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Deltopectoral approach without subscapularis detachment for reverse shoulder arthroplasty. Technique and results of a safe and reproducible subscapularis-sparing approach

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Background: The importance of the subscapularis for reverse total shoulder arthroplasty has been demonstrated, especially for internal rotation and stability. In a deltopectoral approach, a detachment of the subscapularis is performed (tenotomy, tuberosity peeling, or osteotomy), but the tendon is not always repairable at the end. When it is repaired, healing is obtained in only 40%-76% of the cases, with potential consequences for the outcomes. The anterior muscle-sparing (AMS) approach is a deltopectoral approach with preservation of the subscapularis, providing a solution to these problems. We present the surgical technique and results.
Methods: In a retrospective study, we included our first 45 cases of reverse total shoulder arthroplasty performed with the AMS approach for a degenerative affection of the shoulder (massive rotator cuff tear, cuff tear arthropathy, primary glenohumeral arthritis, or rheumatoid arthritis), excluding traumatic and revision cases. The subscapularis was intact in all the cases. The mean age at inclusion was 74.1 years. No patients were lost at the minimum 24-month follow-up. All the patients underwent a clinical evaluation preoperatively and at the last follow-up, including Constant score, simple shoulder value, pain scale, and range of motion. An X-ray evaluation was conducted postoperatively and at the last follow-up to assess implant positioning and evolution.
Results: There was no intraoperative complication, and the mean operative time was 62 minutes. We observed a significant improvement in Constant score (from 36 to 70, $P<.001$), simple shoulder value (from 33 to 81, $P<.001$), pain (from 6.3 to 0.7, $P<.001$), strength (from 0.5 to 3.5, $P<.001$), and most of the active mobilities. Regarding internal rotation, 95% of the patients reached level L3 or higher. Glenoid positioning was considered optimal in more than 90% of the cases (inferior tilt and low position) without any occurrence of superior tilt or high position. The osteophytes could be totally removed in 8 out of 9 cases (88.9%). Six postoperative complications (13.3%) were reported: 1 infection (2.2%), 2 cases of traumatic glenoid loosening (4.4%), 2 acromion fractures (4.4%), and 1 hematoma (2.2%). There was no instability. Eighty percent of the patients could return home, with a mean hospital stay of 1.8 days.
Conclusion: The AMS approach is a safe and reproducible technique. The preservation of the subscapularis has potential benefits regarding internal rotation and stability. In the absence of tendon suture, rehabilitation can be started immediately without motion restriction, allowing for a fast recovery and return to autonomy.

Reverse total shoulder arthroplasty (rTSA) has become over the years a serious option to treat many degenerative and traumatic conditions of the shoulder, with good functional results and an acceptable complication rate.[32,33] Some weak points remain, among them the recovery of the internal rotation and the risk of

The Institutional Review Board of the ethical committee of the Montpelier University Hospital approved this project (IRB-MTP 2022-06-202201112).

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instability. The importance of the subscapularis with regard to prosthesis stability and internal rotation has been well established.[4,6,9,12-16,23-26,28,30] The most used approach for rTSA is the deltopectoral approach, in which takedown of the subscapularis is necessary. The way to detach the subscapularis (osteotomy, peel-off, tenotomy, etc.), the way to reattach it, and the need (or not) to reattach it have fueled discussions for years without the best option being determined. In the literature, it seems that in implanting a rTSA, the subscapularis is judged repairable in only 33%-83% of the cases[8,10,12,13,15,27,30,31,34] but in only 50% in most of the series. Moreover, when the subscapularis can be sutured, it heals in only 40% to 76% of the cases.[9,10,12,14] In fact, all these questions would not be necessary if we preserved the subscapularis when one performed the deltopectoral approach.

Lädermann et al first proposed a deltopectoral approach with preservation of the subscapularis for rTSA, arguing that this would allow for a faster rehabilitation and recovery in the absence of a tendon suture to protect.[20,21] An and Chung[1,7] later described a similar technique with satisfying results. Both of these teams reported comparable functional results and complication rate than with a standard deltopectoral approach, but Lädermann[20] found that with a subscapularis sparing approach, the length of stay was divided by 2, cost saving was estimated at 5900$ per patient, and simple shoulder value (SSV) at 3 months was better (80% vs. 70%). However, they also mentioned technical difficulties relative to lateralized prosthesis, stiff shoulders, complex cases, osteophytes removal, etc., making this approach unsuitable for a routine practice and only adapted to selected cases. This probably explains why this approach, despite being conceptually interesting, has not been more studied and widely adopted.

The anterior muscle-sparing (AMS) approach is an optimized anterior approach through the deltopectoral interval that preserves the deltoid, pectoralis major, and subscapularis. We describe here the surgical technique step by step, with the tips and tricks for the capsular release and an optimal joint exposure, making the technique reproducible and safe. We report the clinical and radiological outcomes of our first 45 consecutive cases. We hypothesized that this approach could be routinely used for rTSA implantation, as an alternative to classical approaches (deltopectoral or superior).

Patients and method

Study design

This is a retrospective observational single-center study. We included all the rTSAs the senior author (A.J.) consecutively performed between September 2019 and September 2021 for degenerative affection of the shoulder (massive rotator cuff tear (MRCT), cuff tear arthropathy (CTA), primary glenohumeral (PGHOA) arthritis, and rheumatoid arthritis (RA)) using the AMS approach, with a minimum follow-up of 24 months. All the patients had a magnetic resonance imaging or arthro-computed tomography (CT) scan preoperatively, and only intact subscapularis (29 cases, 64.4%) or with partial lesion of the upper-third (Lafosse classification[22] type I) (16 cases, 35.6%) were included. We excluded the patients with a significant tear of the subscapularis identified on the imaging or intraoperatively (Lafosse classification[22] type II to V), even if in our practice we also preserved the remaining subscapularis when it is partially torn (type II and III). This guaranteed the study population's homogeneity so we could specifically evaluate the benefit of preserving a complete and functional subscapularis. This study received an institutional review board agreement (Montpelier University Hospital, France, IRB-MTP 2022-06-202201112).

Table I
Demographic data.

	Series
Age mean (SD) (range)	74.1 (10.9) y (52-90)
Sex N (%)	
Male	12 (26.7)
Female	33 (73.3)
Dominant side operated N (%)	31 (70.5)
Body mass index mean (SD) (range)	26.6 (4.7) (17.6-36)
ASA score N (%)	
ASA 1	1 (2.2)
ASA 2	29 (64.4)
ASA 3	15 (33.3)
Professional activity	
Retired	34 (75.6)
In activity	11 (24.4)
Surgical history N (%)	10 (22.2)
Arthroscopic subacromial decompression	3 (6.7)
Arthroscopic cuff repair	7 (15.6)
Etiologie N (%)	
CTA	20 (44.4)
MRCT	18 (40)
PGHOA	5 (11.1)
RA	2 (4.4)

ASA score, American Society of Anesthesiologists; *CTA*, Cuff tear arthropathy; *MRCT*, Massive rotator cuff tear; *PGHOA*, Primary glenohulmeral arthritis; *RA*, Rheumatoid arthritis; *SD*, standard deviation.

Patients

A total of 45 shoulders in 45 patients met the inclusion and exclusion criteria. The mean age at inclusion was 74.1 (10.9) years (range 52-90). There were 12 males (26.7%) and 33 females (73.3%). No patient was lost to a minimum 2-year follow-up. The etiology for rTSA was CTA in 20 cases (44.4%), MRCT in 18 cases (40%), PGHOA in 5 cases (11.1%), and RA in 2 cases (4.4%). The demographic data are summarized in Table I.

Implants and surgical technique

All the procedures were performed by the senior author (A.J.), under combined general anesthesia and interscalenic bloc, in a beach-chair position, with the help of Assist-Arm Limb Positioner (CONMED, Utica, NY, USA).

A short onlay stem was used in every case (Ascend Flex, Stryker/Tornier, Montbonnot Saint-Martin, France), mostly uncemented but cemented in 10 cases (22.2%), when primary metaphyseal stability was not obtained by a press-fit effect due to a poor bone quality. On the glenoid side, the Aequalis baseplate (Stryker/Tornier, Montbonnot Saint Martin, France) was used in 30 cases with a bony lateralization (BIO-RSA for Bony Increased Offset Reverse Shoulder Arthroplasty, as described by Boileau[2]) in 26 cases (86.7%), and the Perform baseplate (Stryker/Tornier, Montbonnot Saint Martin, France) was used in 15 cases, with a metallic lateralization in all the cases (MIO-RSA for Metallic Increased Offset Reverse Shoulder Arthroplasty). The choice between bony and metallic lateralization was done according to the preoperative 3-dimensional planning, the morphology of the glenoid, and the humeral head bone quality. Finally, a bony or metallic lateralization was done in 41 of the 45 cases (91%). A 36-mm standard glenosphere was used in 32 cases, a 39-mm sphere in 9 cases, and a 42-mm sphere in 4 cases.

All the protheses were implanted following the AMS approach. This approach starts with a standard delto-pectoral approach through the same skin incision from the tip of the coracoid process and going through the interval between the deltoid laterally and the pectoralis major medially. The conjoint tendon has to be released and reclined medially, while the upper part of the pectoralis major

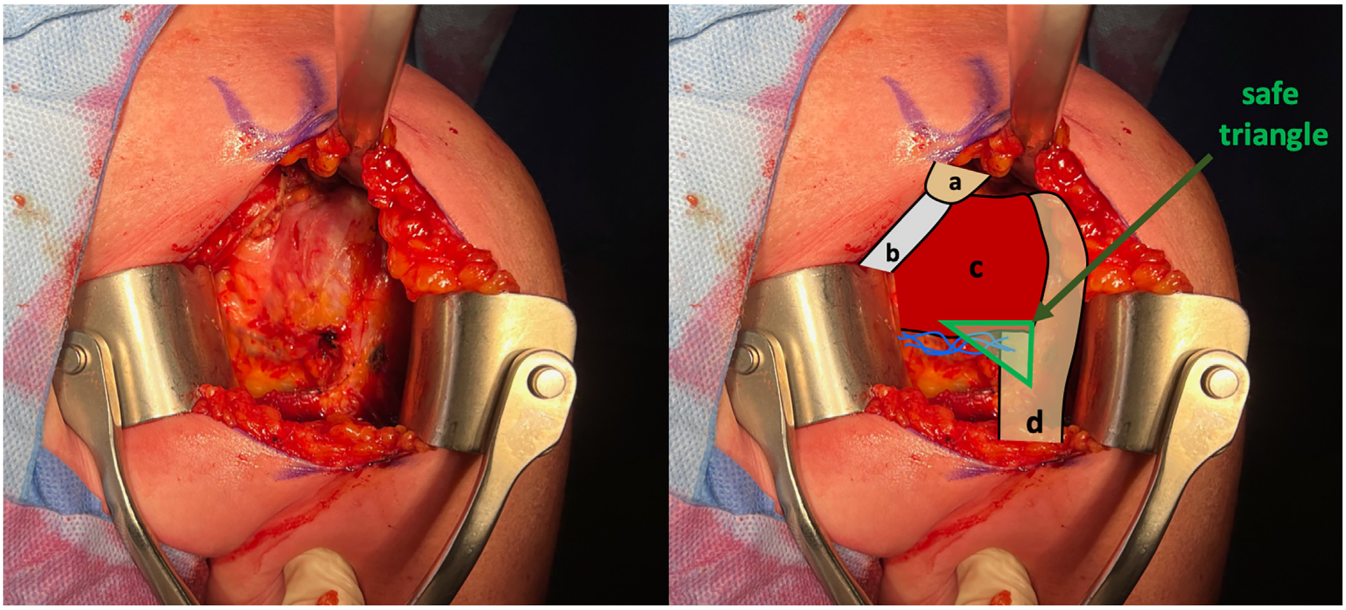

Figure 1 Inferior release: the safe triangle. *a*. Coracoid process. *b*. Conjoint tendon. *c*. Subscapularis. *d*. Humerus.

tendon is preserved. The coraco-acromial ligament is cut for easier exposure. The first specific step is the inferior release to detach the inferior capsule from the calcar, from the anterior to the posterior cord of the inferior gleno-humeral ligament. Inferior osteophytes can be easily removed at this step. Once the subscapularis tendon has been visualized and its integrity confirmed, the "3 sisters" vessels are cauterized. A safe triangular space delimited by the subscapularis, the pectoralis major, and the humerus (Fig. 1) has to be identified, and then the inferior border of the subscapularis is separated from the capsule and reclined upward using a small Langenbeck retractor. Then, the capsule can be safely opened, following the calcar curvature (Fig. 2). A Hohman retractor is placed inside the joint, pushing the soft tissue medially and allowing the surgeon to complete the release to the posterior insertion of the capsule. The second specific step is the antero-superior release (Fig. 3). The goal is to free the anterior capsule from the glenoid as well as the superior part of the subscapularis to ensure its mobility during the procedure. A Hohman retractor is placed inside the joint to push the humeral head posteriorly, and a second retractor is supported on the anterior edge of the glenoid between the subscapularis and the middle glenohumeral ligament. The tensioned middle glenohumeral ligament is cut, and the capsule is released from the coracoid to the inferior part of the glenoid. The third step is the humeral exposure and preparation, which is performed in a superior approach, with the arm in retropulsion (Fig. 4). The subscapularis is protected by a retractor anteriorly, and the remaining posterior cuff is protected by a second retractor posteriorly. Then, the humeral cut and preparation are done from the top down. Guidance (generic guide, patient-specific guide, or mixed reality visualization or guidance) is useful at this step to ensure a correct angulation, version, and height of the cut. Finally, the fourth step is the glenoid exposure and preparation (Fig. 5). Three retractors are needed at this step as follows: a wide glenoid retractor supported on the postero-inferior edge of the glenoid, a Hohman retractor on the postero-superior edge, and another Hohman retractor on the antero-inferior edge to protect and inferiorize the subscapularis. The capsular release is completed posteriorly so that the capsule detachment from the glenoid is circumferential. If all the steps of the release have been performed correctly, the humerus can be then pushed posteriorly in a neutral rotation (or slight internal rotation). If this is not possible, then the capsular release should be completed on one side or the other. Once the humeral and glenoid sides have been prepared, the definitive prosthesis can be implanted and reduced. The final testing assesses the range of motion, stability, absence of impingement, and integrity of the subscapularis. After a meticulous cleaning and hemostasis, the closure is limited to the skin because there is no other structure to repair. The mean operative time was 62 (11) minutes (range 44-90). When the superior cuff was not torn (PGHOA, 5 cases), the intact supraspinatus was first detached from the greater tuberosity, allowing the surgeon to perform the technique exactly as described above, and the tendon was reattached with trans-osseous sutures at the end without any modification of the rehabilitation protocol. In the 40 other cases (CTA, MRCT, and RA), the supra-spinatus was always torn, with extension to infra-spinatus (total or partial) in 35 cases (87.5%), and teres minor was torn in only two cases (5%). No additional tendon had to be detached in those cases.

Postoperatively, patients were given a simple sling to rest and protect the shoulder for the first few days, but there was no strict immobilization. Passive and active motion started at day 1, progressively and with respect to pain level but without restriction of motion, especially regarding internal or external rotations. Patients were allowed to use their shoulder for daily activities from day 1. The patients were allowed to return home at day 1, except for those who asked to go to a rehabilitation center.

Clinical and radiological evaluation

Preoperative evaluation included a complete clinical evaluation, with demographic data, medical and surgical history, active and passive range of motion record, visual scale evaluation of pain, Constant score, and SSV. The preoperative radiologic evaluation, obtained for all the patients, included a 2-incidence X-ray, magnetic resonance imaging, or Arthro-CT for rotator cuff evaluation, and finally a CT scan with 3-dimensional preoperative planning using the Blueprint software (Stryker/Imascap, Plouzané, France).

Postoperatively, all the patients had a clinical evaluation with a minimum 24-month follow-up, including active and passive range of motion record, visual scale evaluation of pain, Constant

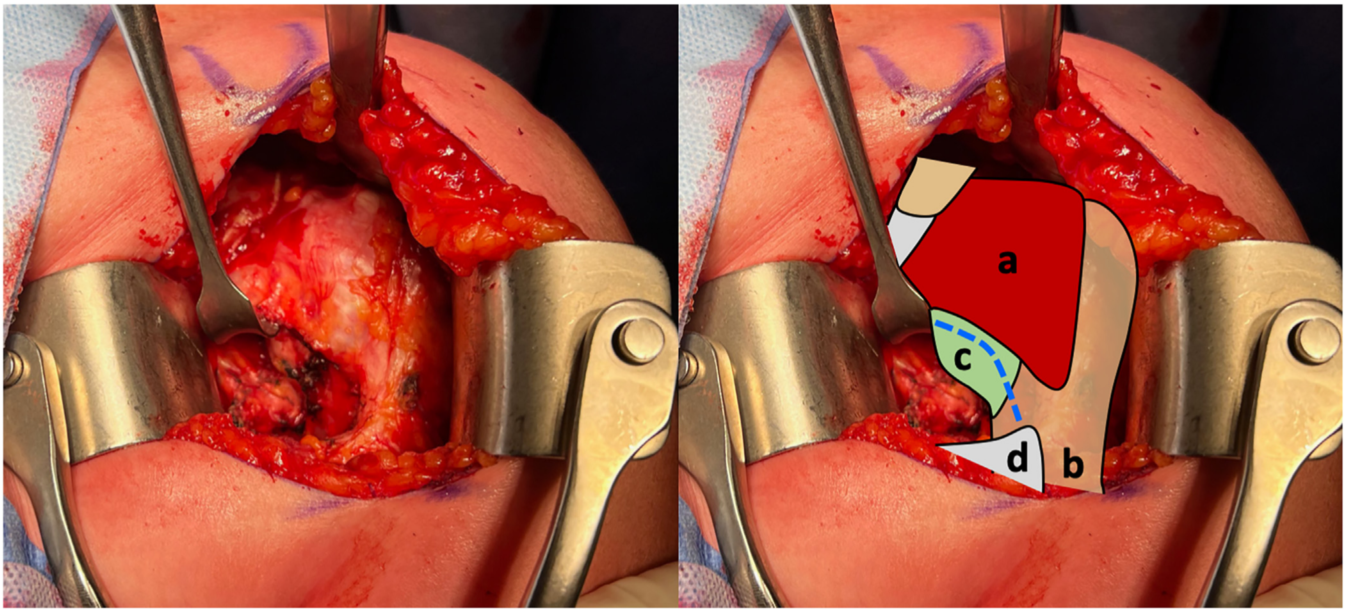

Figure 2 Inferior release: Capsule exposure and opening. *a*. Subscapularis. *b*. Humerus. *c*. Capsule. *d*. Pectoralis major.

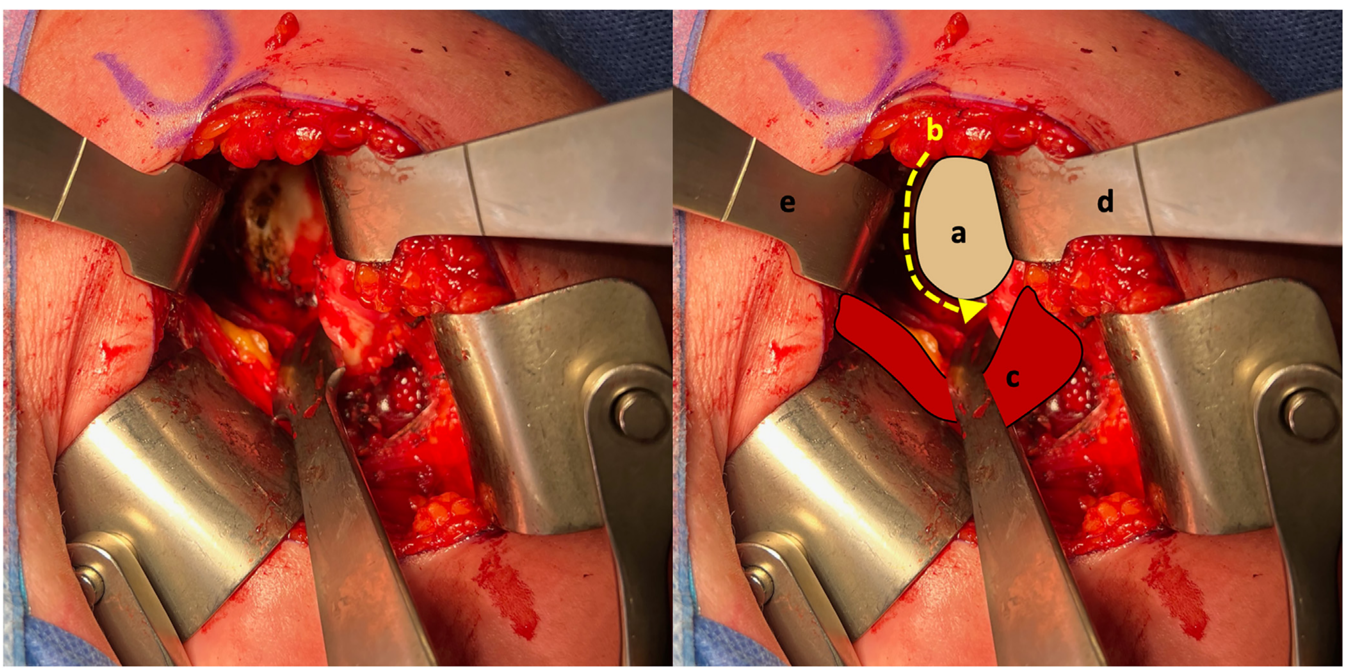

Figure 3 Antero-superior release. *a*. Glenoid. *b*. Anterior capsule and ligaments release, from the coracoid to the inferior glenoid. *c*. Subscapularis. *d*. Intra-articular retractor. *e*. Anterior retractor between the glenoid and the subscapularis.

score, and SSV. Patients who underwent revision surgery were included in the final clinical analysis, because revision was done following the same AMS approach with subscapularis preservation. All the patients had a postoperative X-ray (Fig. 6), on which was assessed humeral stem alignment (Fig. 6, *A*), glenoid implant position, and osteophyte removal (complete or not). The glenoid implant height (Fig. 6, *C*) was assessed according to the inferior gap between the inferior pillar and the inferior part of the sphere and could be high (<−2 mm), flush (−2 mm to 2 mm), or low (>2 mm). The glenoid implant inclination was assessed using the Levigne angle (Fig. 6, *B*) and was categorized as superior (<90°), neutral (90°), or inferior (>90°). Finally, a radiographic evaluation could be obtained at the last follow-up for 40 patients out of 45 (89%) to evaluate the notching rate according to Sirveaux classification[29] and the presence of radiolucent lines, bone resorption, or loosening. The mean radiographic follow-up was 26 (13.1) months (range 21-50)

Statistical analysis

Data collection and analysis were conducted using EasyMedStat software (EasyMedStat, Levallois-Perret, France). All the descriptive

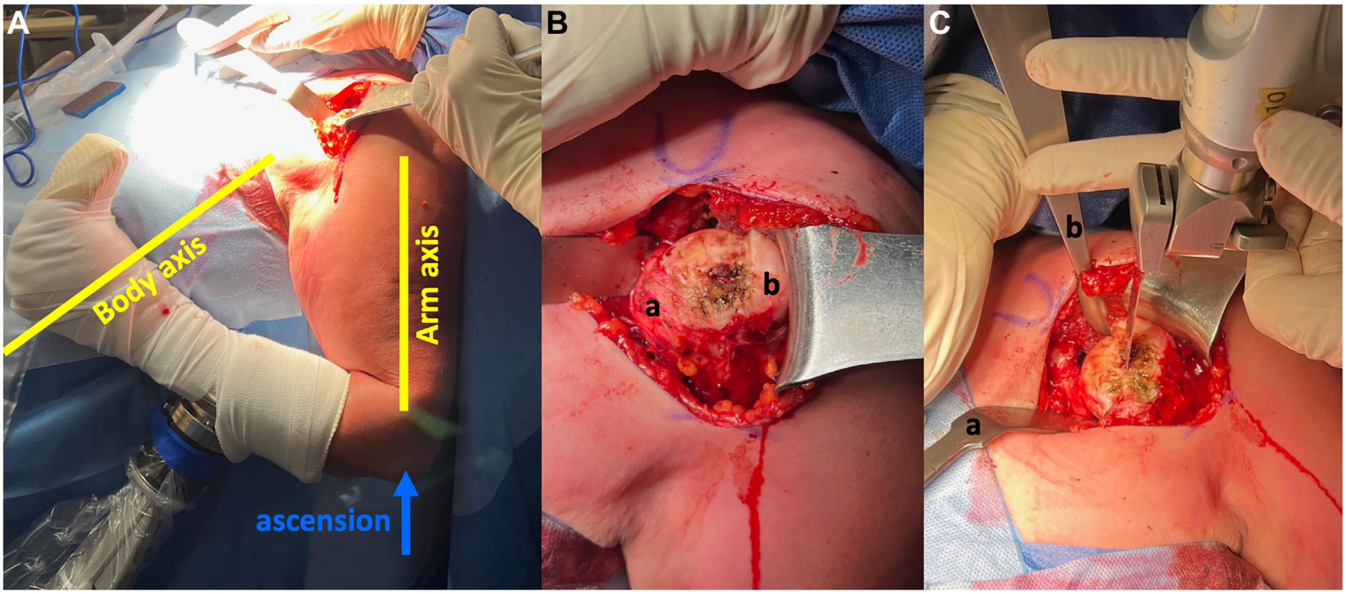

Figure 4 Humeral exposure and humeral cut. (**A**). Arm is positioned in retropulsion. (**B**). Exposure of the humeral head. Vision from above with the subscapularis (a) and the posterior cuff (b). (**C**). Exposure of the anatomical neck with an anterior (a) and a posterior retractor (b) to optimize the neck visualization and protect the tendons from the saw.

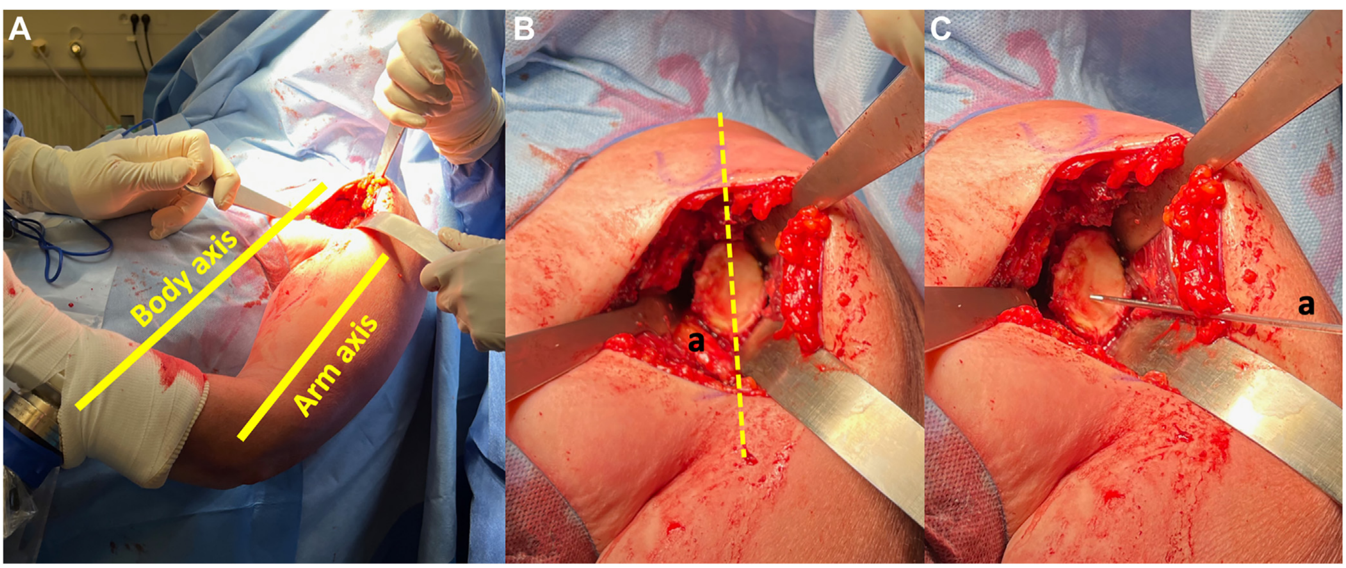

Figure 5 Glenoid exposure and preparation. (**A**). Arm axis is positioned parallel to the body. (**B**). Glenoid exposure needs 3 retractors. Humerus is pushed posteriorly. The subscapularis is crossing inferior to the glenoid (a), and the supero-inferior axis of the glenoid is free. (**C**). Positioning of the guide wire (a) without any limitation regarding inferior tilting.

data were presented in terms of mean (SD) (range min-max). Statistical analysis was conducted with a 95% confidence level. Comparison of qualitative variables used the chi-square test. Quantitative variables were compared using the Student t-test, if the normality was verified with the Shapiro–Wilk test or with the Wilcoxon signed-rank test if not. A *P* value <.05 was considered statistically significant.

Results

All the procedure could be performed with subscapularis preservation, without difficulty related to the approach or intraoperative complication. No secondary tenotomy was needed (even partial).

Postoperatively, 36 patients left the hospital after 1.8 (1.1) days (range 0-5), and 28 of them were at home the day after the surgery. Nine patients (20%) had to go to a rehabilitation center and spend 3.5 (2.1) days (range 1-6) in the hospital, waiting for a place in a center.

The mean clinical follow-up was 28.4 (12.2) months (range 24-50). Table II presents the data from the preoperative and postoperative clinical evaluation. The mean Constant score was 36 (14) (range 9-59) preoperatively and 70 (10) (range 48-94) postoperatively, showing significant improvement (*P* <.001). We also found significant improvement in pain, SSV, active anterior elevation, active lateral elevation, passive, and active external rotation 2 (external rotation with the arm at 90° of abduction), active internal rotation, and strength (Table II). Postoperatively,

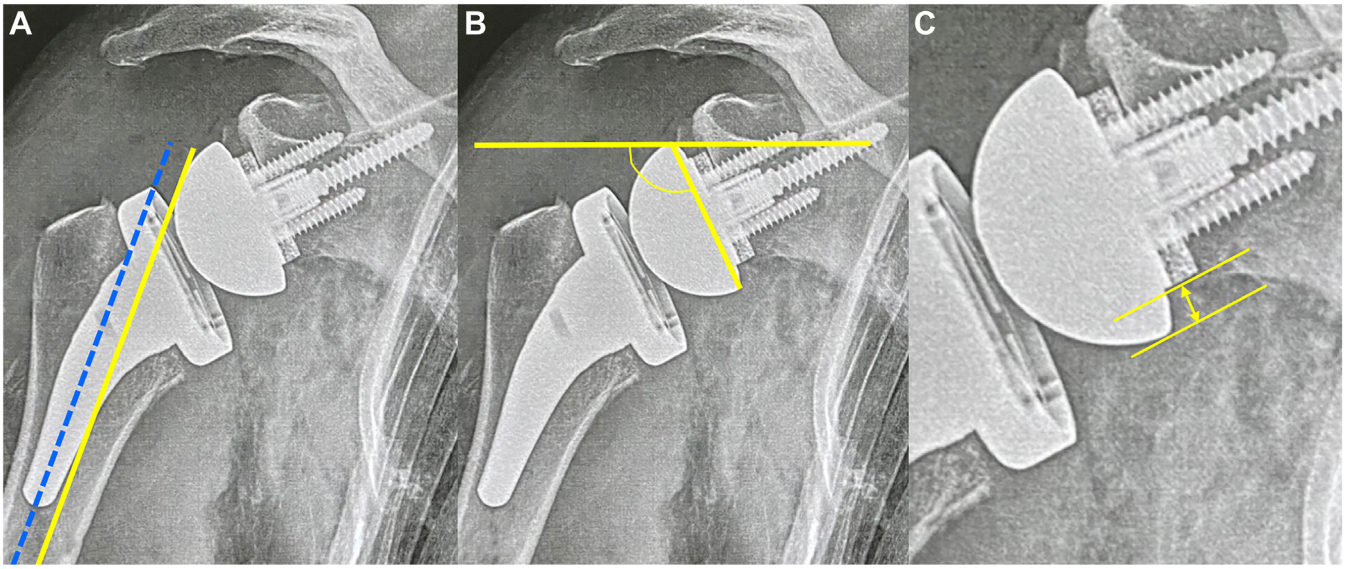

Figure 6 Postoperative X-rays analysis. (**A**). Stem axis (*blue line*) and humeral axis (*yellow line*). (**B**). Levigne angle (value >90° = inferior tilt). (**C**). Inferior offset defining the height of the glenoid implant: high (negative offset), flush (null offset), or low (positive offset).

Table II
Preoperative and last follow-up clinical evaluation.

	Preoperative	Last follow-up	*P*
Pain (0-10)	6.3	0.7	**<.001**
SSV (%)	33	81	**<.001**
Constant score (points)	36	70	**<.001**
Active anterior elevation (°)	83	138	**<.001**
Passive anterior elevation (°)	136	148	.12
Active lateral elevation (°)	72	124	**<.001**
Passive lateral elevation (°)	123	134	.12
Active external rotation 1 (°)	28	27	.78
Passive external rotation 1 (°)	41	41	.89
Active external rotation 2 (°)	48	62	**.01**
Passive external rotation 2 (°)	64	81	**<.001**
Active internal rotation 1 (n)			
Buttock	12	1	**<.001**
Sacrum	7	1	
L3	20	20	
T12	5	13	
T7	0	10	
Strength (kg)	0.5	3.5	**<.001**

SSV, Simple Shoulder Value.
Bold *P* values are statistically significant.

95.6% of the patients (43/45) reached level L3 or higher in active internal rotation.

On the postoperative X-ray, the glenoid implant was positioned in a low position in 41 cases (91.1%) and flush in four cases (8.9%). There was no case with a glenoid implant in a high position. Glenoid inclination was inferior in 42 cases (93.3%) and neutral in three cases (6.7%), with a mean Levigne angle of 107.7 (8.8)° (91-123). The humeral stem was aligned with the humeral axis in 27 cases (60%), in valgus in 15 cases (33.3%) with a mean deviation of 4.1° (1.5) (range 2-7), and in varus in two cases (4.4%) with a mean deviation of 3.5° (0.5) (range 3-4). The mean overall deviation was 1.5 (2.1)° (0-7). Among the nine patients with significant osteophytes on the humeral side preoperatively, removal was complete in eight cases (88.9%) and partial in one case (11.2%).

At the last follow-up, a radiographic evaluation was available for 40 patients (88.9%). The glenoid implant was stable in all the cases without radiolucent lines. A scapular notch was identified in five cases (12.5%), only at grade 1 of Sirveaux classification. Of the 23 cases of bony lateralization, 21 were judged as stable (91.3%), one had a minor lysis, and one had a major lysis. Proximal humerus remodeling attributed to a stress-shielding reaction was reported in eight cases (20%).

Six postoperative complications were recorded (13.3%) as follows: one infection (2.2%), two cases of traumatic early glenoid loosening (4.4%), two acromion fractures (4.4%), and one compressive hematoma (2.2%) needing reoperation. The infection case (Staphylococcus *epidermidis*) underwent 1-step revision following the AMS approach, followed by a 3-month adapted biantibiotherapy, and finally healed, with a Constant score of 77 at the last follow-up and an internal rotation reaching T12. The two cases of glenoid loosening occurred in the first six months after the operation, secondary to a hard fall in active patients. A unipolar revision was performed in both cases, following the AMS approach again, with good outcomes (Constant scores of 71 and 74 at the last follow-up and an internal rotation reaching L3 and T12, respectively).

Discussion

This study reported promising results regarding the use of a subscapularis-sparing approach for routine rTSA implantation. Clinical and radiological outcomes were equivalent to those previously reported for rTSA with classical approaches but with no cases of instability and improved internal rotation, with 95% of the patients able to reach level L3 or higher. Another benefit was the ability to start passive and active rehabilitation as well as use of the arm for daily activities on day 1, without any restriction or sling, thanks to the absence of a tendon suture to protect. This may be valuable for final motion recovery, as well as for patient's comfort, confidence, and return to autonomy.

The importance of the subscapularis for rTSA, although sometimes debated, has been widely reported in the literature, with a positive influence on stability and active internal rotation. Numerous studies have demonstrated a lower rate of instability after rTSA when the subscapularis was sutured.[4,6,13,23,24,26,30] Other studies have shown no significant difference in stability regardless of whether the subscapularis was repaired[8,11,16,27,31,33-35] but often with visible differences and a small number of cases, preventing statistical significance, such as De Fine et al (1.6% vs. 0.8% when repaired),[11] Friedman et al (1.2% vs. 0%),[16] Vourazeris et al (2.6% vs. 0%),[31] and Werner et al (2.8% vs. 0%).[35] Therefore, Edwards et al[13] recommended that an "attempt to repair the subscapularis should be made in every case." In our series, we did not record any case of instability (0%), which supported these findings. Many authors have also reported improvement in active internal rotation when the subscapularis is repaired. Chelli et al[5] reported recently that a functional internal rotation (L3 level reached) was obtained in only 67% of the cases after rTSA and that the repair of the subscapularis was major factor for better internal rotation after rTSA. More interestingly, some authors showed that the benefit was even stronger when the subscapularis has been repaired and has healed based on ultrasound evaluation. Collin et al[9] found that when the subscapularis was repaired, it healed in only 52.6% of the cases. Regarding internal rotation, 85% of the patients with an intact subscapularis reached the L3-L5 level, whereas only 59% of the patients without subscapularis did. Dedy et al[12] and Engel et al[14] reported similar results. Based on a large series of nearly 2000 cases, Rohman et al also found that the absence of subscapularis repair was a significant factor for loss of internal rotation postoperatively. In our series, using the AMS approach, 95% of the patients reached at least level L3, which seemed to be better than the results reported in the literature with classical approaches. On the other hand, some biomechanical studies have suggested that repairing the subscapularis could have a negative influence on the outcomes after rTSA by increasing joint load and deltoid forces and by limiting external rotation.[17,18] However, this has never been demonstrated clinically; no clinical study has reported poorer functional results when the subscapularis was repaired compared to when it was not. One could also emphasize that the suture of the subscapularis leads to more restrictive rehabilitation instructions and therefore could hinder the postoperative range of motion.

If it seems better to repair the subscapularis in every case and better when the tendon heals, then it is reasonable to think that it is even better to preserve it. Subscapularis preservation ensures the tendon's integrity and therefore a benefit regarding stability and internal rotation. As there is no suture to protect, it also allows for early passive and active rehabilitation without any motion restriction. Most of the authors recommend postoperative restrictions for 3 to 6 weeks after reverse shoulder replacement through a deltopectoral approach to protect the subscapularis repair.[3,19] These restrictions includes wearing a sling, delayed internal or external rotations, and delayed active motion. Even with these precautions, the repaired subscapularis only heals in 40%-76% of the cases.[9,10,12,14] With a subscapularis sparing approach, there is no concern about the tendon healing. In our series, rehabilitation could be started immediately without restriction and without risk regarding subscapularis integrity. The patients were allowed to return immediately to the activities of daily living. This facilitated the return to autonomy, especially for older patients and those living alone. This might lead to a shorter stay in the hospital and earlier return to autonomous daily living, as suggested by Lädermann et al[20]

Lädermann et al[21] first described a deltopectoral approach with preservation of the subscapularis in 2016. More recently, a Korean team also published a description of the technique[7] and their results using this approach.[1] Both teams published comparative studies,[1,20] comparing the subscapularis-sparing approach to a classical deltopectoral approach, with a small sample series. None of these authors reported significant differences between the two approaches regarding clinical outcomes, radiographic outcomes, or complication rate, but Lädermann et al reported earlier recovery (better outcomes at 3 months) and a shorter hospital stay with the subscapularis-sparing approach. On the other hand, the two authors agreed on the technique's technical difficulty, the impossibility of using it for complex cases or with lateralized implants, and the difficulty of accessing and removing the inferior osteophytes. In our study, we described a modified and optimized technique, including additional steps, especially the inferior capsular release, allowing for easier mobilization of the joint, exposure of the humerus, and the glenoid, as well as a complete removal of the osteophytes. The use of this particular "AMS approach" did not lead to an increased operative time or specific complications and was compatible with the use of lateralized prosthetic configurations. Because it is kind of a superior approach performed through the deltopectoral interval, we emphasize that this should not be seen as a challenging technique and that it could be accessible to any shoulder surgeon in a routine practice, provided that all the steps are rigorously respected. In our experience, this approach can be used for every cases of rTSA, whatever the etiology, the bone deformity, or the degree of stiffness. In case of intraoperative difficulty, the subscapularis can always be cut secondarily, even if we never had to do it in this series. Therefore, attempt to preserve the subscapularis seems always justified. Moreover, this study only included shoulders with an intact subscapularis for the sake of homogeneity, but the AMS approach can also be used when the subscapularis is partially torn, making the technique even easier. Peserving an altered subscapularis, which could not have been sutured if a detachment had been done (17% to 67% in the literature[8,10,12,13,15,27,30,31,35]) might be interesting too.

This study is a preliminary report of our 45 first cases (including the learning curve), with a detailed description of the technique and assessment of the results. As a preliminary report, this study had some limitations. We had a limited number of patients, a limited follow-up, and no control group. It demonstrated the feasibility and the reliability of the technique, supporting subscapularis preservation, but it could not prove any superiority of the AMS approach compared to the previously described approaches. Obviously, a larger-scale comparative study will be necessary to draw further conclusions. Another limitation was that we only reported cases performed with the same implant, and therefore with the same instrumentation. This study cannot predict possible difficulties that we might encounter with other implant or instrumentation designs, which might require some technical adaptations.

Conclusion

The importance of the subscapularis for internal rotation and stability after rTSA has been demonstrated. However, in the case of detachment, in a classical deltopectoral approach, the tendon is not always repairable. When it is repaired, healing is not always obtained, with potential consequences for the outcomes. The AMS approach is a deltopectoral approach with preservation of the subscapularis, allowing for early rehabilitation without motion restriction as well as promising results, especially regarding internal rotation and stability.

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