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Reverse shoulder Arthroplasty with (or without) subscapularis repair: does it affect range of motion and/or articular stability?

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Ddoutor Bernardo Nunes e Professora Doutora Cláudia Dias

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DESIGNAÇÃO DA ÁREA DO PROJECTO

Ortopedia

TÍTULO MONOGRAFIA

Reverse Shoulder Arthroplasty with (or without) subscapularis repair: does it affect. range of motion and/or articular stability?

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Professor Doutor Manuel Gutierres

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É AUTORIZADA A REPRODUÇÃO INTEGRAL DESTE TRABALHO APENAS PARA EFEITOS DE INVESTIGAÇÃO, MEDIANTE DECLARAÇÃO ESCRITA DO INTERESSADO, QUE A TAL SE COMPROMETE.	☐
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"A alegria está na luta, na tentativa, no sofrimento envolvido e não na vitória propriamente dita."

Mahatma Gandhi

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Reverse Shoulder Arthroplasty with (or without) subscapularis repair: does it affect. range of motion and/or articular stability?

Artroplastia invertida do ombro com (ou sem) reparação do subescapular: Afeta a amplitude de movimento e/ou estabilidade articular?

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Reverse Shoulder Arthroplasty with (or without) subscapularis repair: does it affect range of motion and/or articular stability?

ABSTRACT

Background: The aim of this bibliographic review is to assess the results between the repair and non-repair of the subscapularis tendon in reverse shoulder arthroplasty, regarding range of motion and joint stability.

Methods: Literature search performed in PUBMED using the QUERY "Reverse Shoulder arthroplasty" AND "subscapularis repair", limited to January 1st, 2015 until 16 January 16th, 2021. The inclusion criteria were studies with adult patients submitted to reverse shoulder arthroplasty, comparing subscapularis repair or non-repair, and reporting range of motion and stability as an outcome.

Results: Most of the studies did not find significant differences between the repair and the non-repair of the subscapularis for most of the assessed outcomes. However, lateralization or medialization of the centre of rotation of the prosthesis was identified as an important variable when not repairing the subscapularis, where lateralized prosthesis showed a decreased dislocation rate.

Conclusion: Most studies did not find significant advantages in repairing the subscapularis when considering range of motion. When the subscapularis is not repaired, lateralized prosthesis may provide lower dislocations rates. There is not yet sufficient evidence to demonstrate the indication or contraindication for repair of the subscapular tendon.

Key words: Reverse Shoulder Arthroplasty, Subscapularis Repair, Stability, Range Of Motion.

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INTRODUCTION

Reverse shoulder arthroplasty was initially proposed for the treatment of end-stage rotator cuff arthropathy(1,2). Expanding indications have gradually been suggested in primary and secondary arthritis(2,3), fractures of the proximal humerus and its sequelae(2–5), tumoral resection(2), massive rotator cuff tears(2–4,6,7), other painful cuff arthropathies(3,5,8) or arthroplasty revision(2–4). Good to excellent functional outcomes have been reported(2), especially regarding active elevation(2), external rotation(2), and abduction(2). Nevertheless, some complications can occur, such as neurologic injury, dislocation, periprosthetic fracture, hematoma, infection, scapular notching, mechanical baseplate failure, and acromial fracture(3,4,9–11).

Despite this, concerns have been raised regarding limited range of motion after reverse shoulder arthroplasty(12,13). Studies have demonstrated that possible causes may be related to impingement(14), prosthesis design(5), medialization of the glenosphere or the humerus(5) and management of the subscapularis tendon(15,16). A recent study has demonstrated better outcomes regarding range of motion with the lateralization of the centre of rotation of the prothesis. Inferior placement of the glenosphere and a varus humeral neck shaft were also shown to reduce the adduction deficit and impingement and thus improving range of motion(5,16,17).

The subscapularis is an active internal rotator of the humeral head(15,16,18) and its tendon is released during the deltopectoral approach (tenotomy or osteotomy)(8,15,16).

In the literature, systematic reviews have approached this subject focusing on different clinical outcomes, such as dislocation rates(19) or functional scores(19,20). Notwithstanding, there is still limited evidence regarding the effect of subscapularis management during reverse shoulder arthroplasty (repair or no-repair) in shoulder range of motion – specifically internal rotation.

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The objective of this study is to perform a bibliographic review of studies comparing the repair of the subscapularis with the non-repair in reverse shoulder arthroplasty focusing on outcomes related to range of motion and stability.

METHODS

A literature search was performed in PUBMED using the QUERY "Reverse Shoulder arthroplasty" AND "subscapularis repair", limited to January 1st, 2015 until 16 January 16th, 2021. 140 articles were found, and a full-text reading was performed. Articles that fulfilled the following inclusion criteria were selected: adult patients submitted to reverse shoulder arthroplasty and comparison of subscapularis repair or non-repair and reporting range of motion as an outcome (active forward elevation, external rotation, internal rotation, abduction). Joint stability was also analysed in this literature review.

SUBSCAPULARIS MUSCLE AND TENDON

The subscapularis muscle has important actions in the shoulder. First, it provides internal rotation(4,5,18,19,21) but it is also very important in abduction, adduction, extension, and flexion of the shoulder(4,5,18,21,22). It provides different actions according to the activated portion: the upper two thirds on the tendon – the tendinous portion – are responsible for internal rotation and abduction(18,22). This portion is innervated by the superior subscapular nerve, derived from the brachial plexus 8(receiving fibres from the fifth cervical nerve, C5)(18,21). When the lower third contracts – the muscular portion – adduction occurs(18,22). The lower portion is innervated by the inferior subscapular nerve, also derived from the brachial plexus (receiving fibres from the sixth cervical nerve, C6)(18,21). The stability of the glenohumeral joint depends also on the subscapularis tendon forces, together with the posterior rotator forces(22).

“TO REPAIR OR NOT TO REPAIR? THAT IS THE QUESTION!”

Subscapularis tendon management is a source of controversy in reverse shoulder arthroplasty. Some authors suggested that the repair of the subscapularis may improve reverse shoulder arthroplasty stability(15,16), and range-of-motion(15,16) while decreasing joint dead space(15). Nevertheless, other studies did not find significant differences in these outcomes when the subscapularis was not repaired(22) and some authors even suggest that subscapularis repair may create a biomechanically unfavourable condition due to the change in the joint centre of rotation after reverse shoulder arthroplasty(15). Subscapularis repair has also been associated with limited external rotation and impairment in daily living activities(15).

EFFECT ON RANGE OF MOTION

Subscapularis repair can be important for some authors, and they suggest that it should be done because of is its role in shoulder internal rotation, one of the main movements in many activities of daily living, such as tucking in a shirt in the back of the pants or clothing attach on the back(20). A successful subscapularis tendon repair can enhance a better range of motion and strength on internal rotation(12,23,24). For these authors, a routine repair of the tendon is advised in every case of reverse shoulder arthroplasty(25) and may be performed by transosseous(26,27) or end-to-end repair(27).

On another hand, repairing the subscapularis may antagonize deltoid and posterior cuff, limiting elevation and external rotation, increasing surgery time, and more post-surgery protection is required(23,25). It may also contribute to coracoid impingement(23,25). Besides that, there are not well documented evidence of better outcomes or healing rates(23,25). Subscapularis repair was also associated with a bigger rate and number of reoperations (52,9% vs 0%, with a P val. = 0,01)(4).

Vourazeris et al(15) have studied the outcomes in patients submitted or not to subscapularis repair(15). In this study, with 202 patients, no statistically significant differences in the outcome scores were found (Shoulder Pain and Disability Index (SPADI) Score(28), American Shoulder and Elbow Surgeons Shoulder (ASES) Score(28) and University of California – Los Angeles (UCLA) Shoulder Rating Score(29))(15). They also did not find any advantages regarding range of motion or strength whether the subscapularis was repaired or not(15). After these results they have concluded that repairing or not the subscapularis had no effect in any of the measured range of motion outcomes, (active external rotation, passive external rotation, active forward elevation, active internal rotation, active abduction, external rotation)(15). In lateral designs, repair might not be necessary because the lateralization of the centre of rotation increases the subscapularis tension, making it difficult for external rotation and abduction.(15).

Friedman et al(24), in their comparative study of subscapularis repairing or not, have shown that the subscapularis repaired cohort was associated with better outcome scores according to Simple Shoulder Test (SST)(28,30) and Constant Murley scores(31,32), and was significantly more effective at improving active internal and external rotation(24), but less active abduction score and passive external rotation score(24). These results show that positive outcomes, regarding both range of motion and outcome scores, are achievable both with and without subscapularis repair(24). These results are more associated with the lateralization of the centre of rotation of the prothesis, and Friedman et al show that good outcomes are achieved with or without subscapularis repair, with a lateralized prothesis(24). So, these authors report no differences between repairing or not, but better outcomes with a lateralized prothesis instead of a medialized Grammont style prothesis(24).

Rol et al(12) have also concluded that the subscapularis repair was not associated with better internal rotation outcomes(12). They associate limited internal rotation to the impingement related to the reduced space around the glenosphere, to allow a normal rotation around the humerus(12).

Franceschetti et al(22) have developed a field study in Italy comparing the repair and non-repair of subscapularis(22). They achieved similar results as Vourazeris(15) and Friedman(24), regarding Constant Murley(31,32) and Visual Analogue Scale (VAS) scores (no differences between groups), but they have demonstrated that the abduction value was higher in the non-repairing group and the internal rotation value was significantly higher in the repairing group(22). Regarding external rotation, the non-repairing group have achieved higher values, but the difference was not statistically and functionally significant(22). No differences were found regarding forward flexion(22). They have also put the hypothesis of a higher value of post-operative pain in the repairing group, due to tendon scarring and increased tension on the sutured tendon(22).

Werner et al(16) have demonstrated that the isolated repair of the subscapularis had no significant effect on American Shoulder and Elbow Surgeons Shoulder (ASES) score(28) in reverse shoulder arthroplasty(16). On the other hand, when combined with the glenosphere lateralization (instead of medialization, in the Grammont-style prothesis) resulted in a less improved American Shoulder and Elbow Surgeons Shoulder (ASES)(28) score, when comparing with non-repairing group or medialization group(16).

In the systematic review conducted by Malahias et al(33), regarding range of motion, three out of four studies (of which two were also analysed in this review(8,15)), it was reported that there were no significant differences between repair or not repair. Regarding internal rotation, one of the studies(24) demonstrated a significantly higher improvement in the repair group, but the other ones found no significant differences(33). Additionally, no differences were found regarding external rotation(33). Although subscapularis repair was proven safe and effective for the augmentation of reverse total shoulder arthroplasty(33), it did not offer any additional clinical or functional benefit in range of motion and joint strength of patients treated with lateralized reverse total shoulder arthroplasty(33). Therefore, it may not be routinely performed in patients who have a preoperatively sufficient subscapularis tendon(33).

In another systematic review with metanalysis developed by Matthewson et al (19), of seven studies, (three of them explored in this review(15,16,24)), it has been demonstrated that even though there is some weak evidence of some advantages in

subscapularis repair, the functional outcomes are similar both in subscapularis repairing or not, in reverse shoulder arthroplasty(19). One of the studies have demonstrated better score in Constant Murley evaluation(31,32), improved internal and external rotation on the subscapularis repair group, which was supported by another study analysed in this review(24). Yet, in this study(24), there were only used lateralized centre of rotation prothesis.

EFFECT ON JOINT STABILITY

In the medialized centre of rotation prothesis, "Grammont-style", the centre of rotation is moved to the glenoid face, reducing the load on the baseplate-glenoid interface, and increasing the moment arm of the deltoid(15). This improves active elevation(15) with better outcomes on de daily living activities(15). However, dislocation rates are a concern, so Vourazeris et al, in their study(15) investigated whether hat subscapularis repair can be beneficial to increase the joint stability(15). Nevertheless, they did not find statistically relevant differences between subscapularis repairing or not concerning joint stability and dislocations rates(15). Vourazeris et al(15) advised that subscapularis repair should be effective in medial humeral–medial glenosphere designs (Grammont style) however, in lateral humeral or glenosphere designs, the subscapularis repair is exempt and can be left up to the surgeon(15).

In the study developed by Friedman et al(24), no difference was noted in the complication rates, scapular notching rates, or scapular notching grades between patients with subscapularis repair and those without repair(24). They have also concluded that a lateralized centre of rotation prothesis is associated with decreased deltoid wrapping and more tension on rotator cuff, contributing for better stability(24). In their study, there were no differences between both subscapularis repair and not repair groups, but they advised that those results may not be the same in medial centre of rotation prothesis "Grammont-style"(24).

Another study developed last year by Oh(34) et all came across the identical results of those developed by Friedman(24) and Vourazeris(15). These authors concluded that the subscapularis repair is not influential in the joint stability, in cases of a lateralized shoulder arthroplasty(34). Lateralizing the centre of rotation extends the moment arms of both external and internal rotation, when compared with a medialized centre of rotation(34), restoring the conjugate force between the subscapularis and infraspinous muscle, regardless the reparation or not of subscapularis tendon(34). Beyond that, lateralization of centre of rotation decreases deltoid wrapping and gives more tenson of the rotator cuff, decreasing the joint stability(34). This way, joint stability can increase with the lateralization of the centre of rotation, but is independent of the subscapularis repair(34). It should be noted that these authors carried out a study only with prostheses with lateralized centre of rotation, varying only the lateralization degree(34).

Regarding joint stability, Franceschetti et al(22) did not find any significant differences between repair or not repair the subscapularis tendon. However, they can claim that the prothesis model used in their study, with the lateralized centre of rotation can offer better stability outcomes than the traditional Grammont design, as it would increases the rotator cuff tendon tension, promoting better stability(22). Therefore, in the Grammont design, as there is less deltoid tension and greater risk of impingement, subscapularis repairing can be advised to stabilize the prothesis, preventing the dislocation(22).

When comparing dislocation and/or instability rates, Werner et al(16) could not find any differences between groups(16). They concluded, then, that subscapularis repair is beneficial when conjugated with glenosphere lateralization, otherwise they found no advantages in individualized subscapularis repair in medial glenosphere prothesis(16). In lateralized glenosphere prothesis, they have demonstrated that the repair of subscapularis can translate to substantially less clinical improvement(16). They have also concluded that, for these types of prothesis, the subscapularis repair does not improve stability, in fact this combination may be prejudicial to shoulder function(16).

In a systematic review of comparative trials, developed by Malahias et al(33), using five studies, in which four of them were also analysed in this literature review(8,15,16,24),

these authors concluded that the subscapularis repair did not offer any clinical or functional advantages in lateralized reverse total shoulder arthroplasty, even though this procedure was suggested by some authors to improve the joint stability and decrease of post-operative dislocations(33). Thereby, these authors do not support the subscapularis repair as routine use for patients under reverse shoulder arthroplasty with a preoperatively sufficient subscapularis tendon, because it does not decrease the dislocations rate(33).

In their systematic review, Matthewson et al(19) suggested that subscapularis repair significantly reduces the risk of dislocation in cases of medialized prothesis(19). In lateralized prothesis, there were no difference between groups regarding stability(19). This kind of prothesis appear to be protective against dislocation, where compared with medial prothesis(19). However, the benefits of a lateralized centre of rotation should still be weighed against the potential increased risk of component loosening and revision surgery secondary to increased joint reaction forces(19).

Cheung et al(35), in their study, have identified lack of subscapularis repair as an independent factor of instability after reverse total shoulder arthroplasty(35). They have demonstrated that a successful subscapularis repair would decrease the probability of prothesis dislocation(35). Therefore, they supported the repair of subscapularis tendon, whenever possible, to improve the prosthetic stability(35). Nevertheless, they have used medial centre of rotation prothesis in their study, which may limit the extrapolation of their results to other prosthetic designs.

This bibliographic review has several limitations. This study is subject to selection bias, because the groups of participants compared are different not only by the type of interventions, but also by the type of evaluated outcomes. Besides that, the heterogeneity of the articles, regarding the groups of patients in each study, the types of prosthesis used, and the outcomes reported, was also an important limitation to the development of this study. In this study, it was not possible to compare data statistically because it is not a meta-analysis resulting from a systematic review. Another limitation of this review is that it was carried out based mostly on retrospective comparative

studies. There is still not enough detail to be able to concretely analyse the intended outcomes (range of motion and joint stability).

CONCLUSION

Through the consulted and analysed bibliography, we can conclude that almost all authors do not see great advantages in repairing the subscapular tendon, both in terms of joint stability, functional level, and range of motion.

Although it was not the main aim of this study, through this review it was also possible to suggest that the repair of the subscapular tendon is more effective when used concomitantly with the use of prosthesis with medial rotation centre, “Grammont-style”. With the lateralized rotation centre, some authors do not see benefit in repairing the subscapular tendon, and there are even some authors that advise against the reparation in this type of prothesis.

Despite the studies are highly suggestive, there is still insufficient data to conclude which cases can benefit from simple subscapularis tenotomy and the ones that should be repaired.

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ANEXES

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Chapter in a book

Winquist RA, Frankel VH. Complications of implant use. In: Epps CH Jr, ed. Complications in orthopaedic surgery. Vol. 1. Philadelphia: JB Lippincott Company, 1978:99–129.

Web reference

Hazarika S, Baird E, Palan J. British Orthopaedics Trainees Association: BOTA positional statement on the use of simulation in surgical training, 2013. http://www.bota.org.uk/uploads/post_02291_BOTA_statement_simulation.pdf (date last accessed 25 March 2015).

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