Arthroscopic surgery versus mini-open repair of the full thickness rotator cuff tear, which intervention has the best outcome? Review of the latest evidence

Cirugía artroscópica versus reparación miniabierta del desgarro del manguito rotador de espesor total, ¿qué intervención tiene el mejor resultado? Revisión de la evidencia más reciente

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Abstract

The evolution of arthroscopic surgery led to depending arthroscopic repair of rotator cuff tears. There is some controversy in the literature about the clinical outcomes. However, would the use of arthroscopic rotator cuff repairs provide better clinical outcomes? The general themes in this review will be Postoperative Pain and Functional outcome, Re-tear rate, adhesive capsulitis, Operative time and The Cost of arthroscopic versus mini-open rotator cuff repair.

The search strategy included the evidence based reports relevant to the surgical management (Open and Arthroscopic) of the Rotator cuff tears. The Inclusion criteria were the available evidence from randomised controlled trial, systematic reviews and meta-analyses.

Most of the available evidences demonstrated no significant difference between the arthroscopic and mini-open repair in the primary outcomes. There was a lack of high evidence regarding the re-tear rate of the postoperative rotator cuff repair, the risk of adhesive capsulitis in both interventions and the cost.

Keywords: rotator cuff, arthroscopic, repair, mini open, full thickness tear.

Resumen

La evolución de la cirugía artroscópica llevó a la reparación artroscópica dependiente de los desgarros del manguito rotador. Existe cierta controversia en la literatura sobre los resultados clínicos. Sin embargo, ¿el uso de reparaciones artroscópicas del manguito rotador proporcionaría mejores resultados clínicos? Los temas generales de esta revisión serán el dolor posoperatorio y el resultado funcional, la tasa de re-desgarro, la capsulitis adhesiva, el tiempo operatorio y el costo de la reparación artroscópica versus mini-abierta del manguito rotador.

La estrategia de búsqueda incluyó los informes basados en evidencia relevantes para el tratamiento quirúrgico (abierto y artroscópico) de los desgarros del manguito rotador. Los criterios de inclusión fueron la evidencia disponible de ensayos controlados aleatorios, revisiones sistemáticas y metanálisis.

La mayoría de las evidencias disponibles no demostraron diferencias significativas entre la reparación artroscópica y la miniabierta en los resultados primarios. Hubo una falta de evidencia alta con respecto a la tasa de re-desgarro de la reparación posoperatoria del manguito rotador, el riesgo de capsulitis adhesiva en ambas intervenciones y el costo.

Palabras clave: manguito rotador, artroscópico, reparación, mini abierto, desgarro de espesor total.

Introduction

Rotator cuff tears are one of the most common shoulder pathology in young as well as old age group[1-3]. The prevalence of this condition is about 22% and increase with age[4,5]. The data estimated less than 5% (approximately more than 250,000 patients) underwent surgical repair of the Rotator cuff tears in the USA[6-8]. Repairing the rotator cuff tears are expensive, it has been estimated the annual cost in the USA is more than 3$ billion[9-12]. Mini-open repair considered the gold standard surgical technique in the treatment of all types of rotator cuff tears for many years with mostly good results and patients' satisfaction[2,13-15]. However, the evolution of arthroscopic surgery and the advances of surgical instruments and the development of surgeons' skills led to depending arthroscopic repair of rotator cuff tears. The arthroscopic rotator cuff repair supposed to be less invasive, easy to assess the glenohemoral joint, less postoperative pain and stiffness and easy postoperative rehabilitation[1,13,14,16,17]. There is some controversy in the literature about the clinical outcomes namely the primary outcomes which include pain and shoulder function (the range of motion and rehabilitation) and the secondary outcomes which include re-tear, adhesive capsulitis, operative time and the cost of the rotator cuff repairs (Arthroscopic or mini-open rotator cuff repair). Some studies demonstrated no significant difference in the clinical outcomes between both interventions. However, other studies reported some differences in the clinical outcomes as mentioned above. **Therefore, the question needs to ask:** Would the use of arthroscopic rotator cuff repairs provide better clinical outcomes (the primary outcomes which include pain and shoulder function (the range of motion and rehabilitation) and the secondary outcomes which include re-tear, adhesive capsulitis, operative time and the cost effectiveness of the rotator cuff repairs) than the mini-open surgical repair of the rotator cuff tear?

Literature Search strategy:
The search strategy included the evidence based reports relevant to the surgical management (Open and Arthroscopic) of the Rotator cuff tears. The Inclusion criteria were the available evidence from randomised controlled trial, systematic reviews and meta-analyses. Cohort studies (pros- and retrospective) studies were also considered. The literature search was performed using the Cochrane library, Pubmed, Cinhal, and Web of science database. Words used were "treatment", "management", "rotator cuff", "open", "Surgery", "arthroscop*, "tears", "injury", "mini-open", "cost", "integrity", "re-tear", "adhesive capsulitis", "operative time" , "surgical time", "full thickness". No time limitation. English and german literatures were included in the search strategy. The abstracts were scanned and the relevant articles were reviewed after collecting them in the Endnote. The final search activity showed 63 articles relevant to the case. Seven randomized controlled trial were found, two of them were excluded because they were not relevant to our case[18]. Only 4 systematic reviews and meta-analyses were relevant to our case[3,17,19]. The surgical interventions which associated with Acromioplasty, SLAP repair and any other associated pathology have been excluded.

The general themes in this review will be:

- Postoperative Pain and Functional outcome of arthroscopic versus mini-open repair.
- Re-tear rate and adhesive capsulitis of arthroscopic versus mini-open rotator cuff tear.
- Operative time of arthroscopic versus mini-open rotator cuff repair.
- The Cost of arthroscopic versus mini-open rotator cuff repair

Discussion

Postoperative Pain and Functional outcome of arthroscopic versus mini-open repair Liu et al[20] conducted a randomized clinical trial relevant to our case, compared the clinical outcomes of arthroscopic versus mini-open repair of rotator cuff tears in the time between March 2013 to June 2014 of 100 patients. The study reported a statistically significant difference in favor of the arthroscopic repair compared to the mini-open repair in the first two to four weeks follow-up and no differences after one month follow-up. The randomized trial from Van der Zwaal et al[16] compared the clinical outcome of arthroscopic versus mini-open repair of small to medium size rotator cuff tears, conducted in the time between 2008 and the end of 2010 of 100 patients and one year follow-up period. The study reported that the arthroscopic repairs are slightly superior over the mini-open repair in the first six weeks follow-up in terms of pain and range of motion. However, there was no significant difference after six weeks. This slight difference might be due to the longitudinal surgical technique in splitting the Deltoid muscle during the mini-open surgical intervention[16,17,20]. The outcome measures used for the Liu et al. and Zwaal et al. studies were the Visualize analogue scale (VAS) ,the disabilities of the arm, shoulder and hand (DASH) and The Constant-Murley score (CMS) which were all reliable and valid outcome measures used to assess the primary and secondary outcomes[21]. Carr et al.[10] a randomized controlled trial of 273 patients conducted between 2007 and the end of 2012 "Effectiveness of open and arthroscopic rotator cuff repair (UKUFF)", reported no significant difference in the primary outcomes of pain and weakness, although Carr et al. used a different outcome measure which was the shoulder oxford score (OSS). The (OSS) considered a valid and reliable measure[22,23]. Cho et al.[24] a randomized controlled trial compared the early postoperative outcomes (pain and range of motion) between the arthroscopic and mini-open repair of 60 patients between 2008 and the end of 2009. The authors reported a statistically slightly significant difference in the VAS score (visualize analogue scale) of the arthroscopic repair in the first six weeks and no differences in the early range of motions outcomes. However, the study has its limitations in which the sample size was small (30 patients in each group) and the follow-up period was only six months. In a prospective randomized study of 125 patients with two years follow-up in the time between March 2013 to June 2014 done by Zhang et

al[25] reported no significant difference in pain and functional outcome between both arthroscopic and mini-open rotator cuff repair. The authors used two different outcome measures the American Shoulder and Elbow Surgeons Evaluation Form (ASES) which was a valid, reliable tool and applicable to all type of shoulder interventions[26] and the second was the University of California Los Angeles shoulder score (USLA) outcome measure tool which had its flaw. The USLA was first developed in 1981, in that time; the available data used to develop this tool were limited to prove its validity and reliability. Furthermore, there was no available publications which described the development of this measurement tool[27]. In the meta-analysis of a systematic review included five randomized controlled trial of about 329 patients from Ji et al.[13] there was a slightly significant difference in favor of arthroscopic repair compared to mini-open repair regarding pain on the VAS score in the first 6 weeks ,the homogeneity p=0.002,and a slightly difference in favor of the arthroscopic repair regarding the range of motion, the homogeneity p=0.003. The systematic review and meta-analysis conducted by Huang et al. [3] in a total of 18 studies of about more than 1500 patients has been reported no significant difference in the VAS scale and slightly difference in favor of mini-pen-repair. Shan et al[17] in their systematic review and meta-analysis of 12 studies of 770 patients reported no significant differences in VAS scale after six months, heterogeneity p<0.0001. Moreover, there were no differences in the functional outcomes. These systematic reviews and meta-analyses were of low level of bias according to the PRISMA statement of systematic reviews and AMSTAR tool of assessment of systematic reviews[28], which both considered reliable and valid tools for assessment and reporting protocols of systematic reviews[29]. As a result, although there was no level one evidence, most of the studies reported no significant differences between both interventions (arthroscopic and mini-open rotator cuff repair).

Postoperative complications

- **Re-tear rate of arthroscopic versus mini-open repair**

  The randomized clinical trial conducted by Liu et al.[20] reported no statistically significant difference between the arthroscopic and the mini-open repair surgical interventions in the number of later postoperative re-tear rate of the operative shoulder. However, the study has its limitations in which the numbers of the patients were relatively small (50 patients in each group). Moreover, the rehabilitation treatments as well as the follow-up period were not identical for both interventions that might lead to a potential bias because of the misrepresentation of the interventions. The randomized controlled trial from Carr et al.[10] reported that the Re-tear rate was high and similar at both interventions in about (40%).The study had many strengths, as the number of patients which were allocated in the study was the largest RCT conducted globally, in which 19 teaching and general hospital from all over the united kingdom were involved and the patients were allocated equally in 2 groups (open repair and arthroscopic). Furthermore, the rehabilitations follow-up therapy was identical for both interventions in two years period with minimum cross over rate and dropout. In contrast, the study of Zhang et al.[25] reported a significant high Re-tear rate 74% in the arthroscopic rotator cuff repair after two years follow-up detected by MRI compared to the mini-open repair 35% in the full thickness rotator cuff tear. The authors in this study did not describe the size of the tears preoperatively and the re-tear size of the repair postoperatively and there was no explanations suggested to clarify this large difference in the re-tear rate outcome between the two interventions. However, the study has many weaknesses; firstly, the methods of the study were not clear regarding the randomization and the statistical methods. Secondly, the numbers of the patients were small in size and the patients with full thickness tear were not allocated equally (seven in the min-open versus 17 in the arthroscopic repair) as well as, there was no homogeneity of the types of tears in the study as there were many partial thickness tears with unclear definition in both groups and unclear preoperative diagnosis, that might all be significant for this result. Furthermore, there were about 17 dropped out patients in the follow-up which might have an impact on its significance. The study which has been done by Van der Zwaal et al. [16] reported that the Re-tear rate in arthroscopic repair was slightly higher (17%) compared to open repair (13%). The authors suggested this higher incidence of re-tear rate in arthroscopic repair might be due to the surgical techniques' difficulty in restoring the footprint and placing the Mson-allen stich. However, Brown et al.[30] in their systematic review and meta-analysis of 13 studies of more than 600 patients which studied the effect of suture technique on the re-rupture rate in arthroscopy, had demonstrated no significant effect in all types of sutures and tear sizes. The systematic review and meta-analysis from Shan et al.[17] reported no significant difference in the re- tear rate of the postoperative rotator cuff arthroscopic and mini-open repair after 24 months follow-up in all tear size types.

- **Adhesive capsulitis of arthroscopic versus mini-open rotator cuff tear**

  The randomized controlled trial of Liu et al.[22] reported no statistically significant difference between the arthroscopic and the mini-open rotator cuff repair in the incidence of later postoperative adhesive capsulitis of the operative shoulder. However, the rehabilitation and follow-up therapy were not the same in both groups. In contrast, the randomized trial from van der Zwaal et al.[16] demonstrated that adhesive capsulitis was more significant in mini-open-repair of the rotator cuff tears (13%) compared to arthroscopic rotator cuff repair (11%). A result, there was no level one evidence reported the Re-tear rate as well as for the adhesive capsulitis rate as a postoperative secondary outcome complications for both arthroscopic and mini-open rotator cuff repair surgery.

Operative time of arthroscopic versus mini-open rotator cuff repair

Liu et al.[20] reported in their randomized controlled trial a statistically significance difference between the arthroscopic and mini-open rotator cuff repair in which the mini-open repair required less time than arthroscopy of about (15 minutes). Carr et al.[10] reported in their study a significant difference of shorter

time about (12 minutes) in mini-open repair compared to arthroscopic repair. Van der Zwaal[16] reported the shorter time of the mini-open repair compared to arthroscopic repair without providing the real time surgery acquired for both interventions in their study. In the meta-analysis of the systematic review of 329 patients from Ji et al.[13] has been demonstrated a significant difference in the operative time between arthroscopic and mini-open rotator cuff repair of more than (15 minutes) preferred the open repair, the homogeneity p<0.0001. In the prospective study Adla et al[11] the operative time difference was about (14 minutes) in favor of the mini-open rotator cuff repair. As a result, the studies showed that the mini-open repair needs' less time than the arthroscopic rotator cuff repair.

The Cost of arthroscopic versus mini-open rotator cuff repair

The Cost of the surgical intervention involved the cost of the instruments, hospitalization cost, operation time, cost of the surgeons and the staff, cost of the medications and the cost of rehabilitation. Carr et al.[8] the same randomized controlled trial which was published in 2017 but considered mainly the cost effectiveness of surgery "Effectiveness of open and arthroscopic rotator cuff repair (UKUFF)", reported no significant difference in the cost effectiveness of both the open repair and the arthroscopic repair of rotator cuff tears. The overall cost of treatment in 24 months of the arthroscopic surgery was about 2567 pounds compared to the open surgery that was about 2699 pounds. In a retrospective study of 50 patients conducted in Turkey between 2001 and 2005[1] reported the higher cost of arthroscopic repair in about 900$ per patient compared to 600$ per patient in mini-open repair. However, the study was retrospective in its design with small size sample. Another retrospective study in china of 148 patients between 2010 and 2014[31] reported the cost of arthroscopic repair was significantly higher than mini-open repair. Moreover, the prospective study from Adla et al.[11] which conducted in 2004 of 30 patients and one year follow-up reported the expensive cost of arthroscopic repair compared to mini-open repair in more than 600 pounds difference. However, these studies were all retrospective in design, short time follow-up (not more than one year follow-up) and all have small size samples. Summing up the results, most of the studies which reported the lower cost of the mini-open rotator cuff repair had a weak internal validity, compared to the randomized trial of two years follow-up of (A. J. Carr et al.) which reported no significance diffrence in cost between both interventions[10].

Conclusion

Most of the available evidences demonstrated no significant difference between the arthroscopic and mini-open repair in the primary outcomes.

There was a lack of high evidence regarding the re-tear rate of the postoperative rotator cuff repair, the risk of adhesive capsulitis in both interventions and the cost. Further studies would be suggested to look more closely to the above mentioned outcomes.

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