MASSIVE ROTATOR CUFF TEARS TREATED BY A DELTOID MUSCULAR INLAY FLAP

C. DIERICKX[1], H. VANHOOF[2]

We reviewed 20 patients with a painful massive, irreparable rotator cuff tear, classified as type III according to Gerber (11). They were all treated with an open partial acromionectomy, an attempt for primary repair and an anterior deltoid muscle inlay flap, as described by Apoil and Augereau (1, 2). After minimum follow-up of 12 months (average 23.5 months) 17 out of 20 patients were satisfied and better, and the UCLA shoulder scoring (9) improved from an average of 9.35 to an average of 25.7 (max. of 35). Pain and function improved in all patients, with an average of 4.35 and 4.00 points respectively. Active forward flexion improved in 17, and strength of forward flexion improved in 15 patients. Our results were compared with those of Apoil and Augereau, and with the results obtained by other authors after open or closed acromioplasty and cuff tear debridement. This retrospective study tries to give a critical view of this French technique, and concludes that, although no negative effect can be demonstrated by the use of a deltoid muscle flap, a definite advantage cannot be proved.

Keywords : shoulder ; rotator cuff tear ; deltoid muscle ; reconstruction.
Mots-clés : épaule ; coiffe des rotateurs ; muscle deltoïde ; reconstruction.

INTRODUCTION

Rotator cuff tears do not always need surgery. Indications for surgical repair of a proven tear are persisting chronic pain on activity or at night, and loss of function, resistant to conservative therapy.

According to the size criteria of the American Shoulder and Elbow Surgeons, a tear of more than 5 cm is called massive, but if not retracted and still mobile, it wil not be difficult to close it. Therefore, an intraoperative classification was preferred, as proposed by C. Gerber (11, 12). According to his classification a complete tear is only called massive or type III if, after minimal debridement and mobilization, the remaining cuff cannot be anchored in a slightly medial bony trough when the arm is abducted 60°.

For this type of irreparable tears many techniques have been described :

— Open subacromial decompression (13, 16, 21).
— Arthroscopic debridement and subacromial decompression (6, 10, 14).
— Advancement of the supraspinatus muscle (7, 23).
— Medialization of the insertion (23).
— Freeze-dried rotator cuff graft (15, 18).
— Latissimus dorsi rotation flap (11, 12).
— Fascia lata, free biceps tendon or coracoacromial ligament as grafts (5, 9, 25).
— Transposition of teres minor, infraspinatus, or subscapular tendons (9, and many others).
— Carbon fiber (20, 22).
— Reestablishment of the roof of the bursa (24).

In 1985 Apoil and Augereau (1) described their technique for repair of large tears (> 3 cm and including at least the infra- and supraspinatus tendons) with a distally based deltoid muscular flap to close the cuff defect. Since 1988 the senior

[1] Department of Orthopedics, University Hospital Pellenberg, K.U. Leuven, B-3212 Pellenberg, Belgium.
[2] Orthopedic Service, St.-Jansziekenhuis, Schiepsebos, B-3600 Genk, Belgium.
Correspondence and reprints : H. Vanhoof, St.-Jansziekenhuis, Schiepsebos, B-3600 Genk, Belgium.

author has used this French technique when an irreparable defect was found intraoperatively.

The aim of this study was to evaluate in a retrospective study the results of this technique after a minimum follow-up of 12 months by using the UCLA shoulder rating scale. The results are compared with those of Rockwood (21), Burkhart (6), Esch (10) and Levy (14).

MATERIALS AND METHODS

All cuff tears included in the study were classified intraoperatively as Gerber type III, after debridement of the cuff. Between 1988 and 1992, we treated 21 such cases, all by the use of a deltoid muscular flap to close the defect. One patient was lost to follow-up, but we assumed her to have an unsatisfactory result. We were not able to include her in the study. Twenty patients with a minimum follow-up of 12 months (range 12 to 47 ; average 23.5 months) were reviewed.

The male-to-female ratio was 14/6. The average age at operation was 60.6 years (range 43 to 75 years). Eight patients were less than 60 years and two patients were more than 70 years old. All patients were right-handed, and in 13 cases the procedure was done on the dominant shoulder (65% dominant side). In one patient the deltoid flap was used in a revision procedure for failed rotator cuff repair.

One patient sustained an inferior shoulder luxation. Thirteen patients related their shoulder pain to minor trauma ; one of these was work related. The average period of preoperative complaints was 6.8 months (range 1 to 24 months). Fifteen patients experienced night pain ; 4 patients complained of a lack of power and function, and one had pain during activity. Subacromial infiltrations of steroids were part of the conservative treatment in 14 patients (70%) (average 3.25, range 1 to 10).

Surgical technique

With the patient in beach-chair position and under general anesthesia, the shoulder was draped with the arm free. A 10-cm long coronal incision was started in the supraspinatus fossa and extended 5 cm laterally over the deltoid (see fig. 1). A strong tenoperiosteal flap was carefully stripped from the upper acromial surface, in line with the skin incision.

A limited anterolateral acromionectomy was performed, as described by De Palma in his superoanterior incision (8) and by Bayley and Kessel (5), extended by a deltoid split of maximum 4 cm in line with its fibers (see fig. 2). After transsection of the coracoacromial ligament and partial bursectomy, the cuff remnants were debrided until viable tissue was exposed. All ruptured rotator tendons were mobilized superiorly by blunt and inferiorly by sharp dissection.

While maintaining traction by stay sutures, and with the arm in 60° abduction, an attempt was made to close as much as possible of the rotator cuff with the SCOI suture technique. In two cases Mitek anchors were used. For the remaining defect a deltoid flap of an appropriate size was prepared from the anterior part of the middle deltoid (just anterior to the deltoid split), as described by Apoil and Augereau (1, 2, 4) (see fig. 1). The flap was sutured in the defect to the rotator cuff remnants with resorbable stitches (see fig. 3). Free movement of the repair under the acromion was checked in elevation and abduction.

A secure refixation of the tenoperiosteal flap to the acromion was performed with transosseous stitches. The "deltoid defect" could often be closed.

Postoperative care

Eighteen patients (90%) immediately received a soft abduction pillow of 60°. This pillow was used for 3 to 7 weeks (average : 5 weeks). After this immobilization period, a slow rehabilitation scheme with pendulum and rotational mobilization exercises began. The two others received a sling. Three weeks later, physiotherapy was added.

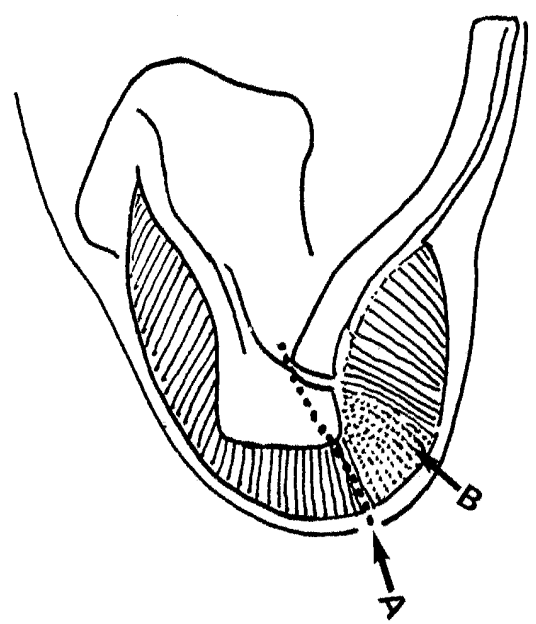

Fig. 1. — A) Skin incision ; B) Deltoid flap.

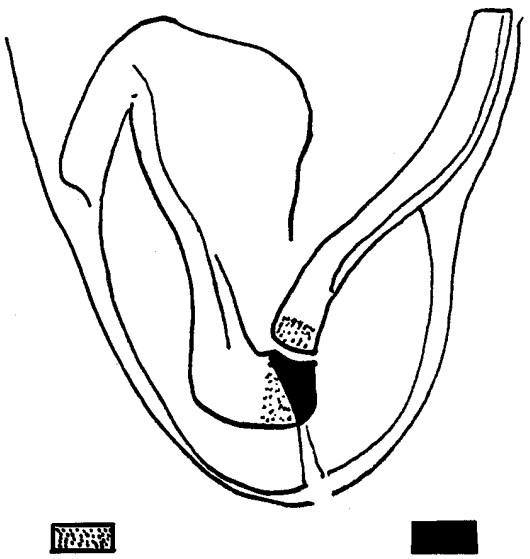

Fig. 2. — Acromioplasty and partial acromionectomy.

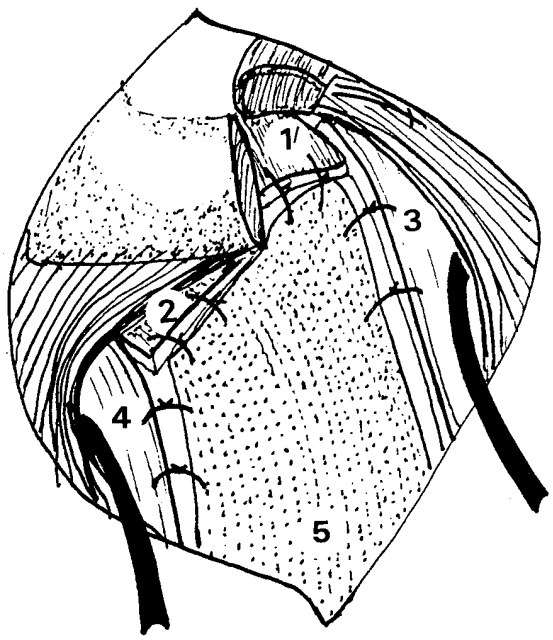

Fig. 3. — 1) Supraspinatus tendon ; 2) Infraspinatus tendon ; 3) Subcapsular tendon ; 4) Teres minor ; 5) Deltoid muscle flap.

Evaluation criteria

We reviewed these 20 patients clinically and röntgenographically. Anteroposterior and Morrison outlet view radiographs were made to measure the acromiohumeral distance. The UCLA Shoulder Rating Scale was used to rate the pre- and postoperative scores (see table I) (9). Pain and function were each rated

Table I. — University of California at Los Angeles end result scores* as described by Ellman (9)

	Points
Pain	
Present all of the time and unbearable ; strong medication frequently	1
Present all of the time but bearable ; strong medication occasionally	2
None or little at rest, present during activities ; salicylates frequently	4
Present during heavy or particular activities only ; salicylates occasionally	6
Occasional and slight	8
None	10
Function	
Unable to use limb	1
Only light activities possible	2
Able to do light housework or most activities of daily living	4
Most housework, shopping, and driving possible ; able to do hair and dress and undress, including fastening brassiere	6
Slight restriction only ; able to work above shoulder level	8
Normal activities	10
Active forward flexion	
150° or more	5
120 to 150°	4
90 to 120°	3
45 to 90°	2
30 to 45°	1
Less than 30°	0
Strength of forward flexion (manual muscle-testing)	
Grade 5 (normal)	5
Grade 4 (good)	4
Grade 3 (fair)	3
Grade 2 (poor)	2
Grade 1 (muscle contraction)	1
Grade 0 (nothing)	0
Satisfaction of the patient	
Satisfied and better	5
Not satisfied and worse	0

* Maximum score, 35 points.

from 1 being the worst score, to 10 being the best score. Active forward flexion and strength of forward flexion were rated on a scale of 0 to 5. A subjective patient satisfaction score of 0 or 5 was added. The maximum total score was 35 points. End results were rated as excellent (34-35 points), good (28-33 points), fair (21-27 points), or poor (0-20 points).

RESULTS

Pain and function improved in all patients. The average UCLA pain score improved significantly (Student t-test difference against zero at the level of 0.0001) : from 2.95 (constant pain) to 7.3 (pain during heavy or particular activities) (see fig. 4).

The average UCLA function score improved significantly ($p < 0.0001$), from 3 (only light activities possible) to 7 (most housework, shopping, and driving possible) (see fig. 5).

Forward flexion improved in 17 (85%) patients and strength of forward flexion improved in 15 (75%) patients. The average UCLA active forward flexion score improved significantly ($p < 0.0001$) from 1.55 (30 to 40°) to 3.8 (> 90°) (see fig. 6).

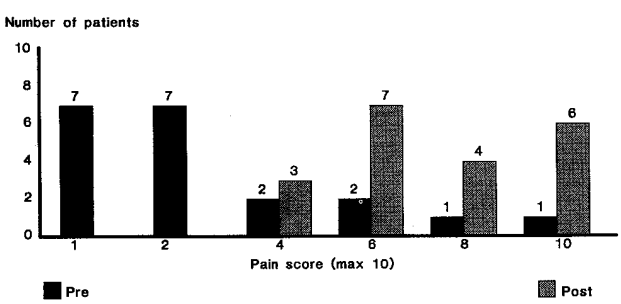

Fig. 4. — Pre- and postoperative pain score (UCLA).

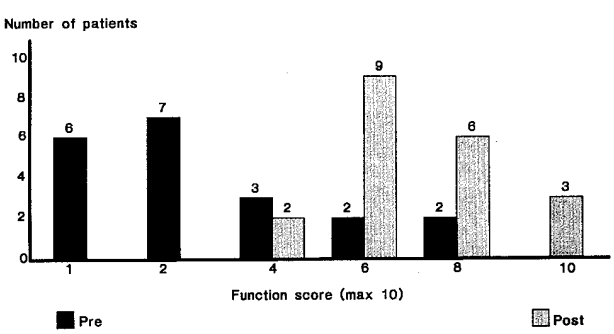

Fig. 5. — Pre- and postoperative function score (UCLA).

The average UCLA score for strength of forward flexion improved significantly ($p < 0.0001$) from 1.85 (= muscle contraction) to 3.35 (= fair) (see fig. 7). All scoring for strength was low because only 2 points were given if the patient could elevate his or her arm against gravity to 90°.

Seventeen patients (85%) were subjectively satisfied and felt better after surgery (see fig. 8). The overall objective scoring showed excellent or good results in 8 patients (40%), fair results in 8 patients (40%), and poor results in 4 patients (20%) (see figs. 9 and 10).

One of the four dissatisfied patients was the only revision included in the study. It was also a work-related traumatic rupture. There were three com-

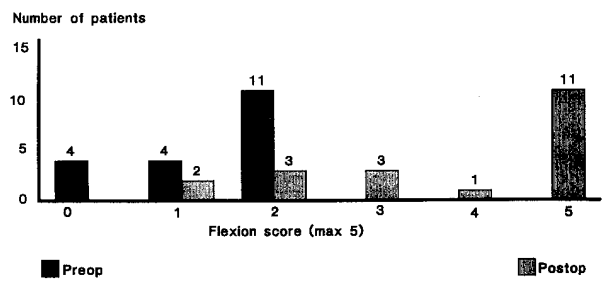

Fig. 6. — Pre- and postoperative flexion score (UCLA).

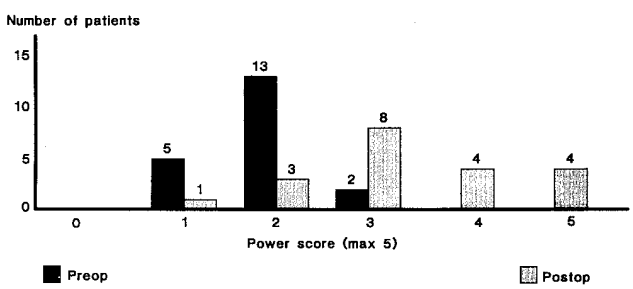

Fig. 7. — Pre- and postoperative power score (UCLA).

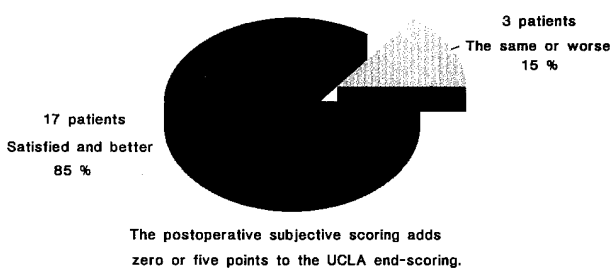

Fig. 8. — Subjective scoring.

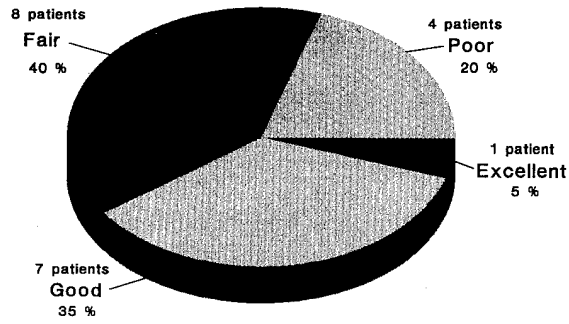

Fig. 9. — Overall result UCLA Postop score.

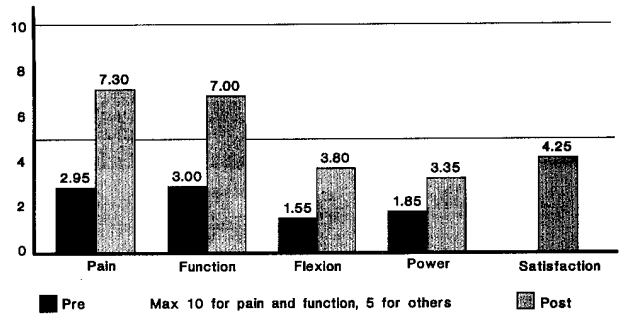

Fig. 10. — Preop and postop UCLA scores.

plications : postoperative wound drainage required a partial revision of the deltoid flap and secondary closure with an ultimately good result. Two patients failed to regain mobility of the involved shoulder and needed manipulation under anesthesia at 2 and at 8 months. They respectively had a poor (14 points) and a fair (27 points) end result. Sixteen patients were retired or were doing only household chores before the operation and continued to do these activities and hobbies afterwards. A 43-year-old soldier returned to slightly reduced activities. One manual laborer remained unemployed due to his unsatisfactory result (see above), and another was disabled by his back problems. One office worker returned to the same job but had to give up contact sports.

We found an inverse correlation between the overall end result and the duration of the complaints before surgery, with a Spearman-Rank correlation coefficient of 0.409 (significant at the level $p < 0.05$). Measurements of the acromiohumeral distance of the anteroposterior and the Morrison outlet view did not correlate with the end result. Neither was there a statistical correlation between the end result and the number of preoperative infiltrations or the presence of a traumatic onset. Two arthro-CT scans made at follow-up showed leakage into the subacromial bursa but also showed a subacromial soft tissue interposition corresponding to the deltoid muscular flap.

DISCUSSION

Apoil and Augereau (1-4), showed the synchronous contraction of the supraspinatus and the deltoid muscle. They suggested a synergistic function of both muscles, and preserved innervation and vascularization of the deltoid muscle flap. They hoped to prevent proximal migration of the humeral head, and they saw humeral head centralization on active abduction as a result of active contraction of the deltoid flap in 6 out of 31 postoperative eccentric humeral heads. (4, Augereau, personal communication). These authors described with their technique, using the Constant scoring system (4), better results than ours : 71% of their patients had excellent, very good or good results, if the postoperative results were sex- and age-matched. The muscular force of active elevation was estimated to be 50% of the opposite shoulder.

All our patients improved significantly concerning pain and function scores, and 85% were satisfied after surgery. The power of active forward flexion improved slightly but was not compared with the opposite site. If we compare our objective overall UCLA scoring of 5% excellent, 35% good, 40% fair and 20% poor results, with results described after open or closed acromioplasty and cuff tear debridement without repair, then they are identical.

Rockwood (21) described 18 patients with extensive rotator cuff tears in whom he felt that repair was inappropriate. He treated them exclusively with open subacromial decompression and with resectional debridement of the degenerated rotator cuff. All his patients obtained relief from pain, and 15 out of 18 had an active range of motion similar to their opposite shoulder.

Burkhart (6) demonstrated that arthroscopic debridement and decompression seem to be all that is necessary for normal pain-free function in patients with painful massive complete rotator cuff tears. His 10 patients improved on the UCLA shoulder rating scale from a mean score of 16.8 to 33.9. He found 3 good and 7 excellent end results.

Esch (10) reported on 6 massive tears out of 71 rotator cuff tears treated by arthroscopic subacromial decompression. He found one poor, two fair, two good, and one excellent result on the UCLA end-result scoring. Levy (14) carried out the same procedure, and of his 11 large and massive tears he reported with the UCLA rating, 1 excellent, 8 good, 2 fair, and 1 poor end results.

Comparison with results of other methods using grafts (15, 18) larger muscle flaps (7, 11, 12, 23) and prosthetic material (19, 20, 22) is difficult.

CONCLUSION

In an attempt to prevent humeral cranial migration and cuff-tear arthropathy (17, 24), we used the deltoid muscle flap for massive rotator cuff tears as described by Apoil and Augereau. Reviewing 20 cases, we found satisfactory results. But when comparing our results with those obtained after less invasive surgical techniques, we found they are comparable. Using a small part of the deltoid muscle did not however jeopardize the strength of forward flexion. We feel that the overall satisfaction rate of 85% and the significant improvement in pain and function scores can be attributed to the wide subacromial decompression, the limited anterolateral acromionectomy and the extensive rotator cuff debridement. Although a persistent soft-tissue interposition may be obtained, we feel that a real contribution to functional improvement cannot be expected from this muscular flap.

Longer follow-up studies are necessary to estimate the value of these deltoid flaps in the prevention of cuff tear arthropathy.

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SAMENVATTING

C. DIERICKX, H. VANHOOF. Massieve scheuren in de rotatoren cuff, behandeld met een deltoïd spierflap.

Twintig patiënten met een pijnlijke massieve, niet-herstelbare scheur van de rotatoren cuff, geclassificeerd als een type III volgens Gerber (13) werden klinisch nagekeken. Allen werden behandeld met een open partiële acromionectomie, een poging tot primair sluiten, en een anterieure spierige deltoïd flap zoals beschreven door Apoil en Augereau (1, 2).
Na een minimum follow-up van 12 maanden (gemiddeld 23.5 maanden), waren 17 van de 20 patiënten tevreden en beter, en de UCLA schouder score (10) verbeterde van een gemiddelde van 9.35 tot een gemiddelde van 25.7 (Maximum is 35).
Pijn en functie verbeterden in alle patiënten, respectievelijk met een gemiddelde van 4.35 en 4.00 punten. Actieve anterieure elevatie verbeterde in 17, en de kracht van anterieure elevatie verbeterde in 15 patiënten. Onze resultaten werden vergeleken met deze van Apoil en Augereau en met de resultaten bekomen door andere auteurs na open of gesloten acromioplasties en cuff debridement. Deze retrospectieve studie probeert een kritische kijk te geven op deze Franse techniek, en besluit dat, hoewel geen negatief effect wordt aangetoond met het gebruik van een spierige deltoïd flap, een voordeel ook niet kan worden bewezen.

RÉSUMÉ

C. DIERICKX, H. VANHOOF. Ruptures massives de la coiffe des rotateurs traitées par lambeau deltoïdien.

Nous avons revu vingt patients présentant une rupture majeure douloureuse et irréparable de la coiffe des rotateurs, classifiée comme type III selon Gerber (13). Tous ont été traités par acromionectomie partielle ouverte, un essai de réparation primaire et par lambeau antérieur deltoïdien, décrit par Apoil et Augereau (1, 2). Après un suivi minimum de 12 mois (la moyenne étant de 23.5 mois) 17 patients sur 20 étaient satisfaits et se sentaient mieux, le score UCLA était passé de 9.35 en moyenne à 25.7 (le score maximum étant de 35).
La douleur et la fonction sont passés chez tous les patients à 4.35 et 4 points.
L'antépulsion active a progressé chez 17 patients et la force d'antépulsion s'est améliorée chez 15 sujets.
Nos résultats ont été comparés avec ceux d'Apoil et Agereau et avec ceux obtenus par d'autres auteurs après une acromioplastie ouverte ou fermée et un débridement de la coiffe.
Cette étude rétrospective vise à porter un jugement critique sur cette technique, et conclut que, bien qu'aucun effet négatif n'ait pu être démontré par l'utilisation du lambeau de deltoïde, aucun gain réel n'a pu être constaté.