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Comparison of Conservative and Operative Treatments of Massive Rotator Cuff Tears

Nari YAMADA, Kazutoshi HAMADA, Tomotaka NAKAJIMA, Kunihiko KOBAYASHI and Hiroaki FUKUDA

Department of Orthopaedic Surgery, Tokai University School of Medicine

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The results of conservative and operative treatment of massive rotator cuff tears were compared. All 9 men and 5 women who were treated conservatively (group I) had a Hamada Gpoup 4 arthrographic tear. The mean follow-up period was 4 years. The operative group (group II) was composed of 23 men and 3 women who had cuff tears of more than 5.0 cm in longest dimension. The mean age range at surgery was 62 years. Following anterior acromioplasty (n = 26), additional procedures included tenorrhaphy (n = 12), fascial grafting (n = 8), laterl transfer of the long head of the biceps brachii tendon (n = 2), muscle transfer of the teres minor (n = 3), muscle transfer of the supraspinatus (n = 1). The mean follow-up period was 4 years. The results were assessed using the Japanese Orthopaedic Association score. The JOA score was increased from 53.2 to 71.1 in group I, and from 58.8 to 85.9 in group II. More improvement in painrelief, muscle strength, and range of motion was obtained in group II than in group I. There was a significantly better final result in the patients without rupture of the tendon of the long head of the biceps brachii muscle.

Key words : Massive rotator cuff tear, Conservative treatment, Operative treatment

INTRODUCTION

Rotator cuff tears of the shoulder are common after age 40. The treatment of massive rotator cuff tears measuring more than 5.0 cm in longest dimension, remains a challenge. In fact, there is no currently accepted standard treatment for this condition. The purpose of this study was to compare the results of conservative treatment with operative treatment in patients with massive rotator cuff tears.

PATIENTS AND METHODS

The patients were divided into two groups: a conservatively treated group (group I) and an operatively treated group (group II). The patients in group I were seen at the Koseiren Uonuma Hospital, Niigata, Japan by one of the authors (K. H.) between 1979 and 1999. The patients in group II underwent surgery at the Tokai University Hospital or the Tokai University Oiso Hospital by the authors between 1982 and 1997. All patients in group I had arthrographic evidence of the Hamada group 4 rotator cuff tears (Fig. 1) [7]. In external rotation, neutral rotation, and internal rotation, arthrography of the massive cuff tears involving both the supraspinatus and infraspinatus tendons showed continuous contours of the humeral head and the subacromial bursa in group 4. Operative examination confirmed a massive rotator cuff tear or a global tear in group II in more than 98% of cases [8].

Group I consisted of 9 men and 5 women with involvement of the right (n = 12) or the left (n = 2) shoulder. The mean age was 70 years (range: 55 to 81 years). There were 8 patients over the age of 70. The time from injury to evaluation ranged from 12 months to 11 years (mean: 44 months). Less than 90° of forward flexion was found on initial evaluation in 5 patients. The follow-up period ranged from 12 months to 19 years (mean: 48 months). Conservative treatment was selected by the patients or next of kin. In the early period of symptoms (1 to 3 weeks), a sling was applied for comfort, and

Nari YAMADA, Department of Orthopaedic Surgery, School of Medicine, Tokai University, Boseidai, Isehara city, Kanagawa 259-1193, Japan

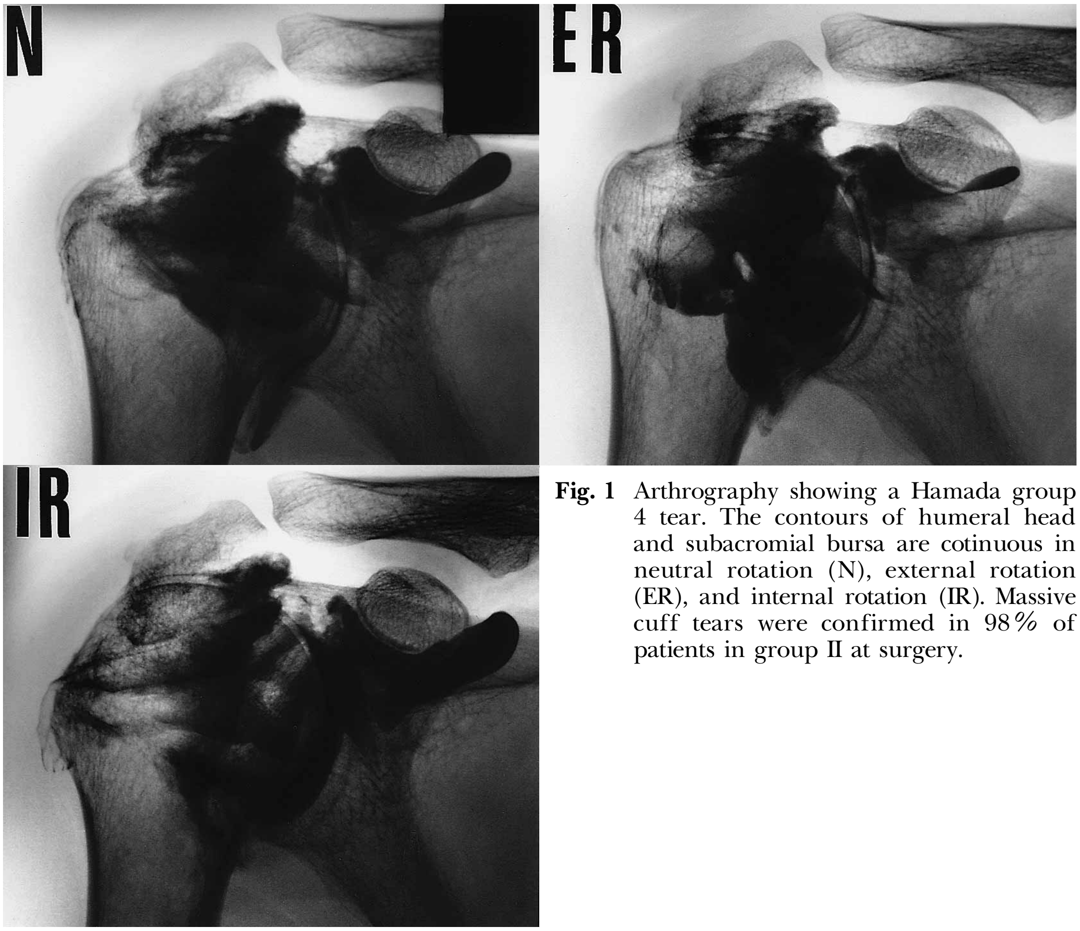

Fig. 1 Arthrography showing a Hamada group 4 tear. The contours of humeral head and subacromial bursa are cotinuous in neutral rotation (N), external rotation (ER), and internal rotation (IR). Massive cuff tears were confirmed in 98% of patients in group II at surgery.

Table 1 Summary of cases (group I, conservative treatment).

Case	Sex, Side, Age	Follow-up (mos)	JOA score (pain, function, ROM, X-ray, stability)	
			Initial	Follow-up
1	M, Rt, 76	19	40 (5, 5, 19, 1, 10)	48 (20, 7, 10, 1, 10)
2	M, Lt, 76	17	41 (5, 5, 13, 3, 15)	58 (20, 7, 13, 3, 15)
3	M, Rt, 55	228	56 (5, 8, 25, 3, 15)	84 (25, 16, 25, 3, 15)
4	M, Rt, 69	27	40 (5, 8, 8, 4, 15)	58 (15, 11, 13, 4, 15)
5	F, Rt, 73	12	63 (10, 12, 22, 3, 15)	79 (20, 16, 25, 3, 15)
6	M, Rt, 74	18	44 (5, 10, 10, 4, 15)	76 (15, 15, 27, 4, 15)
7	M, Rt, 75	20	46 (10, 8, 12, 1, 15)	52 (10, 12, 14, 1, 15)
8	F, Rt, 63	129	52 (5, 11, 17, 4, 15)	82 (25, 16, 22, 4, 15)
9	F, Rt, 76	18	64 (10, 15, 16, 4, 15)	85 (20, 19, 27, 4, 15)
10	M, Rt, 74	49	59 (5, 14, 27, 3, 10)	49 (10, 10, 23, 1, 5)
11	F, Rt, 62	78	51 (5, 12, 18, 3, 15)	78 (15, 15, 30, 3, 15)
12	M, Rt, 58	15	62 (15, 17, 27, 3, 15)	88 (25, 18, 27, 3, 15)
13	F, Rt, 81	33	65 (15, 15, 17, 3, 15)	75 (20, 16, 21, 3, 15)
14	M, Lt, 65	16	62 (10, 13, 21, 3, 15)	83 (20, 17, 30, 3, 15)

JOA: Japanese Orthopaedic Association, ROM: range of motion, Rt: right, Lt: left

Table 2 Summary of cases (group II, operative treatment).

Case	Sex, Side, Age	Follow-up (mos)	JOA score (pain, function, ROM, X-ray, stability) Preoperative	Follow-up
1	M, Lt, 59	281	73 (15, 14, 25, 4, 15)	93 (25, 19, 30, 4, 15)
2	M, Lt, 68	134	55 (5, 17, 15, 3, 15)	98 (30, 20, 30, 3, 15)
3	M, Rt, 71	10 (death)	59 (5, 15, 21, 3, 15)	82 (25, 17, 25, 3, 15)
4	M, Rt, 71	78	49 (5, 11, 15, 3, 15)	98 (30, 20, 30, 3, 15)
5	M, Lt, 73	60	43 (5, 5, 15, 3, 15)	67 (25, 11, 13, 3, 15)
6	M, Rt, 58	87	57 (5, 10, 24, 3, 15)	76 (25, 14, 19, 3, 15)
7	F, Rt, 61	13	59 (5, 11, 23, 5, 15)	90 (25, 17, 28, 5, 15)
8	M, Rt, 49	52	45 (5, 9, 13, 3, 15)	98 (30, 20, 30, 3, 15)
9	M, Rt, 59	53	71 (15, 14, 24, 3, 15)	92 (25, 19, 30, 3, 15)
10	F, Rt, 78	12	49 (20, 6, 5, 3, 15)	75 (25, 14, 18, 3, 15)
11	M, Rt, 52	17	64 (10, 18, 16, 5, 15)	100 (30, 20, 30, 5, 15)
12	M, Rt, 62	14	48 (5, 10, 15, 3, 15)	82 (25, 16, 24, 3, 15)
13	M, Rt, 59	15	55 (5, 14, 18, 3, 15)	80 (25, 16, 24, 3, 15)
14	M, Rt, 61	16	66 (5, 14, 27, 5, 15)	87 (25, 18, 24, 5, 15)
15	M, Rt, 60	13	48 (5, 10, 15, 3, 15)	76 (25, 17, 16, 3, 15)
16	M, Rt, 58	15	51 (5, 10, 18, 3, 15)	83 (25, 13, 27, 3, 15)
17	M, Rt, 54	22	68 (5, 15, 30, 3, 15)	82 (25, 17, 22, 3, 15)
18	M, Rt, 70	12	57 (5, 16, 18, 3, 15)	92 (25, 19, 27, 3, 15)
19	M, Rt, 64	105	67 (5, 17, 27, 3, 15)	87 (25, 20, 24, 3, 15)
20	M, Rt, 59	76	65 (5, 15, 25, 5, 15)	94 (25, 19, 30, 5, 15)
21	F, Rt, 82	43	45 (5, 10, 12, 3, 15)	67 (30, 10, 9, 3, 15)
22	M, Rt, 47	72	71 (15, 16, 27, 3, 10)	93 (25, 18, 30, 5, 15)
23	M, Rt, 60	65	67 (15, 11, 23, 3, 15)	90 (30, 18, 24, 3, 15)
24	M, Lt, 60	24	59 (15, 10, 15, 4, 15)	79 (15, 21, 18, 4, 15)
25	M, Rt, 58	12	72 (10, 16, 28, 3, 15)	87 (25, 17, 28, 3, 15)
26	M, Rt, 64	17	66 (5, 18, 30, 3, 10)	86 (25, 18, 30, 3, 10)

JOA: Japanese Orthopaedic Association, ROM: range of motion, Rt: right, Lt: left

a mixture of 1% lidocaine (4 mL) and dexamethasone sodium phosphate (2 mg) was injected into the subacromial bursa. The injection was performed once or twice a week up to an average of 15 injections. Heat treatment (e.g. hotpacks) and rotator cuff strengthening exercises were used as needed. Passive range of motion exercises were performed mainly for flexion and external rotation (Table 1).

The patients in group II had massive cuff tears as described by Post (more than 5.0 cm in longest dimension) [19]. The 24 men and 2 women had involvement of the right (n = 22) or the left (n = 4) shoulder. The mean age was 62 years (range: 47 to 82 years). There were 6 patients over the age of 70. Less than 90° of forward flexion was found on initial evaluation in 2 patients. The time from injury to surgery ranged from 1 month to 4.5 years (mean: 13 months).

Anterior acromioplasty was performed in all cases [13, 15]. Additional procedures included tenorrhaphy (tendon to bone) (n = 12), fascia grafting (n = 8), Bush procedure (lateral transfer of the long head of the biceps brachii tendon) (n = 2), muscle transfer of the teres minor (n = 3), and muscle

Table 3 Details of Surgery (group II, operative treatment).

Case	Interval from onset to surgery (mos)	Defect size (length × height)	LHB	Procedure	Closure
1	20	7.0 × 7.0 cm	torn	fascia graft	water-tight
2	2	5.0 × 4.0 cm	intact	tenorrhaphy	water-tight
3	54	6.5 × 6.5 cm	intact	tenorrhaphy	water-tight
4	3	4.4 × 5.5 cm	intact	tenorrhaphy	water-tight
5	24	7.0 × 4.5 cm	torn	tenorrhaphy	non-water-tight
6	4	7.0 × 4.5 cm	torn	tenorrhaphy	non-water-tight
7	12	5.0 × 4.0 cm	intact	fascia graft	water-tight
8	2	5.0 × 4.5 cm	intact	tenorrhaphy	water-tight
9	6	5.0 × 4.0 cm	intact	fascia graft	water-tight
10	2	5.0 × 4.0 cm	intact	tenorrhaphy	water-tight
11	9	5.0 × 5.0 cm	intact	tenorrhaphy	water-tight
			Mitek anchor		
12	5	5.0 × 3.5 cm	intact	tenorrhaphy	non-water-tight
13	3	3.5 × 5.0 cm	intact	tenorrhaphy	water-tight
14	3	5.0 × 4.5 cm	flattened	fascia graft	water-tight
15	54	6.0 × 5.0 cm	torn	tenorrhaphy	non-water-tight
16	7	5.0 × 4.0 cm	intact	tenorrhaphy	water-tight
17	10	6.0 × 4.5 cm	intact	tenorrhaphy	water-tight
18	9	5.0 × 5.0 cm	intact	Bush	water-tight
19	1	5.0 × 5.0 cm	flattened	Bush	water-tight
20	5	5.0 × 3.0 cm	inflamed	tenorrhaphy	non-water-tight
21	30	5.0 × 4.0 cm	intact	tenorrhaphy (postoperative infection)	water-tight
22	36	4.5 × 6.0 cm	intact	fascia graft	water-tight
23	6	5.0 × 5.0 cm	dislocated	fascia graft	water-tight
24	9	9.0 × 5.0 cm	dislocated	Debeyre Bush	water-tight
25	4	5.0 × 4.0 cm	intact	transfer TM	water-tight
26	16	8.0 × 4.0 cm	torn	Debeyre transfer PM	water-tihgt

LHB: long head of the biceps brachii

transfer of the supraspinatus (Debeyre procedure) (n = 1) [4, 12]. In 22 cases (84%), the rotator cuff was closed completely at surgery (water-tight group). In 4 cases (16%), water-tight closure could not be obtained (non-water-tight group). In the 4 cases, there was an average cuff defect of approximately 5 mm (Tables 2 & 3).

The standard postoperative physical therapy regimen began on postoperative day 3 with passive ROM excercises for flexion and external rotation, and pendulum exercises. Passive extension and internal rotation were started on day 14. Pulley exercises were added after attaining 90° of passive flexion. Active ROM and isometric exercises of the

SHOULDER EVALUATION SHEET

I.D.Number Name Sex(M/F)

Age Side involved(R/L) Name of Disease

Day of Operation Name of Operation

Date of Recording Signed

I. PAIN (30 Points)

None	30
Tenderness or minimal pain in sports or heavy labor	25
Minimal pain in ADL	20
Moderate and tolerable pain (Analgesic needed, occasional night pain)	10
Severe pain (ADL limited, frequent night pain)	5
Totally incapacitated because of pain	0

II. FUNCTION (20 Points)

Total Function (10 Points)

Strength in Abduction (5 Points)

Normal	5
Excellent	4
Good	3
Fair	2
Poor	1
Zero	0

★To be measured at 90 degrees of abduction or at possible abduction level.

Endurance (5 Points)

More than 10 seconds	5
More than 3 seconds	3
Less than 2 seconds	1
Zero	0

★Time in seconds of holding 1kg dumb-bell horizontally with elbow extended and forearm pronated.

Activities of Daily Living (10 Points)

Combing hair	1
Making knot in back	1
Reaching mouth	1
Sleep on involved side	1
Reaching side pocket (jacket)	1
Reaching opposite axilla	1
Open and close sliding door	1
Reaching overhead shelf	1
Self hygienic care	1
Wearing jacket	1

Subtract one point from above for each unable activity, specify:

1. 2. 3.

III. RANGE OF MOTION (30 Points)

Elevatoin (15 Points)

More than 150 degrees	15
More than 120 degrees	12
More than 90 degrees	9
More than 60 degrees	6
More than 30 degrees	3
0 degrees	0

External Rotation (9 Points)

More than 60 degrees	9
More than 30 degrees	6
More than 0 degrees	3
More than −20 degrees	1
Less than −20 degrees	0

Internal Rotation (6 Points)

Above T_{12} spinous process	6
Above L_5 spinous process	4
Gluteal	2
Below gluteal	0

IV. ROENTGENOGRAPHIC EVALUATION (5 Points)

Normal	5
Moderate changes or subluxation	3
Advanced changes or dislocation	0

V. JOINT STABILITY (15 Points)

Normal	15
Slight instability or apprehension	10
Severe instability or history or state of subluxation	5
Relevant history or state of dislocation	0

Remarks: Record range of motion and pain of elbow and hand disabilities, if present.

Total (   ) Points

Pain	( )
Function	( )
R.O.M.	( )
X-ray	( )
Stability	( )

Evaluation after treatment

Doctor: satisfied, or unsatisfied

Patient: satisfied, or unsatisfied

Fig. 2 The results were assessed using the 1987 Japanese Orthopaedic Association (JOA) score. The JOA score is based on pain (30 points), function (20 points), range of motion (30 points), radiographic evaluation (5 points) and joint stability (15 points). The maximum score is 100 points. ROM: range of motion.

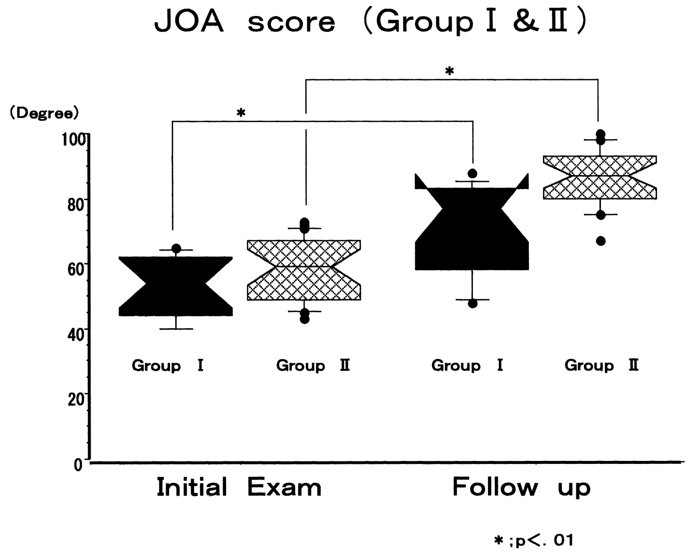

Fig. 3 The mean JOA score in group I was increased from 53.2 at the initial evaluation to 71.1 at the last follow-up ($p = .0021$). The mean JOA score in group II was increased from 58.8 preoperatively to 85.9 at the last follow-up ($p < .0001$). There were statistically significant differences in the Japanese Orthopaedic Association (JOA) score in the conservatively and operatively treated patients (group I · II) between the initial examination and at the final follow-up.

external rotators were started on day 36. The follow-up period ranged from 12 months to 23 years (mean 48 months).

The results were assessed using the Japanese Orthopaedic Association (JOA) score (Fig. 2) [24]. The JOA score is based on pain (30 points), function (20 points), ROM (30 points), radiographic evaluation (5 points), and joint stability (15 points). The maximum score is 100 points. The results were analysed by using Statview Version 5.0 for windows. Wilcoxon signed-ranks test or Mann-Whitney's U test was used for statistical analysis. A p-value less than 0.01 was considered significant.

Muscle strength was evaluated in 3 patients in group I and 9 patients in group II using a Cybex II + or Cybex 340 machine. The tested positions were flexion/extension with the elbow extended and the forearm in neutral position, and internal/external rotation at 30° and 90° of abduction in the supine position. The peak torque at 60 degrees per second was measured. The Simple regression was used for statistical analysis. A p-value less than 0.05 was considered significant.

RESULTS

JOA score

The mean JOA score in group I was increased from 53.2 at the initial evaluation to 71.1 at the last follow-up ($p = .0021$) (Fig. 3). In group I there were a 57.7% improvement in JOA pain score ($p = .0012$) (Fig. 4), a 21.5% improvement in JOA function score ($p = .0060$) (Fig. 5) and a 17.9% improvement in JOA ROM score ($p = .0501$) (Fig. 6).

The mean JOA score in group II was increased from 58.8 preoperatively to 85.9 at the last follow-up ($p < .0001$) (Fig. 3). In group II there were a 70.9% improvement in JOA pain score ($p < .0001$) (Fig. 4), a 25.9% improvement in JOA function score ($p < .0001$) (Fig. 5) and a 18.1% improvement in JOA ROM score ($p = .0037$) (Fig. 6). There was no significant difference of improvement in bilateral JOA ROM scores.

Manual muscle strength testing (MMT) of

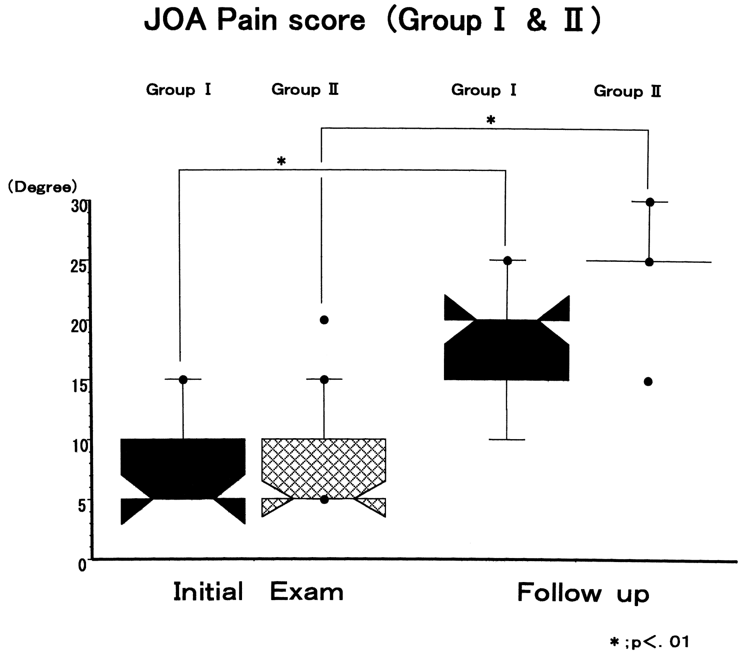

Fig. 4 There was a 57.7% improvement in the Japanese Orthopaedic Association (JOA) pain score in conservatively treated patients (group I) (p = .0012). There was a 70.9% improvement in the JOA pain score in operatively treated patients (group II) (p < .0001).

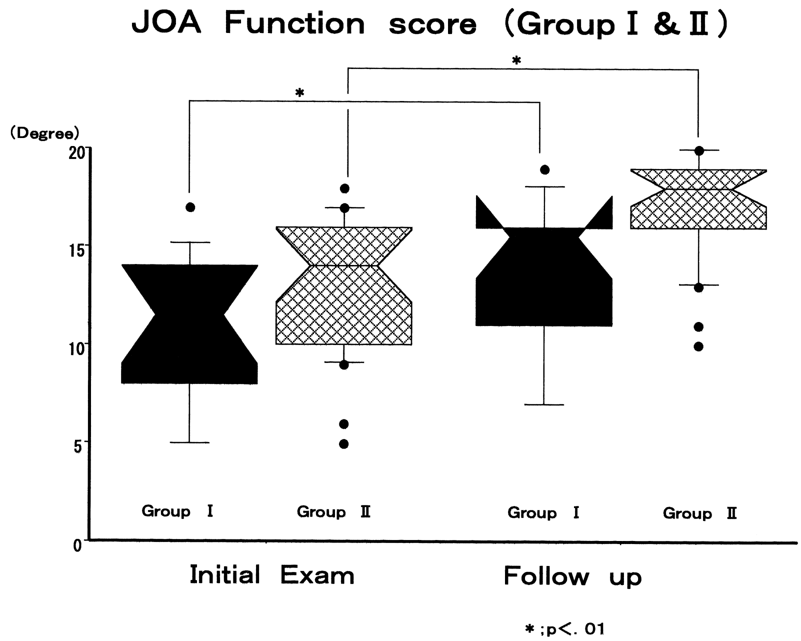

Fig. 5 There was a 21.5% improvement in the Japanese Orthopaedic Association (JOA) function score in conservatively treated patients (group I) (p = .0060). There was a 25.9% improvement in the JOA function score in operatively treated patients (group II) (p < .0001).

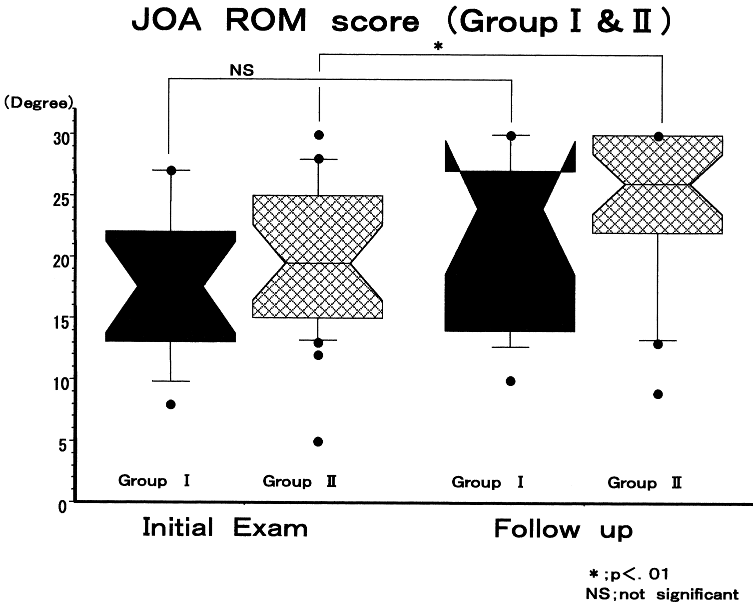

Fig. 6 There was a 17.9% improvement in the Japanese Orthopaedic Association (JOA) range of movement (ROM) score in conservatively treated patients (group I) ($p = .0501$). There was an 18.1% improvement in the JOA ROM score in operatively treated patients (group II) ($p < .0001$). In group I there was no statistically significant difference.

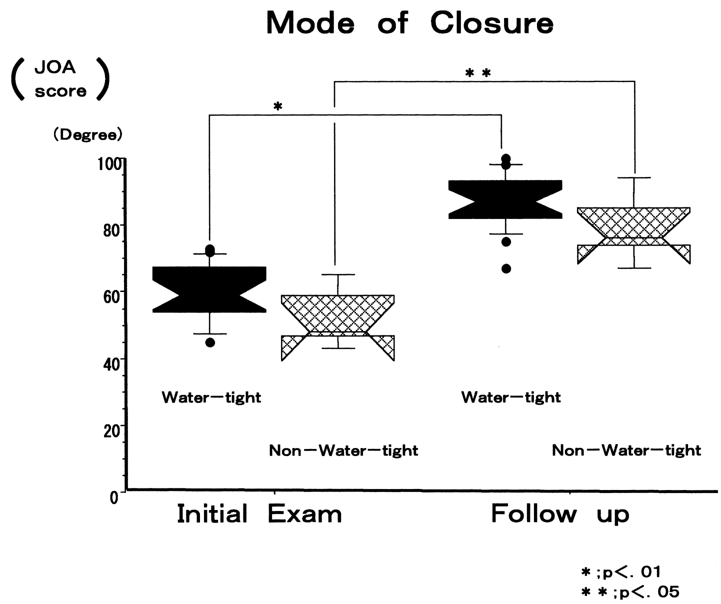

Fig. 7 In water-tight group there was a 31.0% improvemet of JOA score ($p < .0001$), and in the non-water-tight group there was a 33.3% improvement of JOA score ($p = .0431$). The differences between pre & postoperative improvement were statistically significant ($p < .05$). The difference between preoperative water-tight and preoperative non-water-tight was not statistically significant ($p = .0587$). And the difference between of postoperative water-tight and postoperative non-water-tight was not statistically significant, too ($p = .0898$).

abduction and external rotation revealed more complete recovery in group II (score: 5^{-}) than in group I (score: 4^{-}). On self-assessment, 8 patients in group I and 22 patientsin group II were satisfied. In group I, 12 patients felt motion pain during activities of daily living (ADL), especially with abduction. In group II, 23 patients had no motion pain. They were able to use the affected upper extremity without restrictions.

Effect of age

The JOA score in group II was 14 points higher than in group I. There was a significant difference in age distribution between group I and group II ($p = .0086$). This was mainly due to a larger number of patients over the age of 70 in group I. In the 6 patients younger than 70, the pretreatment JOA score was 53.8 points, and posttreatment JOA score was 78.8 points ($p = .0277$). The 8 patients older than 70 had a pretreatment JOA score of 52.8 points and a posttreatment JOA score of 65.3 points ($p = .0421$). The difference was statistically significant ($p < .05$).

Group II was further divided by age with a cut-off of 70 years. In the 20 patients younger than 70, the preoperative JOA score was 61.4 points, and the postoperative JOA score was 87.7 points ($p < .0001$). The 6 patients older than 70 had a preoperative JOA score of 52.7 points and a postoperative JOA score of 80.2 points ($p = .0277$). The difference was statistically significant ($p < .05$).

There was a statistically significant difference in the preoperative JOA score between these two subgroups ($p = .0174$). In over 70 ages there were no significant posttreatment differences in JOA score between group I and group II ($p = .1368$). The difference was not statistically significant ($p > .05$).

Timing of treatment

Reasonably good results were obtained if treatment was started within 6months of the on set of symptoms in Group I. On the other hand, good results were obtained in most patients in group II if surgery was performed within 1 year. Those 18 patients within 1 year at surgery had a preoperative JOA score of 59.2 points and a postoperative JOA score of 87.8 points ($p = .00002$). The difference was statistically significant ($p < .01$). The 8 patients more than 1 year at surgery had a preoperative JOA score of 58.0 points and a postoperative JOA score of 81.8 points ($p = .0115$). The difference was statistically significant ($p < .05$).

Comparison of mode of closure

In the water-tight group there was a 31.0% improvement of JOA score ($p < .0001$), and in the non-water-tight group there was a 33.9% improvement of JOA score ($p = .0431$) (Fig. 7). The differences between pre- and postoperative improvement were statistically significant ($p < .05$). The difference between of preoperative water-tight and preoperative non-water tight groups was not statistically significant ($p = .0587$). And the difference between of postoperative water-tight and postoperative non-water-tight groups was not statistically significant, too ($p = .0898$).

Comparison based on rupture of the long head of biceps brachii tendon (LHB)

Rupture of the LHB was noted in 4 patients in group I by physical examination and arthrography. In group II, 5 ruptures were identified atsurgery.

In group I with intact LHB there was a 25.8% improvement of JOA score ($p = .0080$), and with ruptured LHB there was a 22.7% improvement of JOA score ($p = .0679$) (Fig. 8). The JOA score in the patients with a ruptured LHB was lower than in the patients intact LHB. The difference between of intact LHB and ruptured LHB in JOA score after conservative treatment was statistically significant ($p = .0161$).

In group II with intact LHB, there was a 32.4% improvement of JOA score ($p < .0001$), and with ruptured LHB there was a 27.9% improvement of JOA score ($p = .0422$) (Fig. 9). The JOA score in the patients with a ruptured LHB was lower than in the patients with intact LHB. The difference between of intact LHB and ruptured LHB in JOA score was not statistically significant postoperatively ($p = .1009$).

Evaluation of muscle strength by isokinetic muscle testing by Cybex None of the 14 patients in group I were able to comply with the exercises because of motion pain. The 9 patients in group II had greater isokinetic strength on supine (flexion/extension) at follow-up than preoperatively. Isokinetic evaluation of internal and external rotation

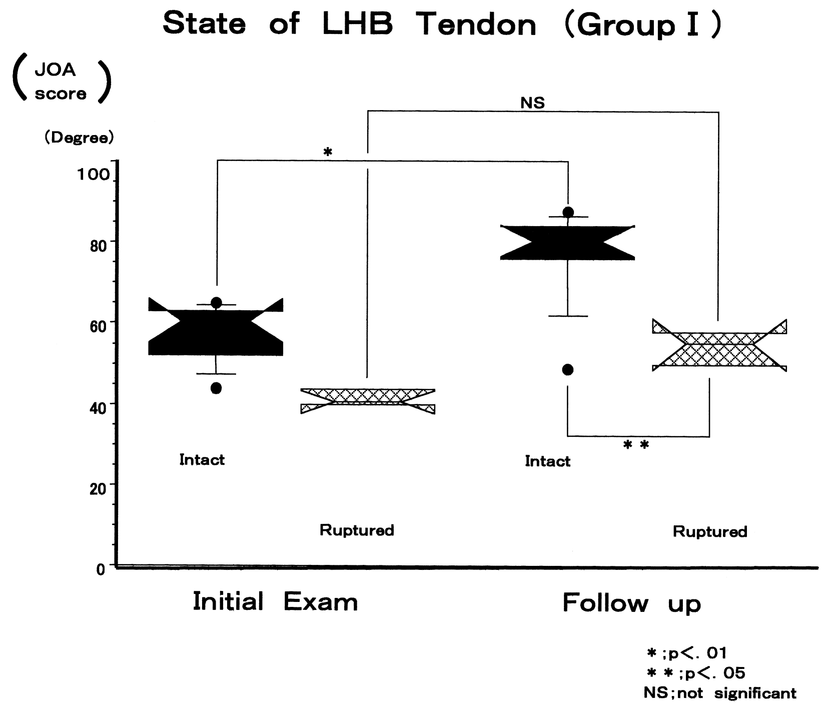

Fig. 8 In group I with intact LHB there was a 25.8% improvement of JOA score (p =.0080), and with ruptured LHB there was a 22.7% improvement of JOA score (p =.0679). The JOA score in the patients with a ruptured LHB was lower than in the patient with an intact LHB. The difference between intact LHB and ruptured LHB in JOA score after conservative treatment was statistically significant (p =.0161).

at 30°and 90° of abduction did not demonstrate a statistically significant difference in preoperative strength between the involved and uninvolved sides. There were no significant differences in strength between the preoperative state and at follow-up on the involved side.

There were no postoperative differences between the involved and uninvolved sides.

DISCUSSION

The treatment of massive rotator cuff tears remains a challenge [27]. There is no currently accepted standard for treatment of this condition [2, 5, 6]. Conservative treatment is often adopted because reasonable results can not be guaranteed with operative treatment. Theoretically, the clinical results of conservative management should determine the indications for operative treatment [9]. In order to clarify the end results of conservative therapy and surgery, we performed this comparative study.

The JOA score was used for outcome assessment in this retrospective study. The greatest improvement was obtained in pain, regardless of the mode of treatment. Motion pain persisted in 12 patients in group I and 3 patients in group II. The improvements in ROM and MMT were greater in group II than in group I. Muscle atrophy and joint contracture are progressive when the ROM and power are restricted by pain. The patients with sufficient residual muscle strength had a good prognosis. The ROM and MMT after treatment were improved with pain relief. Aizawa *et al.* have emphasized that weakness of the external rotator muscles in the elderly is associated with poor outcome [1]. In general, patients with a massive rotator cuff tear cannot efficiently transmit muscle power. Therefore, the aim of conservative treatment should be to prevent joint contracture and muscle atrophy. The prognosis of conservative treatment can be determined by the residual muscle power.

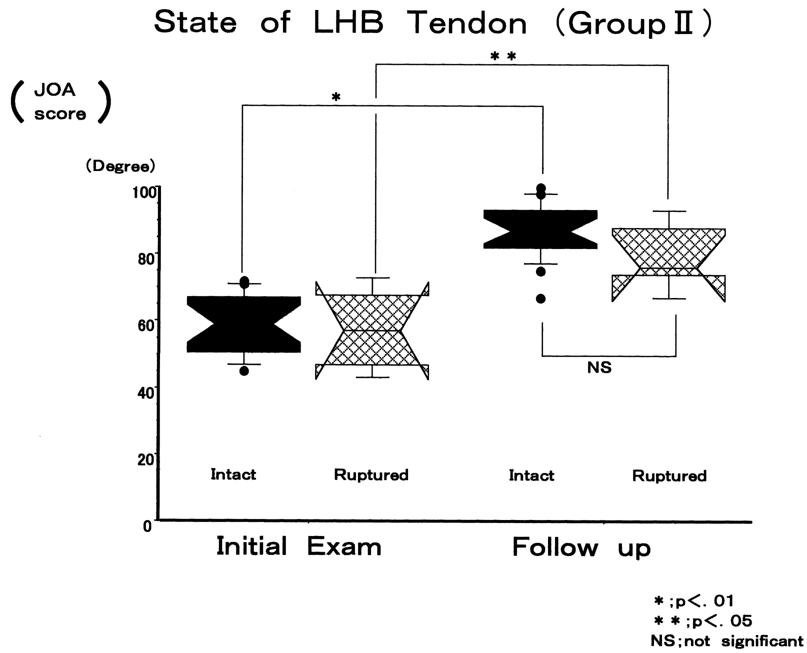

Fig. 9 In group II with intact LHB there was a 32.4% improvement of JOA score (p < .0001), and with ruptured LHB there was a 27.9% improvement of JOA score (p =.0422). The JOA score in the patients with a ruptured LHB was lower than in the patients with an intact LHB. The difference between of intact LHB and ruptured LHB in JOA score was not statistically significant postoperatively (p =.1009).

On the other hand, the MMT and ROM can be improved by rotator cuff repair. Pain relief in group II was significant (p < .0001), which resulted in improvement in the MMT and ROM. Rokito described that the complete restoration of muscle strength should require more than one year postoperatively [22].

The preoperative JOA score in group II was dependent on age, which was compared with conservative group (p =.7463). The postoperative JOA score was independent of age (p =.0277). There were no significant differences after treatment in the JOA scores between groups I and II in the patients older than 70 (p =.1368). Therefore, age does not appear to affect operative or conservative treatment of massive rotator cuff tears. Worland described that the satisfactory results could be obtained for painful massive rotator cuff tears regardless of the patient's age [25]. Massive rotator cuff tears result in progressive shortening and degeneration of the supraspinatus tendon. This makes mobilization and repair of the tendon difficult. Shimizu *et al.* have recommended early repair after confirming the diagnosis [23]. In our study, an interval of up to 12 months from the onset of symptoms to surgical intervention did not affect the postoperative JOA score. Intervals longer than 12 months were associated with postoperative difficulties with contracture of the rotator cuff. Our postoperative scores were good even for an intervals of longer than 12 months, because we gave priority to the repair of external rotator muscles rather than to the water-tight repair in all case. Those patients who had degenerative findings, especially, sclerosis of the acromion and/or the greater tuberosity on plain radiography, had a worse outcome.

Nobuhara *et al.* have emphasized the need for a complete water-tight repair in all massive rotator cuff tears [17, 18]. They kept the patients immobilized in the zero position (Saha) for postoperative 5 days [22]. We have always attempted a water-tight repair since we believe that the articular cartilage is protected by an intact rotator cuff [16].

However, if a water-tight repair cannot be performed, even in 40 degrees of abduction, a non-water-tight repair should be performed because too much tension in the closure may result in capsular contracture or rerupture. If reconstruction of the infraspinatus and teres minor tendons can be securely performed, the superior migration of the humeral head can be prevented [20]. Burkhart has emphasized the repair of the posterior rotator cuff to improve functional prognosis [3]. Thus, good postoperative outcomes can be expected even in the absence of a water-tight closure, provided that the repair of the external rotators is satisfactory.

Kumar *et al.* have described the role of the LHB, an important humeralhead depressor, in preventing migration of the humeral head superiorly when the elbow is flexed and the forearm is supinated [11]. In our study, those patients with an intact LHB did better in both groups than those with a ruptured LHB [26]. This was particularly true in group I. The state of the LHB is an important determinant of prognosis in patients with a massive rotator cuff tear [14].

Ito *et al.* have reported that three kinds (60°, 180°, and 240°/sec) of muscle strength testing of the external rotators after cuff repair correlate well with the JOA score [10]. We evaluated muscle strength at only 60°/sec, because the senile patients could not comply with a faster testing speeds. Also, some pretreatment data with the Cybex machines could not be measured due to pain. There were no significant differences in muscle strength testing between the preoperative and postoperative state. Muscle strengthening of the external rotators was performed with rubber bands for 12 months after surgery.

In this retrospective study, the results of conservative and operative treatment of massive rotator cuff tears were compared. Although the two groups were not entirely comparable, pain relief, ROM, and muscle strength recovered more favorably in the surgical group than in the conservative treatment group. Reasonable operative results can be expected if surgery is performed within 1 year of the on set of symptoms. The mode of closure does not affect the outcome. Patients with an intact long head of the biceps branchii have a better prognosis, independent of the method of treatment.

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