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ORIGINAL STUDY

Operative techniques for treatment of chronic massive rotator cuff lesions : Deltoid flap transfer versus arthroscopic debridement

Fabian Blanke, Joëlle Sachser, Martin Majewski

From the Department of Orthopaedics, University Hospital Basel, Basel, Switzerland

The treatment of chronic massive rotator cuff lesions remains challenging. Extensive reconstruction techniques as deltoid flap transfer as well as low invasive arthroscopic debridement techniques were established and showed good results. In present study 106 patients with massive rotator cuff lesions were treated by deltoid muscle flap transfer (n = 47 group I) and by arthroscopic debridement (n = 59 group II). Postoperative outcome was determined by amount of pain, range of motion, shoulder functionality according to Constant-Murley Shoulder Score and radiological assessment of acromiohumeral distance (AHD). Statistically analysis was done by the T-Test and Mann-Whitney-U-Test. Both groups showed significant improvement of range of motion compared to preoperative situation, but statistical analysis revealed no significant difference between both groups either in flexion or abduction. Overall shoulder functionality increased significantly in group I (30,2 points) and group II (20,6 points) postoperative, however group I improved significantly more in overall functionality compared to group II (p < 0,01). Therefore, present study showed that surgical treatment with arthroscopic debridement or deltoid muscle flap transfer can improve shoulder function in patients with chronic massive rotator cuff lesions. Deltoid muscle flap showed significantly better results in overall shoulder function and seems superior regarding clinical outcome. However, in regard to the good outcome a detailed risk-benefit analysis should be done before a deltoid-flap transfer is performed.

Keywords : massive rotator cuff lesion, deltoid flap, debridement, treatment

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INTRODUCTION

Treatment of rotator cuff lesions (RCL) is complex and needs special intention. The surgical options are based on: tendon retraction, muscular atrophy, size of the lesion, acromio-humeral distance and individual expectations *(5,14,24,25,28)*. In many cases, acute massive RCLs will be treated with surgical repair *(1,20)*. However, the treatment of chronic massive RCLs remains challenging. Chronic ruptures are usually accompanied with significant atrophy, fatty degeneration, muscle fibrosis and cranial migration of the humeral head. Thus, tendon repair is often not satisfactory *(4,7,14,15,19)*. In cases of superior RCLs, Deltoid flap transfer might be an option. However, flap necrosis and rupture or an irreversible insufficiency of the deltoid might be a risk *(13, 27)*. On the other hand, minimal invasive

- Fabian Blanke[1,3], M.D.
- Joelle Sachser[1], M.S.
- Martin Majewski[1,2], M.D., M.B.A.

[1]*Department of Orthopedic Surgery, University Hospital Basel, Basel, Switzerland*

[2]*Department of Orthopedic Surgery, Hospital Oberengadin, Samedan, Switzerland*

[3]*Department of Orthopedic Sports Medicine and Arthroscopic Surgery, Hessing Stiftung Augsburg, Augsburg*

Correspondence : Fabian Blanke, Department of Orthopedic Sports Medicine and Arthroscopic Surgery, Hessing Stiftung Augsburg, Hessingstraße 17, 86199 Augsburg, Germany.

E-mail : Fabian.Blanke@hessing-stiftung.de

techniques, as arthroscopic debridement, are preferred in many cases. Arthroscopic debridement shows good results in pain reduction, but positive effects on shoulder function are doubted *(1,5,8,25)*. Currently, there is a lack of data comparing both treatment options regarding postoperative shoulder function. Therefore, the aim of this retrospective study was to compare arthroscopic debridement and deltoid flap transfer in patients with chronic massive RCLs.

SUBJECTS AND METHODS

472 patients with chronic massive rotator cuff lesions and surgical treatment were found at our database between 1996-2012. Patients with superior tendon tear type IV according to Bateman, with a minimum tendon retraction grade III according to Patte and minimum muscle atrophy grade III according to Thomazeau were included into the study *(4, 24, 28)*.

Patients with an injury of subscapularis tendon, with peripheral neurologic pathology of the upper extremity (lesions of the n. axillaris, plexus lesions etc.), with shoulder instabilities or endoprosthesis were excluded.

Preoperative x-rays (true a.p., axial, y-view) were used to close out patients with bony pathologies or osteoarthritis (> grade 2 according to Kellgren-Lawrence) (17)

Finally, 106 patients with massive rotator cuff lesions were included into the study. 47 (group I) were treated by deltoid muscle flap transfer and 59 (group II) by arthroscopic debridement. Mean age of group I was 54,3 years (39-65) and 63,4 years (43-88) of group II. In group I 43 patients were male and 4 patients female. In group II 34 patients were male and 25 patients were female.

Deltoid flap transfer was performed according to Augereau et al. *(3).* Arthroscopic debridement consisted of subacromial bursectomy, rotator cuff tendon debridement, subacromioal debridement, acromioclavicular joint resection and tenotomy of long head biceps tendon.

In group I duration of symptoms averaged 21 months (1-120 months) in group II 23 months (1-144 months). Follow-up examination was at least performed 24 (24-36) months after surgical intervention in both groups.

Radiographs were performed with true a.p. view with zero-position of the arm and outlet-view. The acromio-humeral distance was measured in the a.p view *(22)*. Postoperative outcome was determined by pain, range of motion and level of shoulder function. The subjective level of pain was determined by visual analogue scale (VAS: 0-15 points). Range of motion was evaluated as pain-free active shoulder joint flexion (0°-180°) and abduction (0°-180°). Total shoulder function were assessed through the Constant-Murley Shoulder Score *(9)*. Statistical analysis was performed by student T-Tests for each parameter within the group and the Mann-Whitney-U-Test for the comparison between the two groups. The significance level was set at $p < 0.05$.

RESULTS

Overall outcome

In group I the acromiohumeral distance (AHD) averaged 8mm (3-14mm) pre-and postoperatively ($p > 0.05$). In Group II the AHD decreased significantly from 7.7mm (2-12mm) preoperatively to 6.7mm (2-13mm) postoperatively ($p = 0.01$). In group I the level of pain was lowered to 4.5 points (0-10 points) postoperatively from 11 points (0-15 points) preoperatively ($p = 0.0125$). In group II there was a pain reduction from 9.9 points (0-15 points) to 3.4 points (0-12 points) ($p = 0.005$). In group I the range of motion showed an improvement in flexion from 88° (0-130°) to 133° (60-180°) and in abduction from 72° (0-110°) to 128° (40-180°) ($p = 0.0025$). In group II flexion improved from 106° (30-140°) to 140° (40-180°) and abduction from 103° (40-130°) to 139° (50-180°) ($p = 0.01$). The constant score as a measure of the total shoulder function (0-100 points) improved in group I from 31.1 points (11-50 points) preoperatively to 61.3 points (0-78 points) post-operatively ($p = 0.005$). In group II the constant score improved from 33.9 points (9-65 points) preoperatively to 54.5 points (9-77 points) postoperatively ($p = 0.0075$) (Table I and Fig. 1).

Table I. — Postoperative outcome of patients with deltoid flap transfer (group I) and arthroscopic debridement (group II)AHD : acromiohumeral distance ; mm: millimetres ; pts: points ; deg: degree

	Deltoid flap transfer			**Debridement**		
	Pre OP	Post OP	P-value	Pre OP	Post OP	P-Value
AHD, mm(∅)	8mm	8mm	>0,05	7,7mm	6,7mm	0.01
Pain, pts. (∅)	4,5	11	0.0125	3,4	9,9	0.005
Abduction, deg. °(∅)	72°	128°	0,0025	103°	139°	0,01
Flexion, deg. ° (∅)	88°	133°	0.0025	106°	140°	0,01
Constant Score, pts. (∅)	31,1	61,3	0,005	33,9	54,5	0,0075

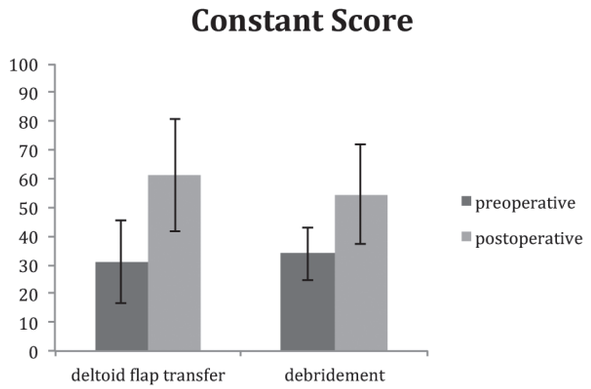

Fig. 1. — Constant-Murley Score pre- and postoperative

Comparison between group I and group II

In group I AHD remained constant with 8mm pre- and postoperative. In group II AHD decreased by 1mm postoperative without a significant difference compared to group I (p> 0,05). Both groups showed an average reduction of pain by 6.5 points postoperatively without significant differences (p >0.05). Flexion and abduction improved significantly postoperatively. However, no significant differences between both groups could be shown (p = 0,059). The Constant-Murley Score showed average improvement of 30.2 points in group I and 20.6 points in group II, which means a significant difference (p = 0.01). The improvement of shoulder activity averaged 8.4 points postoperatively in group I, whereas the improvement in group II averaged 4.7 points postoperatively, which was significant less (p = 0.01). In summary there were no significant differences between both groups concerning AHD, improvement of pain and range of motion. However shoulder activity and overall shoulder functionality improved significantly more in group I compared to group II.

Complications

In group I two patients hat early necrosis of the deltoid flap within two weeks postoperatively and two patients had persistent pain symptoms because of a flap rupture which was confirmed with ultrasound six months after operation. All 4 patients required revision surgery. In comparison, no complications occurred within group II.

DISCUSSION

The present study illustrates that arthroscopic debridement and deltoid muscle flap transfer are able to improve shoulder function in patients with chronic massive rotator cuff lesions. Patients with deltoid muscle flap transfer show significant better results in overall shoulder function and seem to have superior results in clinical outcome. However, complication rate after deltoid muscle flap transfer was high and the protective effect of deltoid muscle flaps against increasing cranial head migration remains unclear. Thus a detailed risk-benefit analysis should be done before a deltoid-flap transfer is performed. During the past years different salvage options have been introduced to treat massive chronic RCLs *(23)*. For patients with severe pain and low expectations to shoulder function, arthroscopic debridement with or without long biceps tendon

tenotomy, acromioplasty and acromioclavicular joint resection is considered *(6,25)*. For patients with high functional expectations, reconstructive muscle transposition therapies might be a better option *(2,3,12)*. The literature reported comparable results after deltoid flap transfer and latissimus dorsi transposition *(29)*. By deltoid flap transfer the rotator cuff lesion will be closed by an innervated, vascularized active muscle. The closure of the glenohumeral joint might lead to a static depressor effect avoiding further cranial migration of the humerus *(3,26)*. On the other hand, flap necrosis, flap rupture and irreversible insufficiencies of the deltoid muscle are feared risks *(3,11,13)*. The present study showed that arthroscopic debridement and deltoid flap transfer lead satisfactory outcome results with improvement of pain, range of motion and overall shoulder function. However, patients with deltoid flap transfer achieved better functional results compared to patients with arthroscopic debridement and showed no further cranial migration of the humeral head. These results are consistent with earlier studies. *(11,13,16,21,26,27,29)*.

Schneeberger et al. reported a long-lasting protection effect of the shoulder mobility with a flexion of >90° in 93% of the patients after six years following deltoid muscle flap transfer *(27)*. Vandenbussche et al. described a significant increase of average shoulder flexion from 100° to 157° 10.5 years after deltoideus flap transfer *(29)*. In two-thirds of the patients a cranial migration of the humerus could be avoided *(29)*. However, improvements of shoulder function show a high variation across different studies and the postoperative complication rate is quite high *(11,13,26)*. Moreover, the protection effect against increasing cranial migration of the humeral head and concomitant osteoarthritis remains unclear. Glanzmann et al. found a progressive cranial migration as a result of a muscle flap-arthropathy 175 months after deltoideus muscle flap transfer *(13)*. Therefore deltoid flap transfer seems to be a viable option in young patients with chronic massive rotator cuff lesions but a detailed risk-benefit analysis should be performed before surgical intervention.

In contrast there is a larger consensus in the literature concerning arthroscopic debridement for treatment of chronic massive RCLs. This minimal-invasive therapy for irreparable RCLs showed good results with improvement of pain and shoulder functionality in several studies *(10,18,25)*. Kempf et al. evaluated 210 patients in a multicenter study 26 months after an isolated acromioplastic, isolated LBT-tenotomy or a combination of both. The Constant Murley Score increased from 38.2 to 79.7 points *(18)*. A positive effect of additional LBT-tenotomy in patients with involvement of the supra- and infraspinatus tendon was seen *(18)*. These observations are also similar to the results of the present study. Moreover, despite AHD decreased by 1mm postoperative there was no significant difference of cranial migration compared to patients with deltoid muscle flap transfer.

However, progression of cranial migration of the humerus can apparently not be stopped by arthroscopic debridement. Moreover postoperative shoulder functionality was superior in patients with deltoid flap transfer in present study. Therefore, arthroscopic debridement with LBT-tenotomy might be a sufficient treatment option in patients with chronic massive RCLs and low expectations to shoulder functionality.

Obviously this study contains several limitations. Firstly present study is a retrospective analysis with a previously selected population and without a non-operative control group. Moreover, group I (deltoid- flap transfer) was almost 9 years younger and included primarily active patients, mostly male, with high expectations to shoulder functionality which suggest the assumption of a retrospective selection bias. Finally, follow up time was quite short, therefore no conclusions for long-term results could be provided.

CONCLUSION

Present study showed that surgical treatment with arthroscopic debridement or deltoid muscle flap transfer can improve shoulder function in patients with chronic massive rotator cuff lesions. Deltoid muscle flap transfer showed significantly better results in overall shoulder function and seems superior regarding clinical outcome. However,

complication rate after deltoid muscle flap transfer was high, thus a detailed risk-benefit analysis should be done before a deltoid-flap transfer is performed.

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