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# Surgical Technique and Functional Results of Irreparable Cuff Tears Reconstructed with the Long Head of the Biceps Tendon

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## Abstract

*The purpose of the study was to evaluate the results obtained from patients who were treated with open surgical technique using the long head of the biceps tendon for irreparable tears of the rotator cuff tendons. Between May 1992 and January 1997, 14 patients underwent rotator cuff reconstruction of irreparable tears at our clinic. These patients were evaluated before and after a minimum follow-up of 26 months (mean: 40.2 months) following surgery with the Constant's functional score. The long heads of the biceps tendons were found to be hypertrophied in all 14 shoulders and in 10 of them they were also subluxated. After re-seating the surgically enlarged biceps tendon onto the center of the uncovered head region, the biceps tendon to cuff tendon repair and the biceps tenodesis were done in all shoulders. The mean functional Constant's score before surgery was 46.7 points (poor) and the mean postoperative score at the final follow-up was 75.35 points (good). Satisfactory results were achieved in 85.7% of the patients. These results suggest that this surgical technique can be used to attain a painless and functional shoulder after irreparable cuff tear reconstruction.*

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Clinical determinants of a durable rotator cuff repair are the quality and the amount of intact cuff tendon tissue. In a new tear, even if the retraction is severe, the torn tendon end can be easily returned to its original position. However, in chronic tears, where the torn tendon ends are retracted with fatty degeneration exposing the humeral head, the repair is more difficult.<sup>1-3</sup> An irreparable tear of the rotator cuff is described as a tear that cannot be repaired primarily by reattachment of the torn cuff tendon to the greater tuberosity after debridement of the avascular margin.<sup>4</sup> Rockwood and Hawkins reported at least 50% satisfactory results with the debridement of irreparable rotator cuff tears.<sup>5,6</sup> However, recent studies suggest that the prognosis of a debrided irreparable rotator cuff is not as favorable as commonly thought. A debrided cuff deteriorates with time and cuff perforation leads to glenohumeral cartilage degeneration. On the other hand, surgical repair has generally yielded satisfactory long-term results.<sup>4</sup>

Rotator cuff tears are frequently accompanied by tenosynovitis of the long head of the biceps brachii, which can occur in two types: hypertrophic or atrophic tendinitis.<sup>7-12</sup> In many cases, the biceps tendon is found to be hypertrophied and flattened to the contour of the humeral head, as if trying to become a substitute cuff. Rowe states that in chronic ruptures of the rotator cuff, the head depressor responsibility of the biceps tendon increases and the tendon hypertrophies.<sup>13</sup> In 1958, Bush proposed the use of a flattened long head of the biceps tendon for irreparable defects of the rotator cuff and noted an increased depressor effect of the tendon when it was re-seated for repairing cuff defects.<sup>14</sup>

In this cohort study, the results of the biceps tendon use in 14 irreparable cuff tears with a follow-up of at least 26 months and our modified surgical technique for the reconstruction of the irreparable cuff defect are detailed.

## Patients and Methods

All massive cuff tears that cannot be repaired primarily by reattachment of the torn cuff tendon to the greater tuberosity after debridement of the avascular margin are classified as irreparable tears. Between May 1992 and January 1997, 14 irreparable rotator cuff tears were reconstructed with the biceps tendon and included in our study group. The primary indications for surgery were pain and functional limitation in all patients. Patients who had previous surgery on the rotator cuff were not included. During surgery, a technique comprising anterior acromioplasty, subacromial decompression, reconstruction of the torn cuff with the long head of biceps tendon and biceps tenodesis was applied by one of us (O.G.).

Five patients were male and nine were female. The patients' ages ranged from 48 to 75 years, with a mean of 60.3 years. Ten patients had involvement of the dominant extremity. All described an inability to use the upper extremity to perform activities of the daily living and work. Six of patients performed manual work.

The patients' histories, the results of the clinical examination, preoperative radiographs, and subjective questionnaires documenting preoperative and postoperative pain, function, and satisfaction were analyzed.

The cutoff of 1997 was selected so that all patients would have at least two years of follow-up at the time when the review was initiated.

## Operative Technique

With the patient in semi-sitting position the anterolateral part of the deltoid was incised vertically without superior detachment. Anteroinferior acromioplasty and resection of the bursal tissue were performed in all patients and combined with a resection of the inferior acromioclavicular osteophytes. After debridement of the avascular tissue, the vascularized tendon edges of the rotator cuff were found to be retracted to such an extent that they could not be reattached to the humerus near the greater tuberosity. An irreparable defect of 5 cm or more that involved the supraspinatus and the infraspinatus tendons was noted in seven shoulders and a tear involving the supraspinatus and the

subscapularis in one shoulder. Five patients had tears involving the supraspinatus, the infraspinatus, as well as the subscapularis tendons. One patient had a tear involving all the rotator cuff tendons (Table 1). The long head of the biceps tendon was hypertrophied in all 14 shoulders and in 10 shoulders it was also subluxated. The transverse ligament over the bicipital groove was incised and the long head of the biceps then moved into the center of the area uncovered by the torn cuff. By making three or four split thickness incisions parallel to the longitudinal axis, the biceps tendon was enlarged to cover the exposed humeral head. Initially this enlarged biceps tendon was sutured to the edges of the rotator cuff along the margin of the defect. Subsequently, the distal portion of the enlarged biceps tendon was brought laterally to be anchored in a new sulcus near the greater tuberosity with the arm of the patient in adduction (Figs.1 and 2).

## Postoperative Management

An abduction splint with a large axillary pad was employed for six weeks. The postoperative rehabilitation was performed under the supervision of a physiotherapist with experience in shoulder rehabilitation. The rehabilitation program consisted of passive range-of-motion exercises starting in the third postoperative week, followed by active range-of-motion exercises when the healing of the cuff was thought to be secure at six weeks.

## Results

Seventeen patients underwent surgery for irreparable cuff tears between 1992 and 1997. However, three patients were lost to follow-up. Therefore only the results of the 14 patients with sufficient follow-up are presented in this section.

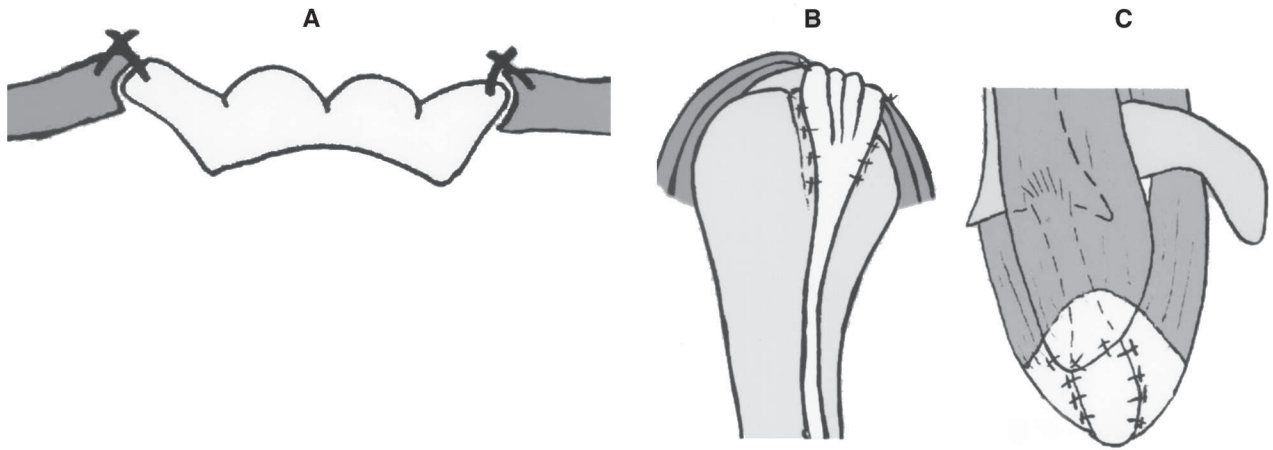
The average duration of time between the onset of symptoms and the surgical repair was 17.7 months (range: 2 to 36 months; standard error, 3.061), (Table 2).

The same examiner who used Constant's functional score to evaluate the shoulder function assessed all 14 patients after a minimum follow-up of 26 months (maximum: 72 months; average, 40.7 months; standard error, 3.662). The

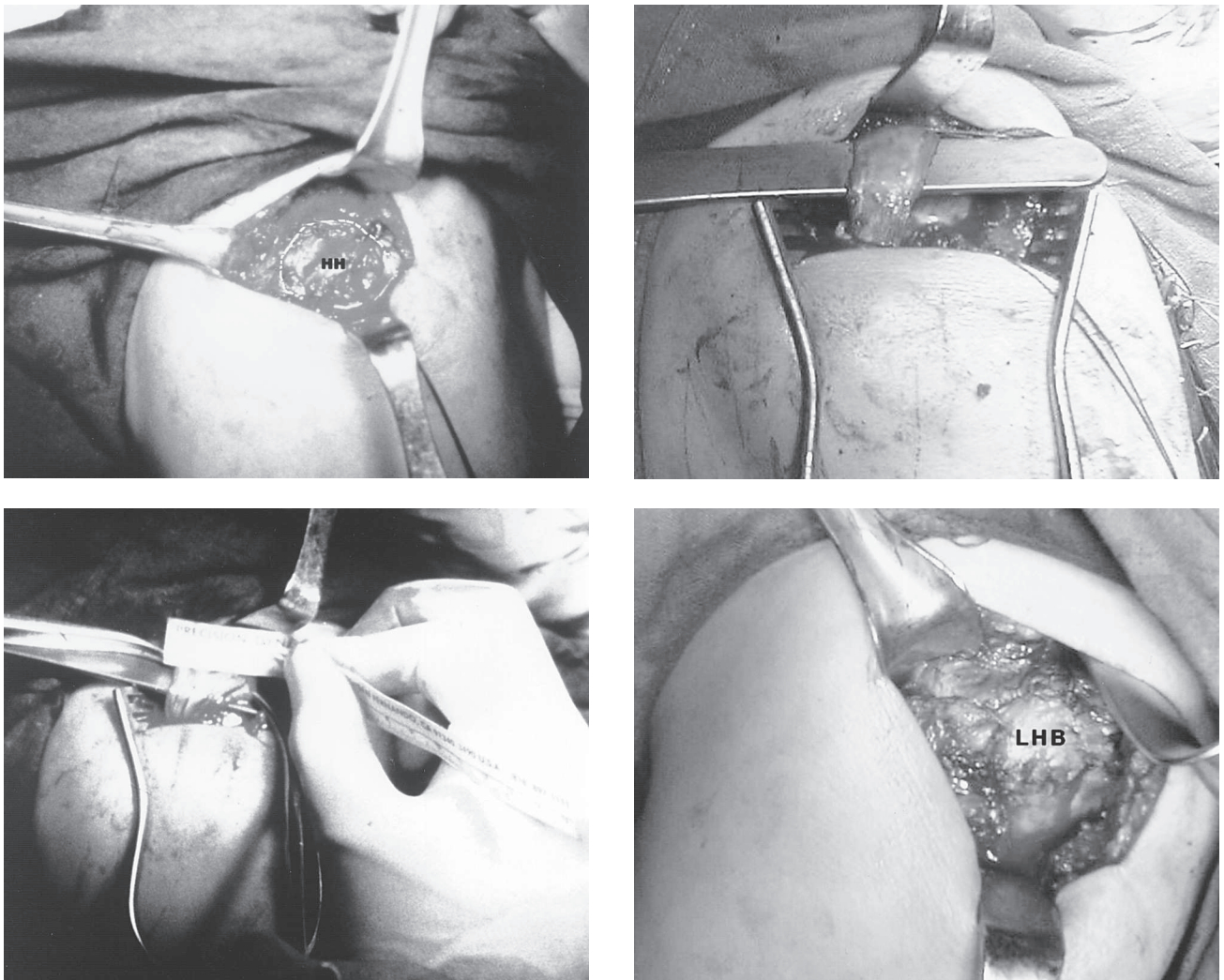
**Table 1** The Operative Findings and Functional Scores of the 14 Patients

Torn Rotator Cuff Tendons	No. of Patients	Total Functional Score		Constant's Score (Mean/100 points)	
		Preop	Postop	Preop Mean	Postop Mean
SS, IS (Two tendons)	7	318	540	45 (poor)	77 (good)
SS, SuS (Two tendons)	1	64	100	64 (fair)	100 (excellent)
SS, IS, SuS(Three tendons)	5	236	363	47 (poor)	73 (good)
SS, IS, SuS, TM(Four tendons)	1	36	52	36 (poor)	52 (fair)
TOTAL	14	654	1055	46.7 (poor)	75.35 (good)

SS: supraspinatus, IS: infraspinatus, SuS: subscapularis, TM: teres minor.



**Figure 1** A, Transverse cut of the long head of the biceps tendon showing the technique of enlargement with split thickness incisions parallel to the longitudinal axis. The lateral (B) and the superior view (C) showing biceps tenodesis after re-seating in a newly formed groove and cuff repair.



**Figure 2** Left to right: The supraspinatus and the infraspinatus tendons have been detached (A) completely exposing the humeral head (HH) in an irreparable cuff tear. The hypertrophied long head of the biceps tendon (B). The long head of the biceps tendon after enlargement (C). The postoperative view showing repaired rotator cuff defect with the enlarged and re-seated tendon (D).

**Table 2** Patient Data

Patient (Age, Sex)	Dominant Side	Duration of Symptoms (months)	Torn Cuff Ligament	Follow-up (months)	Forward Elevation Preop/Postop	External Rotation Preop/Postop	Internal Rotation Postop	Pain/Overall Functional Result
GK (50,F)	Yes	12	SS,IS	36	70°/160°	15°/45°	T 12	Mild/ Good
SI (55,F)	No	6	SS,IS	37	60°/160°	10°/50°	T 12	Moderate/ Good
EK (58,M)	Yes	24	SS,IS	26	40°/180°	15°/80°	T 7	None/Excellent
AS (48,F)	Yes	18	SS,IS, SuS	26	30°/140°	0°/30°	L 3	None/ Good
AK (65,F)	Yes	24	SS,IS, SuS	60	40°/130°	15°/50°	T 12	None/ Excellent
GS (61,F)	No	30	SS,IS, SuS	72	40°/160°	20°/60°	T 12	None/ Good
IB (75,M)	Yes	17	SS,SuS	48	30°/150°	20°/80°	T 7	None/ Excellent
SE (74,F)	No	4	SS,IS, SuS	48	20°/90°	-5°/20°	L 3	None/ Poor
OY (51,M)	No	4	SS,IS, SuS	48	60°/170°	15°/50°	T12	None/ Excellent
Gko (58,F)	Yes	36	SS,IS	36	50°/160°	15°/50°	L 3	Mild/ Good
HS (61,F)	Yes	15	SS,IS	28	60°/110°	15°/45°	T 12	Mild/ Good
AE (62,M)	Yes	2	SS,IS	30	75°/150°	20°/45°	T 12	Mild/ Good
BA (60,M)	Yes	20	SS,IS	28	60°/145°	20°/80°	T 12	None/ Excellent
MT (65,F)	Yes	36	SS,IS, SuS,TM	38	30°/95°	10°/30°	Sacrum	Mild/ Fair

SS: supraspinatus, IS: infraspinatus, SuS: subscapularis, TM: teres minor.

preoperative functional status of each patient was determined on the day before the surgery, which in this series averaged 46.7 out of 100 points (range: 28 to 64 points; standard error, 2.856). A total of nine patients (64.3%) scored between 0 and 50 points and five patients (35.7%) between 51 and 64 points. The overall postoperative Constant's functional score averaged 75.35 out of 100 (range: 45 to 100 points; standard error, 4.129) (Table 1). Objective functional results were 35.72% excellent (80 to 100 points), 50% good (65 to 79 points), 7.14% fair (51 to 64 points), and 7.14% poor (0 to 50 points). Overall pain scores averaged 12.5 out of 15 points (range: 0 to 15 points; standard error, 0.869). Range of activity scores averaged 16.29 out of 20 (range: 6 to 20 points; standard error, 1.183), while active mobility scores averaged 32 out of 40 points (standard error, 1.729). Muscular strength increased from an average score of 9.14 out of 25 points preoperatively to 13.7 out of 25 points postoperatively (range: 8 to 20 points; standard error, 1.286). The postoperative muscular strength score was weak (2 to 8 points of 25) in 14.3% and fair (10 to 20 points) in 85.7% of the patients.

There were no infections in this series of 14 tears.

The patients were satisfied with their results in 85.7% of cases.

## Discussion

Although different operative techniques (local flaps, distal flaps, allografts, and synthetic materials) have been used for the treatment of irreparable rotator cuff tears, they have not been uniformly successful in improving motion and relieving pain. Compared to the outcomes of these operative techniques our satisfactory results in the range of 85.7% seem to be more promising.<sup>5,6</sup>

In the literature there are few reports focusing on the

biceps tendon for the repair of irreparable cuff tears.<sup>1-14</sup> Nobuhara used the long head of the biceps for the treatment of massive rotator cuff tears in 44 shoulders, which is the largest series in the literature concerning the use of the biceps. However, Nobuhara did not enlarge or re-seat the long head of the biceps tendon. Neither did he perform tenodesis on the biceps tendon. After tenodesis of the long head of the biceps tendon in the bicipital groove, some surgeons cut it from its glenoidal attachment using it as a flap.<sup>15</sup> Rockwood, after splitting the long head of the biceps tendon from its glenoidal insertion, transferred it together with a supraspinatus and subscapularis flap onto the defected area.<sup>16</sup> Burkhart reported good outcomes of massive posterior rotator cuff tears repaired with the biceps tendon.<sup>17</sup> The surgical technique used by us was predicated on the idea that the long head of the biceps tendon can be utilized functionally and anatomically as a substitute for the rotator cuff. We believe that after the repair with the long head of the biceps the contractions at the rotator cuff are transmitted to the biceps tendon flap, which supports the rotator cuff. Complete or partial repair of the torn cuff by using the biceps tendon also positively influences the fixation security. The intraarticular tendinous biceps flap used for the repair was kept as long as possible to allow easy cuff repair and the tenodesis of the re-seated biceps tendon was at a position that enabled it to act as a fixed head depressor.

Ting and colleagues suggested that the lateral head of the biceps might be a greater contributor to the abduction and flexion in the compromised shoulder than in the normal shoulder.<sup>18</sup> The concomitant enlargement of this tendon may indicate a use-induced hypertrophy. In a study performed by Ozaki,<sup>19</sup> EMG activity in patients with a rotator cuff tear of less than 5 cm was found to be increased compared to healthy subjects. This increased activity may

represent a compensation for the decreased function of the torn cuff and could be responsible for the hypertrophy of the biceps accompanying small and medium rotator cuff tears. Massive tears with a dislocated biceps tendons demonstrated no similar increase in EMG activity.

Conservation or tenodesis of the dislocated long head of the biceps tendon remains debatable. According to most investigators, conservation of the long head of the biceps is not successful because of persisting pain. However successful results were obtained after biceps tenodesis.<sup>16</sup>

One might consider the small number of the patients in this study as a shortcoming. Initially the study group included three more patients. However, these patients, whose early follow-up results were all satisfactory, were lost to follow-up. Since 1997, we have treated an additional 19 cases of irreparable cuff tears using the same surgical technique; unfortunately results from only the short-term follow-ups are available and thus the long-term results are not available for this report. They all had satisfactory early functional outcome. The satisfactory early results support our view that this surgical technique can be used to attain a painless and functional shoulder after irreparable cuff tear reconstruction.

## Conclusion

The results in this small series of 14 patients were satisfactory. It can be postulated that for patients with irreparable rotator cuff tears the reconstruction with the biceps tendon can be applied to achieve a painless and functional shoulder.

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