

# Rotator Cuff Tears in the Elderly Patients

Michael B. Geary, BA<sup>1</sup> and John C. Elfar, MD<sup>1</sup>

Geriatric Orthopaedic Surgery  
& Rehabilitation  
2015, Vol. 6(3) 220-224  
© The Author(s) 2015  
Reprints and permission:  
sagepub.com/journalsPermissions.nav  
DOI: 10.1177/2151458515583895  
gos.sagepub.com



## Abstract

Rotator cuff tears (RCT) are a common clinical problem in the geriatric population, and debate exists over how to best provide pain relief and restore shoulder function. Treatment options can be broadly divided into nonsurgical and surgical, with the majority of patients initially placed on a trial of conservative therapy. For those with irreparable RCT, low functional demand, or interest in nonoperative management, there are a number of nonsurgical treatments to consider, including rehabilitation and injections of corticosteroids, hyaluronate, and platelet-rich plasma. Surgical treatment is increasingly common, as geriatric patients remain active with high functional demands. Studies in elderly populations have demonstrated satisfactory healing and clinical results following surgical repair. Predictors of poor outcome after repair are large tear size as well as higher stages of fatty infiltration. Decompression is a less invasive surgical option that has been shown to provide short-term pain relief, though the lasting effects may deteriorate over time. A number of factors must be weighed when considering which patients are likely to benefit from surgical intervention.

## Keywords

rotator cuff tear, rotator cuff repair, decompression, debridement, conservative management, rehabilitation, corticosteroids, hyaluronate, platelet-rich plasma

## Introduction

Advanced age is associated with a higher incidence of rotator cuff tears (RCT),<sup>1-3</sup> with rates as high as 80% in those older than 80 years of age.<sup>1</sup> In addition to the increased prevalence of RCT with aging, there is a higher rate of large and massive tears,<sup>4</sup> which are less amenable to surgical repair.<sup>5,6</sup> Individuals are increasingly active into the later decades of life, and those having RCT require orthopedic care that can support and restore high functioning lifestyles.

Management can be broadly divided into nonsurgical and surgical treatment. The majority of patients are initially placed on a trial of nonsurgical management, since symptoms may resolve or become tolerable to a point of satisfaction. A common feature shared among nonsurgical protocols is a rehabilitation program to strengthen and support the affected shoulder. Various injections into the subacromial space and glenohumeral joint have been used, including, but not limited to, corticosteroids, hyaluronic acid, and, in recent years, platelet-rich plasma (PRP). These interventions have provided mixed results.

In cases of failed conservative treatment in appropriate surgical candidates, options for further management include repair of the RCT or decompression and debridement. A major concern with RCT repairs in older patients is decreased vascularity and healing potential of the tendons.<sup>7,8</sup> With poorer healing, there is an increased risk of rerupture, and older age is associated with higher rates of failure following repair.<sup>9-12</sup> When managed nonoperatively, RCT in the elderly

patients can increase in size<sup>13</sup> and in the degree of fatty infiltration,<sup>14</sup> both of which decrease the likelihood of a successful future repair. The challenge, therefore, becomes identifying patients with the greatest chance for a successful repair and optimizing timing such that the tear does not progress to a point of irreparability.

## Nonsurgical Management

### *Exercise and Rehabilitation*

Exercise and rehabilitation, often conducted under the guidance of a physical therapist, are an important part of managing RCT in the elderly patients. In their multicenter, prospective cohort study of 452 full-thickness RCT in patients with an average age of 62, Kuhn et al<sup>15</sup> tracked long-term outcomes following a 12-week physical therapy protocol. At a 2-year follow-up, satisfaction was assessed based on whether or not the patients had elected to undergo surgery, and the authors found that nonoperative management was effective for 74% of patients.

<sup>1</sup> Department of Orthopaedics and Rehabilitation, University of Rochester Medical Center, Rochester, NY, USA

### **Corresponding Author:**

John C. Elfar, Department of Orthopaedics and Rehabilitation, University of Rochester Medical Center, 601 Elmwood Avenue, Box 665, Rochester, NY 14642, USA.

Email: john\_elfar@urmc.rochester.edu

Similar satisfaction rates were found by Merolla et al<sup>16</sup> in their study of 40 patients older than 60 who underwent 6 months of nonoperative treatment for RCT, which included pain control, stretching, and strengthening. At 1-year follow-up, 75% of the group reported good outcomes. Moosmayer et al<sup>17</sup> conducted a randomized controlled study comparing nonoperative treatment to repair in small- and medium-sized RCT. Patients randomized to physiotherapy (average age 61) underwent a twice-weekly rehabilitation protocol for a minimum of 18 weeks. Results were favorable, and only 17% of patients randomized to rehabilitation elected to have surgery. However, at a 12-month follow-up, surgery outperformed rehabilitation alone based on American Shoulder and Elbow Surgeons (ASES)<sup>18</sup> and Constant<sup>19</sup> scores.

These results suggest that exercise protocols are effective at providing pain relief and satisfaction in the majority of elderly patients with RCT. However, functional outcomes may be superior following surgical repair in those with smaller tears that are amenable to surgery.

### Corticosteroid Injections

Corticosteroid injections (CSI) are often used to treat tendon pathology due to their powerful anti-inflammatory effects.<sup>20</sup> Earlier studies have reported successful results following CSI for RCT,<sup>21,22</sup> however, more recent clinical and biological data have questioned the value and safety of corticosteroids in treating RCT. Supraspinatus biopsies from patients receiving subacromial injections of methylprednisolone have demonstrated potentially harmful effects of steroids on tendons, including decreased cell proliferation and vascularity.<sup>23,24</sup>

Although no studies have examined the use of CSI in the geriatric population specifically, unfavorable results from younger patients raise concern over efficacy. In their systematic review of CSI for rotator cuff disease, Koester et al<sup>25</sup> concluded that CSI is not efficacious. In their study of 78 patients with RCT (average age 62), Shibata et al<sup>26</sup> randomized patients to 5-weekly injections of either dexamethasone or hyaluronate into the glenohumeral joint. Four weeks after the final injection, 62.5% of those randomized CSI were unsatisfied and wished to undergo surgery. Taken together, the current evidence does not categorically support the use of CSI for definitive nonsurgical management of RCT.

### Hyaluronate Injections

Hyaluronate is a component of synovial fluid that contributes to joint lubrication,<sup>27</sup> and it has been used to treat patients with rotator cuff injury. Chou et al<sup>28</sup> conducted a randomized, double-blind, placebo-controlled trial of hyaluronate injections for patients with rotator cuff lesions and partial RCT, however, none had complete tears. Patients were given weekly injections of 25 mg sodium hyaluronate (SH) for 5 consecutive weeks, and after unblinding, patients randomized to placebo were given the option to undergo SH injections. At a minimum 2-year follow-up, 91% of the 44 patients who received

SH injections had satisfactory results, defined by a Constant score of 80 or higher, or improvement in Constant score by 10 points or more. It should be noted that the published minimal clinically important difference for Constant scores in patients with RCT is estimated to be 10.4.<sup>29</sup> Less favorable results were reported by Shibata et al<sup>26</sup> in their study comparing the short-term effects of hyaluronate to CSI. At a 4-week follow-up after 5-weekly injections of 25 mg SH, 58% of those receiving SH were not satisfied and elected to undergo surgery.

The previous studies on hyaluronate for RCT included patients with average age less than 60 years, and as such, no definitive conclusions can be made regarding its efficacy for geriatric RCT. The results in younger patients are mixed, and further studies should be conducted to determine the utility of hyaluronate injections in managing RCT.

### Platelet-Rich Plasma Injections

Platelet-rich plasma is an autologous blood product containing supraphysiological concentrations of platelets that can activate various growth factors involved into the tissue repair process.<sup>30,31</sup> Its use in the management of RCT stems from its reported success in treating lateral epicondylitis.<sup>32,33</sup> Further, in vitro studies of tenocytes from degenerative RCT have shown that PRP increases cell proliferation and extracellular matrix synthesis.<sup>34,35</sup> However, clinical studies of PRP injections for RCT have provided mixed results.

Most studies of PRP have examined its effect on healing following surgical repair of RCT. No such study has clearly shown definitive clinical benefit.<sup>36,37</sup> In their double-blind, randomized controlled study of 40 patients (average age 51) with RCT, Kesikburun et al<sup>38</sup> randomized patients to a single 5-mL injection of either PRP or saline, in addition to a standard 6-week exercise program. At 1-year follow-up, the authors found that PRP was no better than placebo at improving quality of life, pain, disability, and shoulder range of motion. In contrast, positive results were reported by Rha et al<sup>39</sup> in their study of 39 patients (average age 45) with tendinosis or partial RCT. Patients were randomized to either 2 injections of PRP or dry needling spaced 4 weeks apart. At the 6-month follow-up, those treated with PRP had superior results in terms of pain, function, and range of motion.

The use of PRP in treating RCT is a relatively new concept. Clinical results are mixed and do not currently demonstrate its efficacy in nonoperative management. Further, none of the current literature evaluates the use of PRP in the elderly population, and as such, the evidence does not suggest any benefit.

## Surgical Management

### Surgical Repair

A number of recent studies have investigated the rates of healing and satisfaction in elderly patients undergoing surgical repair of full-thickness RCT. In a prospective trial by Flurin et al<sup>40</sup> in patients older than 70 years, 143 RCT were randomized to either repair or decompression. The authors reported

improved Constant<sup>19</sup> and ASES<sup>18</sup> scores in both groups at 1-year follow-up, however, the repair group scored significantly better than those with decompression alone. Complete healing was found in 81.5% of repairs, and the greatest predictor of rerupture was stage 2 or 3 fatty infiltration.<sup>41,42</sup> This is similar to healing rates reported by others.<sup>43-45</sup> Djahangiri et al<sup>43</sup> found 70% healing after repair in a population older than 65 years of age based on ultrasound assessment at a mean follow-up of 57 months. In a prospective study of RCT repairs in patients aged 70 or older, Robinson et al<sup>44</sup> achieved healing in 68% of their 69 patients, determined by ultrasound at median follow-up of 14 months. In their retrospective review of 42 RCT repairs in patients aged 65 and older, Fehring et al<sup>45</sup> reported a healing rate of 79% detected by ultrasound at a minimum 1-year follow-up. However, higher retear rates have also been reported,<sup>46,47</sup> in particular when stratifying results for large and massive RCT. The retear rates among repairs of massive RCT were 63% in the study from Robinson et al<sup>44</sup> and 100% among the 5 massive tears repaired by Charoussat et al.<sup>47</sup>

Patient satisfaction must be considered when weighing management options for RCT, since those without canonical healing may be asymptomatic, and, conversely, those with objective healing may have continued pain. In 39 arthroscopic repairs of RCT in patients 70 years or older followed for at least 2 years, Verma et al<sup>48</sup> found that 94% were satisfied with their results and would undergo surgery again. This is higher, though similar, to the 87% satisfaction rate reported by Grondel et al<sup>49</sup> and 81% reported by Rebuzzi et al,<sup>50</sup> both of which used University of California-Los Angeles (UCLA) scores<sup>51</sup> of 28 or higher as a cutoff for satisfaction. Interestingly, when stratifying according to tear size, Grondel et al<sup>49</sup> found 100% good or excellent UCLA scores following repair of small (less than 1 cm) and medium (1-3 cm) tears. Moreover, 1 study exclusive to massive RCT in patients older than 70 years revealed a 78% satisfaction rate following repair, also based on UCLA scores of 28 or higher.<sup>52</sup> Overall, the evidence has demonstrated that satisfactory results can be achieved through surgical repair of RCT in elderly patients.

### *Decompression and Debridement Without Repair*

Subacromial decompression, acromioplasty, and debridement of RCT without repair are reasonable alternatives in those patients for whom repair is unlikely to succeed or in patients with low functional demands seeking pain relief. Kempf et al<sup>53</sup> retrospectively reviewed 195 cases of RCT treated with acromioplasty (average age 61), and, at a minimum 1-year follow-up, 16.5% of patients subjectively reported that they were cured and another 71.8% reported an improvement. The authors advocate acromioplasty, especially for elderly patients with less functional demand. Satisfaction rates as high as 94% have been reported following subacromial decompression for RCT.<sup>54,55</sup> Some authors have focused specifically on massive tears (>5 cm) deemed irreparable and the outcomes following decompression and debridement.

Gartsman<sup>56</sup> found that 69% of 33 consecutive patients with massive RCT (average age 62) treated with acromioplasty and resection of the coracoacromial ligament reported improvement in their shoulder conditions at a minimum follow-up of 2 years. Similarly, Rockwood et al<sup>57</sup> reported satisfaction in 83% of 57 patients (average age 60) with massive RCT undergoing acromioplasty, subacromial decompression, and debridement.

Other studies report less favorable results from debridement and decompression as definitive treatment for RCT. In their study comparing arthroscopic debridement and decompression to open repair of RCT, Melillo et al<sup>58</sup> found only 8% satisfaction among those undergoing debridement and decompression, and 92% of patients in this group opted for revision surgery. A recurrent concern with this management option is that the initial pain relief and satisfaction may deteriorate over time. Zvijac et al<sup>59</sup> performed a longitudinal study of 25 patients with full-thickness RCT who underwent arthroscopic subacromial decompression. Using UCLA scores of 28 or higher as a cutoff, 86% were satisfied at a mean follow-up of 24.6 months, but this decreased to 69% when patients were reevaluated at a mean of 45.8 months.

The current literature suggests that decompression and debridement can provide relief and satisfaction, a result found in a majority of patients, however, there may be concern regarding its long-term satisfaction.

### **Conclusion**

Rotator cuff tears are common among the aging population and can be managed through either nonoperative or surgical therapy. Conservative management is an important first-line approach for those with irreparable tears, low functional demand, or interest in pursuing nonsurgical treatment. The results of rehabilitation programs to strengthen and support the shoulder have been positive and provide satisfaction to the majority of patients. Often rehabilitation is supplemented by injections of corticosteroids, hyaluronate, or PRP. The current literature raises concerns over the possible detrimental effects of CSI on tendon and muscle tissue, and the clinical evidence does not currently support the use of hyaluronate or PRP as definitive therapy for nonsurgical management of RCT in the elderly patients.

As geriatric patients are increasingly active with higher functional demands, more patients are being considered for surgical management of RCT. The current evidence has shown that satisfactory healing and functional results can be achieved through repair, especially when selecting those patients and tear characteristics that are most amenable to surgery. Caution should be used when considering repair of large and massive tears or tears with a high degree of fatty infiltration. Further, patient comorbidities must be considered when determining who can safely undergo surgery. Decompression with debridement is able to provide pain relief and satisfaction in those with irreparable tears, though concern may exist regarding deterioration over time.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## References

- Milgrom C, Schaffler M, Gilbert S, van Holsbeeck M. Rotator-cuff changes in asymptomatic adults. The effect of age, hand dominance and gender. *J Bone Joint Surg Br.* 1995;77(2):296-298.
- Sher JS, Uribe JW, Posada A, Murphy BJ, Zlatkin MB. Abnormal findings on magnetic resonance images of asymptomatic shoulders. *J Bone Joint Surg Am.* 1995;77(1):10-15.
- Yamaguchi K, Ditsios K, Middleton WD, Hildebolt CF, Galatz LM, Teefey SA. The demographic and morphological features of rotator cuff disease. A comparison of asymptomatic and symptomatic shoulders. *J Bone Joint Surg Am.* 2006;88(8):1699-1704.
- Gumina S, Carbone S, Campagna V, Candela V, Sacchetti FM, Giannicola G. The impact of aging on rotator cuff tear size. *Musculoskelet Surg.* 2013;97(suppl 1):69-72.
- Matthews TJ, Hand GC, Rees JL, Athanasou NA, Carr AJ. Pathology of the torn rotator cuff tendon. Reduction in potential for repair as tear size increases. *J Bone Joint Surg Br.* 2006;88(4):489-495.
- Matthews TJ, Smith SR, Peach CA, Rees JL, Urban JP, Carr AJ. In vivo measurement of tissue metabolism in tendons of the rotator cuff: implications for surgical management. *J Bone Joint Surg Br.* 2007;89(5):633-638.
- Funakoshi T, Iwasaki N, Kamishima T, et al. In vivo visualization of vascular patterns of rotator cuff tears using contrast-enhanced ultrasound. *Am J Sports Med.* 2010;38(12):2464-2471.
- Rudzki JR, Adler RS, Warren RF, et al. Contrast-enhanced ultrasound characterization of the vascularity of the rotator cuff tendon: age- and activity-related changes in the intact asymptomatic rotator cuff. *J Shoulder Elbow Surg.* 2008;17(1 suppl):96S-100S.
- Nho SJ, Brown BS, Lyman S, Adler RS, Altchek DW, MacGillivray JD. Prospective analysis of arthroscopic rotator cuff repair: prognostic factors affecting clinical and ultrasound outcome. *J Shoulder Elbow Surg.* 2009;18(1):13-20.
- Tashjian RZ, Hollins AM, Kim HM, et al. Factors affecting healing rates after arthroscopic double-row rotator cuff repair. *Am J Sports Med.* 2010;38(12):2435-2442.
- Boileau P, Brassart N, Watkinson DJ, Carles M, Hatzidakis AM, Krishnan SG. Arthroscopic repair of full-thickness tears of the supraspinatus: does the tendon really heal? *J Bone Joint Surg Am.* 2005;87(6):1229-1240.
- Cho NS, Rhee YG. The factors affecting the clinical outcome and integrity of arthroscopically repaired rotator cuff tears of the shoulder. *Clin Orthop Surg.* 2009;1(2):96-104.
- Maman E, Harris C, White L, Tomlinson G, Shashank M, Boynton E. Outcome of nonoperative treatment of symptomatic rotator cuff tears monitored by magnetic resonance imaging. *J Bone Joint Surg Am.* 2009;91(8):1898-1906.
- Zingg PO, Jost B, Sukthankar A, Buhler M, Pfirrmann CW, Gerber C. Clinical and structural outcomes of nonoperative management of massive rotator cuff tears. *J Bone Joint Surg Am.* 2007;89(9):1928-1934.
- Kuhn JE, Dunn WR, Sanders R, et al. Effectiveness of physical therapy in treating atraumatic full-thickness rotator cuff tears: a multicenter prospective cohort study. *J Shoulder Elbow Surg.* 2013;22(10):1371-1379.
- Merolla G, Paladini P, Saporito M, Porcellini G. Conservative management of rotator cuff tears: literature review and proposal for a prognostic. Prediction Score. *Muscles Ligaments Tendons J.* 2011;1(1):12-19.
- Moosmayer S, Lund G, Seljom U, et al. Comparison between surgery and physiotherapy in the treatment of small and medium-sized tears of the rotator cuff: a randomised controlled study of 103 patients with one-year follow-up. *J Bone Joint Surg Br.* 2010;92(1):83-91.
- Kocher MS, Horan MP, Briggs KK, Richardson TR, O'Holleran J, Hawkins RJ. Reliability, validity, and responsiveness of the American Shoulder and Elbow Surgeons subjective shoulder scale in patients with shoulder instability, rotator cuff disease, and glenohumeral arthritis. *J Bone Joint Surg Am.* 2005;87(9):2006-2011.
- Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res.* 1987;(214):160-164.
- Paavola M, Kannus P, Jarvinen TA, et al. Treatment of tendon disorders. Is there a role for corticosteroid injection? *Foot Ankle Clin.* 2002;7(3):501-513.
- Weiss JJ. Intra-articular steroids in the treatment of rotator cuff tear: reappraisal by arthrography. *Arch Phys Med Rehabil.* 1981;62(11):555-557.
- Bokor DJ, Hawkins RJ, Huckell GH, et al. Results of nonoperative management of full-thickness tears of the rotator cuff. *Clin Orthop Relat Res.* 1993;(294):103-110.
- Dean BJ, Franklin SL, Murphy RJ, Javaid MK, Carr AJ. Glucocorticoids induce specific ion-channel-mediated toxicity in human rotator cuff tendon: a mechanism underpinning the ultimately deleterious effect of steroid injection in tendinopathy? *Br J Sports Med.* 2014;48(22):1620-1626.
- Poulsen RC, Watts AC, Murphy RJ, Snelling SJ, Carr AJ, Hulley PA. Glucocorticoids induce senescence in primary human tenocytes by inhibition of sirtuin 1 and activation of the p53/p21 pathway: in vivo and in vitro evidence. *Ann Rheum Dis.* 2014;73(7):1405-1413.
- Koester MC, Dunn WR, Kuhn JE, Spindler KP. The efficacy of subacromial corticosteroid injection in the treatment of rotator cuff disease: a systematic review. *J Am Acad Orthop Surg.* 2007;15(1):3-11.
- Shibata Y, Midorikawa K, Emoto G, Naito M. Clinical evaluation of sodium hyaluronate for the treatment of patients with rotator cuff tear. *J Shoulder Elbow Surg.* 2001;10(3):209-216.
- Marshall KW. Intra-articular hyaluronan therapy. *Curr Opin Rheumatol.* 2000;12(5):468-474.
- Chou WY, Ko JY, Wang FS, et al. Effect of sodium hyaluronate treatment on rotator cuff lesions without complete tears: a

- randomized, double-blind, placebo-controlled study. *J Shoulder Elbow Surg.* 2010;19(4):557-563.
29. Kukkonen J, Kauko T, Vahlberg T, Joukainen A, Aärimala V. Investigating minimal clinically important difference for Constant score in patients undergoing rotator cuff surgery. *J Shoulder Elbow Surg.* 2013;22(12):1650-1655.
  30. Marx RE. Platelet-rich plasma (PRP): what is PRP and what is not PRP? *Implant Dent.* 2001;10(4):225-228.
  31. Eppley BL, Woodell JE, Higgins J. Platelet quantification and growth factor analysis from platelet-rich plasma: implications for wound healing. *Plast Reconstr Surg.* 2004;114(6):1502-1508.
  32. Peerbooms JC, Sluimer J, Bruijn DJ, et al. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double-blind randomized controlled trial: platelet-rich plasma versus corticosteroid injection with a 1-year follow-up. *Am J Sports Med.* 2010;38(2):255-262.
  33. Thanasas C, Papadimitriou G, Charalambidis C, Paraskevopoulos I, Papanikolaou A. Platelet-rich plasma versus autologous whole blood for the treatment of chronic lateral elbow epicondylitis: a randomized controlled clinical trial. *Am J Sports Med.* 2011;39(10):2130-2134.
  34. Hoppe S, Alini M, Benneker LM, Milz S, Boileau P, Zumstein MA. Tenocytes of chronic rotator cuff tendon tears can be stimulated by platelet-released growth factors. *J Shoulder Elbow Surg.* 2013;22(3):340-349.
  35. Jo CH, Kim JE, Yoon KS, Shin S. Platelet-rich plasma stimulates cell proliferation and enhances matrix gene expression and synthesis in tenocytes from human rotator cuff tendons with degenerative tears. *Am J Sports Med.* 2012;40(5):1035-1045.
  36. Rodeo SA, Delos D, Williams RJ, Adler RS, Pearle A, Warren RF. The effect of platelet-rich fibrin matrix on rotator cuff tendon healing: a prospective, randomized clinical study. *Am J Sports Med.* 2012;40(6):1234-1241.
  37. Weber SC, Kauffman JI, Parise C, Weber SJ, Katz SD. Platelet-rich fibrin matrix in the management of arthroscopic repair of the rotator cuff: a prospective, randomized, double-blinded study. *Am J Sports Med.* 2013;41(2):263-270.
  38. Kesikburun S, Tan AK, Yilmaz B, Yaşar E, Yazicioğlu K. Platelet-rich plasma injections in the treatment of chronic rotator cuff tendinopathy: a randomized controlled trial with 1-year follow-up. *Am J Sports Med.* 2013;41(11):2609-2616.
  39. Rha DW, Park GY, Kim YK, Kim MT, Lee SC. Comparison of the therapeutic effects of ultrasound-guided platelet-rich plasma injection and dry needling in rotator cuff disease: a randomized controlled trial. *Clin Rehabil.* 2013;27(2):113-122.
  40. Flurin PH, Hardy P, Abadie P, et al. Rotator cuff tears after 70 years of age: a prospective, randomized, comparative study between decompression and arthroscopic repair in 154 patients. *Orthop Traumatol Surg Res.* 2013;99(8 suppl):S371-378.
  41. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. *Clin Orthop Relat Res.* 1994;(304):78-83.
  42. Flurin PH, Hardy P, Abadie P, et al. Arthroscopic repair of the rotator cuff: prospective study of tendon healing after 70 years of age in 145 patients. *Orthop Traumatol Surg Res.* 2013;99(8 suppl):S379-384.
  43. Djahangiri A, Cozzolino A, Zanetti M, et al. Outcome of single-tendon rotator cuff repair in patients aged older than 65 years. *J Shoulder Elbow Surg.* 2013;22(1):45-51.
  44. Robinson PM, Wilson J, Dalal S, Parker RA, Norburn P, Roy BR. Rotator cuff repair in patients over 70 years of age: early outcomes and risk factors associated with re-tear. *Bone Joint J.* 2013;95-B(2):199-205.
  45. Fehring EV, Sun J, Cotton J, Carlson MJ, Burns EM. Healed cuff repairs impart normal shoulder scores in those 65 years of age and older. *Clin Orthop Relat Res.* 2010;468(6):1521-1525.
  46. Dezaly C, Sirveaux F, Philippe R, et al. Arthroscopic treatment of rotator cuff tear in the over-60s: repair is preferable to isolated acromioplasty-tenotomy in the short term. *Orthop Traumatol Surg Res.* 2011;97(6):S125-130.
  47. Charoussat C, Bellaiche L, Kalra K, Petrover D. Arthroscopic repair of full-thickness rotator cuff tears: is there tendon healing in patients aged 65 years or older? *Arthroscopy.* 2010;26(3):302-309.
  48. Verma NN, Bhatia S, Baker CL III, et al. Outcomes of arthroscopic rotator cuff repair in patients aged 70 years or older. *Arthroscopy.* 2010;26(10):1273-1280.
  49. Grondel RJ, Savoie FH, III, Field LD. Rotator cuff repairs in patients 62 years of age or older. *J Shoulder Elbow Surg.* 2001;10(2):97-99.
  50. Rebuzzi E, Coletti N, Schiavetti S, et al. Arthroscopic rotator cuff repair in patients older than 60 years. *Arthroscopy.* 2005;21(1):48-54.
  51. Romeo AA, Bach BR Jr, O'Halloran KL. Scoring systems for shoulder conditions. *Am J Sports Med.* 1996;24(4):472-476.
  52. Worland RL, Arredondo J, Angles F, Lopez-Jimenez F. Repair of massive rotator cuff tears in patients older than 70 years. *J Shoulder Elbow Surg.* 1999;8(1):26-30.
  53. Kempf JF, Gleyze P, Bonnomet F, et al. A multicenter study of 210 rotator cuff tears treated by arthroscopic acromioplasty. *Arthroscopy.* 1999;15(1):56-66.
  54. Jaffe M, Frank A, Beaufils P. Endoscopic acromioplasty in total rupture of the rotator cuff [in French]. *Rev Chir Orthop Reparatrice Appar Mot.* 1994;80:369-378.
  55. Levy HJ, Gardner RD, Lemak LJ. Arthroscopic subacromial decompression in the treatment of full-thickness rotator cuff tears. *Arthroscopy.* 1991;7(1):8-13.
  56. Gartsman GM. Massive, irreparable tears of the rotator cuff. Results of operative debridement and subacromial decompression. *J Bone Joint Surg Am.* 1997;79(5):715-721.
  57. Rockwood CA Jr, Williams GR, Jr, Burkhead WZ Jr. Debridement of degenerative, irreparable lesions of the rotator cuff. *J Bone Joint Surg Am.* 1995;77(6):857-866.
  58. Melillo AS, Savoie FH III, Field LD. Massive rotator cuff tears: debridement versus repair. *Orthop Clin North Am.* 1997;28(1):117-124.
  59. Zvijac JE, Levy HJ, Lemak LJ. Arthroscopic subacromial decompression in the treatment of full thickness rotator cuff tears: a 3- to 6-year follow-up. *Arthroscopy.* 1994;10(5):518-523.