequent reasons for visiting a shoulder specialist is a rotator cuff lesion [18]. A rotator cuff tear can be caused by trauma or occur due to intrinsic [5, 6] and extrinsic [23] factors with increasing age [26]. Traumatic tears tend to be larger than non-traumatic lesions [12]. Partial-thickness tears can progress into full-thickness lesions, whilst large full-thickness tears, especially if involving two or more tendons, tend to increase in size and can become irreparable over time [8, 10, 16, 28].

If a degenerative rotator cuff lesion becomes symptomatic, conservative treatment with anti-inflammatory medication, steroid injections and physical therapy is often recommended as first-line treatment [9, 11]. However, non-operative management fails to restore the structural tissue damage since rotator cuff tears show no tendency toward spontaneous healing [28]. In contrast, surgical rotator cuff repair offers the possibility of tendon-to-bone healing. Healing rates following rotator cuff repair are subject to wide variation. Differences in structural healing are observed to be associated with tear size, degree of fatty infiltration, and patient age [3, 7, 17, 25]. In many clinical studies, rotator cuff reconstruction has been proven to restore function, reduce pain, and retard muscular deterioration such as atrophy and fatty degeneration [4]. But do these structural advantages of surgical tissue repair really lead to better clinical results than those achieved by conservative

treatment? From the patient's point of view: Is surgical rotator cuff repair worth the effort? These questions are discussed with animation in the medical literature. Patients' demands as well as the growing socioeconomic impact of health care warrant judicious decision-making by health care providers especially with respect to surgical indications.

Randomized controlled trials (RCTs) should be the main source of evidence to answer these questions. Moreover, such trials should look for long-term follow up periods, since stable clinical results after repair of degenerative musculoskeletal tissue will not occur within the first years. A handful of studies compare operative versus conservative management of rotator cuff tears [13, 15, 21]. Piper et al. [24] identified only three RCTs that met the inclusion criteria for a systematic review in a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) analysis. Piper et al. found a small superiority of clinical results in the surgical arm, with only a few sub-elements reaching statistical significance. Since publication of that review paper in 2018, only one further RCT on this topic has been published. However, that particular paper by Moosmayer et al. can be considered as a hallmark paper, since it offers 10-year follow-up in 95% of patients; 1- and 5-year data on this study group have been reported in earlier publications [20–22]. Such an undertaking in orthopedic clinical research is comparatively rare and could prove to be game-changing in a field where evidence from RCTs has been relatively scant to

date. Therefore, although adding only one more paper, the authors consider an update of Piper's systematic review to be crucial, aiming to expand knowledge of the correct therapeutic approach in patients suffering from symptomatic degenerative rotator cuff tears.

Materials and methods

Piper et al. conducted a systematic review in accordance with the PRISMA statement [19]. Three RCTs with a minimum follow-up of 12 months were selected for analysis [13, 15, 20]. One study included a subgroup of patients that underwent physical therapy and subacromial decompression only, without tendon reconstruction [13]. This subgroup was excluded in Piper's analysis. This same study [13] displayed pain measurements as a subscale of the Constant and Murley score, which could not be accurately compared to the visual analog scale (VAS) pain score. Therefore, pain values were also not included. Since Piper's literature search, only one RCT has been published, namely the 10-year results of Moosmayer's cohort [21]. Thus, the analysis performed by Piper et al. was extended by the 10-year results.

In detail, fixed and random effect meta-analyses were performed according to the review by Piper et al. [24]. Briefly, differences in the intervention effect (surgery or physical therapy) regarding constant and pain scores were investigated. Heterogeneity was assessed by the Q test of heterogeneity and the I^2 statistic. For the presentation of the

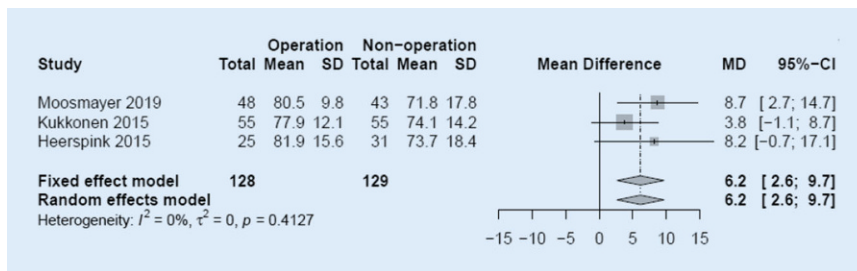


Fig. 1 ▲ Forest plot for Constant and Murley score. *SD* standard deviation, *MD* mean difference, *CI* confidence interval

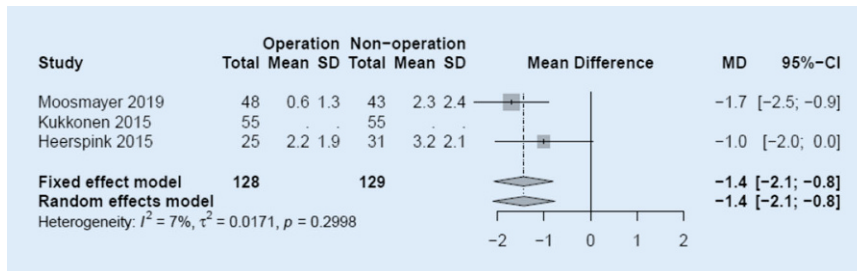


Fig. 2 ▲ Forest plot showing the visual analog scale. *SD* standard deviation, *MD* mean difference, *CI* confidence interval

meta-analyses, forest plots were generated showing the confidence intervals of the individual studies along with the pooled mean difference. Analyses were carried out using R Software for Statistical Computing (Version 4.0.3) with the add-on meta-package (Version 4.15-1) [2].

Results

Meta-analyses for the outcomes of the Constant and Murley score as well as VAS pain score were conducted. Heterogeneity was estimated to be low for both models ($I^2 = 0\%$ and $I^2 = 7\%$ for the Constant–Murley score and the VAS pain score, respectively). The authors therefore report their results from the fixed-effects models. This meta-analysis shows superior results for the Constant and Murley score in the operatively treated cohort (■ Fig. 1). The mean difference between operatively and non-operatively treated patients was 6.2 points (95% confidence interval, 2.6; 9.7, $P < 0.001$).

VAS pain score also improved more in the operatively treated patients, with a mean difference of -1.4 compared to the non-operatively treated patients (95% confidence interval -2.1; -0.8, $P < 0.001$; ■ Fig. 2).

Discussion

In the previous systematic review, Piper et al. found statistically significant superiority in favor of the surgical approach with respect to Constant and Murley Score as well as the VAS pain score. However, the minimally important clinical difference (MICD) remained unsurpassed.

Kukkonen defined the threshold for rotator cuff tears to be 10.4 points in the Constant and Murley score [14]. For the VAS pain score, Tashjian [27] defined an improvement by -1.4 to be the critical difference to make the patient sufficiently “feel better” (MICD) and 3 or less to achieve a patient acceptable symptomatic state (PASS). Including the 10-year results in the analysis, the MICD of 10.4 points in the Constant score is still not met. However, the difference in the VAS pain score at 1.4 corresponds exactly with the defined threshold. In Moosmayer’s 10-year results, the difference between the operatively treated patients (VAS mean 0.6) and the non-operatively treated cohort (VAS mean 2.3) is even greater at 1.7. The operatively treated patients in both RCTs with monitoring of the VAS score [15, 21] reported a mean VAS value below the PASS of 3 at

0.6 and 2.2, respectively. In the non-operatively treated groups, Moosmayer’s cohort reached an acceptable pain score of 2.3 after 10 years, while Lambers Heerspink’s cohort was above this at 3.2 at 12-months and thus not at an acceptable pain level.

Although this review highlights the superiority of long-term clinical results after surgical rotator cuff repair, one should not underestimate the fact that a non-operative approach has the capacity to lead to long-lasting pain relief and acceptable shoulder function. Thus, decision-making between a conservative and operative approach in the situation of degenerative rotator cuff tear remains an individual and challenging situation.

The RCTs included patients with small to medium rotator cuff tears and low grades of fatty infiltration (I–II), mostly involving the supraspinatus tendon only. The reviews offer no information on treatment strategies with respect to complex, large, multi-tendon tears or tears with high degrees of fatty infiltration or atrophy. The presented results include all patients that were enrolled in the RCTs. However, it should be noted that the groups of patients in the surgical study arms represent a mixture of healed and not healed tendons. While Kukkonen et al. [12] do not report on non-healing, Lambers Heerspink [15] found an unusually high number of reruptures at 73.7% of cases at 1-year follow-up. Moosmayer [21] et al. report a retear rate of 34% partial and full thickness tears detected by ultrasound. Both authors conducted subgroup analysis and clearly demonstrated that patients with intact tendons at the time of follow-up achieve better clinical results than those with non-healing. The group of healed tendons outweigh the overall result of the surgical group.

In an analysis of retear rates, it is necessary to take the underlying surgical method of rotator cuff repair into account. Lambers Heerspink et al. performed mini-open single row suture anchor fixation, while Moosmayer et al. used a method of suture-based transosseous mini-open repair. Arthroscopic transosseous equivalent double row repair is currently considered to offer the highest biomechanical robustness of

B. Wirth · L. Weinhold · R. Müller-Rath

Surgical reconstruction of small and medium rotator cuff tears shows superior long-term results

Abstract

Background. Degenerative rotator cuff tears are common in elderly patients. However, the treatment strategies remain controversial. While physiotherapy can lead to pain relief and improved shoulder function, spontaneous tendon healing will not take place and, thus, non-operative management bears the risk of tear progression. Surgical management is the only way to restore the tendon-to-bone interface in spite of a considerable number of rears.

Methods. The present study reviewed the data provided by randomized controlled trials (RCTs) that have compared physiotherapy

with surgical rotator cuff repair. Systematic reviews of this kind have been published before; however, this paper re-analyzes the data, given that Moosmayer et al. recently published an RCT with 10-year follow-up. Such long-term data are comparatively rare in the field of musculoskeletal surgery and therefore a reconsideration of treatment recommendations seems necessary.

Results. The results show a mean difference in the Constant and Murley score of 6.2 points (95% confidence interval, 2.6; 9.7, $P < 0.001$) in favor of the surgical groups. The visual analog scale pain score also improved more in

the operatively treated patients with a mean difference of -1.4 (95% confidence interval -2.1 ; -0.8 , $P < 0.001$).

Conclusion. In summary, this review shows superior clinical results for surgical repair of small- to medium-sized degenerative rotator cuff tears especially in the long term compared to physiotherapy.

Keywords

Rotator cuff lesion · Conservative treatment · Operative treatment · Long-term follow-up · Constant–Murley score

Die operative Rekonstruktion kleiner und mittelgroßer Rotatorenmanschettenrupturen lohnt sich auf lange Sicht

Zusammenfassung

Hintergrund. Degenerativ entstandene Rotatorenmanschettenrupturen finden sich bei älteren Patienten häufig. Die korrekte Therapie ist jedoch Thema vieler Diskussionen. So kann Physiotherapie zu einer relevanten Schmerzlinderung und Verbesserung der Funktion führen. Rotatorenmanschettenrupturen tendieren aber dazu, an Größe zuzunehmen, wobei die konservative Therapie keine strukturelle Heilung herbeiführen kann. Somit bleibt die operative Therapie die einzige Möglichkeit, die Sehnen-Knochen-Verbindung wiederherzustellen, auch wenn erneute Rupturen nicht selten sind.

Methodik. In dieser Arbeit wurden randomisierte, kontrollierte Studien (RCT) untersucht, welche Physiotherapie und operative Therapie von Rotatorenmanschettenrupturen vergli-

chen haben. Es wurden bereits systematische Reviews über dieses Thema veröffentlicht. In der vorliegenden Arbeit wurden die Daten aber neu analysiert, da Moosmayer et al. kürzlich die Ergebnisse einer RCT mit 10-Jahres-Nachverfolgung publiziert haben. Eine solche Verlaufsduer ist vergleichsweise selten in der muskuloskeletalen Chirurgie und muss unserer Meinung nach in der Beurteilung und Empfehlung einer geeigneten Therapie berücksichtigt werden.

Ergebnisse. Die Resultate unserer Analyse zeigen eine „mean difference“ des Constant-Murley-Scores von 6,2 Punkten (95 %-Konfidenzintervall 2,6–9,7; $P < 0,001$) zugunsten der operativ behandelten Gruppen. Der Schmerzwert auf einer visuellen Analogskala verbesserte sich bei den operierten Patienten

ebenfalls deutlicher mit einer Mittelwertdifferenz von $-1,4$ (95 %-Konfidenzintervall $-2,1$ bis $-0,8$; $P < 0,001$).

Schlussfolgerungen. Zusammenfassend zeigt dieses Review überlegene klinische Resultate bei operativ behandelten Patienten mit kleiner bis mittelgroßer degenerativ bedingter Rotatorenmanschettenruptur verglichen mit Physiotherapie. Dieser Unterschied wird vor allem durch Hinzunahme von Langzeitdaten erkennbar.

Schlüsselwörter

Rekonstruktion der Rotatorenmanschette · Konservative Therapie · Operative Therapie · Langzeitnachsorge · Constant-Murley-Score

the tendon-to-bone repair construct [1]. The literature demonstrates improvements in healing rates due to double-row techniques in comparison to single-row repair, such as applied by Lambers Heerspink [15]. Although the present review does not include subgroup calculation, the authors assume that the high rate of non-healing in one of the three RCTs leads to a bias towards underemphasis of the clinical superiority of tendon repair in both reviews. Thus, the application of modern and durable techniques might shift the pendulum

even further in favor of operative rotator cuff repair.

In summary, this review shows that surgical repair of torn rotator cuff tendons offers clinically relevant superior results regarding pain development in comparison to a conservative approach, especially in the long term. Although there is a statistically significant improvement in clinical and functional results in the operatively treated patients, the clinically relevant difference for the Constant and Murley score was not met. Further research is needed with special emphasis

on integrating patient cohorts that have been treated with current standard techniques of arthroscopic double-row repair into systematic reviews of this kind.

Corresponding address

Dr. Leonie Weinhold, M.Sc.

Institut für Medizinische Biometrie und Epidemiologie (IMBIE), University Hospital Bonn

Sigmund-Freud-Str. 25, 53105 Bonn, Germany
leonie.weinhold@imbie.uni-bonn.de

Funding. Open Access funding enabled and organized by Projekt DEAL.

Declarations

Conflict of interest. B. Wirth, L. Weinhold, and R. Müller-Rath declare that they have no conflicts of interest.

This article does not contain any studies with human participants or animals performed by any of the authors.

Open Access. This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

1. Anderl W, Heuberger PR, Laky B et al (2012) Superiority of bridging techniques with medial fixation on initial strength. *Knee Surg Sports Traumatol Arthrosc* 20:2559–2566
2. Balduzzi S, Rucker G, Schwarzer G (2019) How to perform a meta-analysis with R: a practical tutorial. *Evid Based Ment Health* 22:153–160
3. Björnsson HC, Norlin R, Johansson K et al (2011) The influence of age, delay of repair, and tendon involvement in acute rotator cuff tears: structural and clinical outcomes after repair of 42 shoulders. *Acta Orthop* 82:187–192
4. Gladstone JN, Bishop JY, Lo IK et al (2007) Fatty infiltration and atrophy of the rotator cuff do not improve after rotator cuff repair and correlate with poor functional outcome. *Am J Sports Med* 35:719–728
5. Gumina S, Arceri V, Carbone S et al (2013) The association between arterial hypertension and rotator cuff tear: the influence on rotator cuff tear sizes. *J Shoulder Elbow Surg* 22:229–232
6. Hallgren HC, Eliasson P, Aspenberg P et al (2012) Elevated plasma levels of TIMP-1 in patients with rotator cuff tear. *Acta Orthop* 83:523–528
7. Hantes ME, Karidakis GK, Vlychou M et al (2011) A comparison of early versus delayed repair of traumatic rotator cuff tears. *Knee Surg Sports Traumatol Arthrosc* 19:1766–1770
8. Hebert-Davies J, Teeffey SA, Steger-May K et al (2017) Progression of fatty muscle degeneration in atraumatic rotator cuff tears. *J Bone Joint Surg Am* 99:832–839
9. Itoi E, Tabata S (1992) Conservative treatment of rotator cuff tears. *Clin Orthop Relat Res* 275:165–173
10. Kim YS, Kim SE, Bae SH et al (2017) Tear progression of symptomatic full-thickness and partial-thickness rotator cuff tears as measured by repeated MRI. *Knee Surg Sports Traumatol Arthrosc* 25:2073–2080
11. Krischak G, Gebhard F, Reichel H et al (2013) A prospective randomized controlled trial comparing occupational therapy with home-based exercises in conservative treatment of rotator cuff tears. *J Shoulder Elbow Surg* 22:1173–1179
12. Kukkonen J, Joukainen A, Itala A et al (2013) Operatively treated traumatic versus non-traumatic rotator cuff ruptures: a registry study. *Ups J Med Sci* 118:29–34
13. Kukkonen J, Joukainen A, Lehtinen J et al (2015) Treatment of nontraumatic rotator cuff tears: a randomized controlled trial with two years of clinical and imaging follow-up. *J Bone Joint Surg Am* 97:1729–1737
14. Kukkonen J, Kauko T, Vahlberg T et al (2013) Investigating minimal clinically important difference for Constant score in patients undergoing rotator cuff surgery. *J Shoulder Elbow Surg* 22:1650–1655
15. Lambers Heerspink FO, Van Raay JJ, Koorevaar RC et al (2015) Comparing surgical repair with conservative treatment for degenerative rotator cuff tears: a randomized controlled trial. *J Shoulder Elbow Surg* 24:1274–1281
16. Mall NA, Kim HM, Keener JD et al (2010) Symptomatic progression of asymptomatic rotator cuff tears: a prospective study of clinical and sonographic variables. *J Bone Joint Surg Am* 92:2623–2633
17. Meyer DC, Wieser K, Farshad M et al (2012) Retraction of supraspinatus muscle and tendon as predictors of success of rotator cuff repair. *Am J Sports Med* 40:2242–2247
18. Mitchell C, Adebajo A, Hay E et al (2005) Shoulder pain: diagnosis and management in primary care. *BMJ* 331:1124–1128
19. Moher D, Liberati A, Tetzlaff J et al (2009) Preferred reporting items for systematic reviews and meta-analyses: the Prisma statement. *PLoS Med* 6:e1000097
20. Moosmayer S (2010) Comparison between surgery and physiotherapy in the treatment of small and medium-sized tears of the rotator cuff. *J Bone Joint Surg Br*. 92(1):83–91. <https://doi.org/10.1302/0301-620X.92B1.22609>
21. Moosmayer S, Lund G, Seljom US et al (2019) At a 10-year follow-up, tendon repair is superior to physiotherapy in the treatment of small and medium-sized rotator cuff tears. *J Bone Joint Surg Am* 101:1050–1060
22. Moosmayer S, Lund G, Seljom US et al (2014) Tendon repair compared with physiotherapy in the treatment of rotator cuff tears: a randomized controlled study in 103 cases with a five-year follow-up. *J Bone Joint Surg Am* 96:1504–1514
23. Neer CS 2nd (1983) Impingement lesions. *Clin Orthop Relat Res* 173:70–77
24. Piper CC, Hughes AJ, Ma Y et al (2018) Operative versus nonoperative treatment for the management of full-thickness rotator cuff tears: a systematic review and meta-analysis. *J Shoulder Elbow Surg* 27:572–576
25. Shimokobe H, Gotoh M, Honda H et al (2017) Risk factors for retear of large/massive rotator cuff tears after arthroscopic surgery: an analysis of tearing patterns. *J Orthop Surg Res* 12:140
26. Tashjian RZ (2012) Epidemiology, natural history, and indications for treatment of rotator cuff tears. *Clin Sports Med* 31:589–604
27. Tashjian RZ, Deloach J, Porucznik CA et al (2009) Minimal clinically important differences (MCID) and patient acceptable symptomatic state (PASS) for visual analog scales (VAS) measuring pain in patients treated for rotator cuff disease. *J Shoulder Elbow Surg* 18:927–932
28. Zingg PO, Jost B, Sukthankar A et al (2007) Clinical and structural outcomes of nonoperative management of massive rotator cuff tears. *J Bone Joint Surg Am* 89:1928–1934