Open versus arthroscopic subacromial decompression

A prospective, randomized study of 34 patients followed for 8 years

Torstein Husby, Jan-Ragnar Haugstvedt, Merete Brandt, Inger Holm and Harald Steen

Rikshospitalet University Hospital, Department of Orthopaedics, NO-0027 Oslo, Norway
Correspondence: torstein.husby@rikshospitalet.no
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ABSTRACT In a randomized prospective study, we selected 15 patients for arthroscopic subacromial decompression (ASD) and 19 patients for open subacromial decompression (OSD). All had impingement syndrome (Neer grade II), and had been unsuccessfully treated without surgery for more than 6 months. The UCLA Shoulder Rating Scale, Visual Analogue Scales for pain and satisfaction, isokinetic dynamometer recordings and physical testing were assessed preoperatively and at 1 (except isokinetic testing), 3, 6, and 12 months, and, finally, 8 years after surgery. We found essentially no differences in the clinical tests between the groups during this period. The use of ASD or OSD seems to be a matter of cosmesis and personal preference.

Open subacromial decompression (OSD) for the treatment of chronic impingement syndrome in the shoulder has been well documented (Pujadas 1970, Neer 1972, 1983, Hawkins and Kennedy 1980, Raggio et al. 1985, Post and Cohen 1986). Arthroscopic subacromial decompression (ASD) was first performed in 1983 by Ellman and has since been shown to be an effective alternative to open acromioplasty (Ellman 1987, 1988, 1989, Esch et al. 1988, Ellman and Kay 1991, Johannsen et al. 1997, Kim et al. 1997, Stephens et al. 1998). Only a few prospective randomized studies have compared ASD to OSD (Lindh and Norlin 1993, Sachs et al. 1994, T'Jonck et al. 1997). These authors have been concerned about the comparability of the ASD and OSD groups in these series.

We compared the short- and long-term effects of the ASD and OSD methods in the treatment of impingement syndrome (Neer grade II) in a prospective randomized study.

Patients and methods

When planning this study, it was decided that the clinically important mean differences between the groups should be at least 5 units for the UCLA Shoulder Rating Scale. Previous use of this scale indicated that the standard deviation was about 5. To obtain a statistical power of 0.80, at least 16 patients had to be included in each group (Mardia et al. 1983, Kleinbaum et al. 1987). The level of significance was set at 0.05.

We selected 39 consecutive patients with clinically verified impingement syndrome (Neer grade II; Neer 1983) in a prospective, randomized study with two treatments for subacromial decompression: closed ASD, and open OSD. The ASD group included 20 patients and the OSD group 19 (Table 1). After 8 years, we performed follow-up examinations on 15 patients in the ASD and all 19 in the OSD groups and their results are reported. They all had had symptoms for more than 6 months preoperatively, and had received nonsurgical treatment with NSAID, local steroid injections, physical therapy, ultrasound or a combination of these. Only patients with a positive Neer's impingement sign and a positive local anesthesia subacromial injection test were included (Neer 1983). Preoperative radiographs were taken, to assess glenohumeral and acromioclavicular arthrosis, measure the subacromial calcifications and record the distance between the humeral head and the undersurface of the acromion.

Table 1. Characteristics of two groups who underwent arthroscopic subacromial decompression (ASD) or open subacromial decompression (OSD)

	ASD (n = 15)			OSD (n = 19)		
Female/male	8/7			11/8		
Right/left	10/5			10/9		
Dominant / nondominant side	10/5			8/11		
Manual work/sedentary	9/6			11/8		
	Mean	SD	Range	Mean	SD	Range
Age at operation	42	11	29–61	45	8.3	27–59
Duration of symptoms (months)	19	11	6–36	32	23	8–96
Preoperative sick-leave (weeks)	16	22	0–78	10	18	0–52
Duration of operation (minutes)	82 [a]	22	50–120	52 [a]	14	27–90
Postoperative sick-leave (weeks)	5.7	4.8	0–16	10	14	0–61

[a] ASD significantly different from OSD ($p < 0.0001$)

Ultrasonography of the rotator cuff was done preoperatively. All patients with substantial rotator cuff degeneration or rupture (Neer grade III), arthrosis in the glenohumeral or acromioclavicular joints or any other concomitant lesions were excluded from the study. Those with a reduced range of motion were also excluded. Ultrasound showed rotator cuff edema in 1 patient in the ASD group, 5 in the OSD group, and minor degeneration in 2 (1 in each group).

All patients first underwent a diagnostic arthroscopy of the shoulder joint, using Esch et al.'s method (1987). If other causes of pain were detected, the patients were excluded from the study (3 patients). Randomization with closed envelopes to the ASD or OSD groups was done after this diagnostic arthroscopy. All surgical procedures were performed with the patient in the lateral position, the arm abducted 30° and with 4 kg plaster traction. The ASD was performed with Ellman's method (1988, 1989), using saline for irrigation. The OSD was performed via a 4 cm skin incision in line with the deltoid, and a T-shaped incision over the proximal deltoid muscle. About 1.5 cm of the anterior deltoid was pulled down from the acromion to facilitate exposure. The anterolateral and central portion of the subacromial bone were resected, as recommended by Neer (1972), and the coracoacromial ligament was cut with scissors or a knife. The ASD was performed with the arthroscope in the posterior portal and the working portal laterally, with Esch et al.'s method (1987). After bursectomy with a 5.5 mm synovial resector, 8–10 mm of the anterolateral and central portions of the subacromial bone was removed with a burr, analogous to the Neer (1972) technique. The coracoacromial ligament was released by sectioning the anterior margin of the acromion with a burr (Caspari and Thal 1992); small remnants being cut by a knife or basket forceps. Calcific deposits were left untreated.

Postoperatively, there were no limitations regarding physical activity and all patients were taught by a physical therapist a home training program before leaving the hospital.

Blinded physical follow-up examinations included the evaluation of humeroscapular rhythm, range of motion in flexion, abduction, external rotation and painful shoulder arch. The tests were done preoperatively and at 1, 3, 6, 12, and 96 months postoperatively. Isokinetic muscle strength was tested on a Cybex 6000 dynamometer (Cybex-Lumex Inc, Ronkonkoma, New York) before and at 3, 6, 12, and 96 months after surgery. Isokinetic recordings were not done at 1 month since it was considered to be too early because of discomfort. External/internal rotation was tested in the standing position with the feet apart and the elbow at 90° of flexion. Angular velocities were 60°/s and 180°/s and the patients repeated these 5 times at each velocity. The mean value of the 5 repetitions of total work (TW) was the isokinetic parameter used to evaluate muscle strength. The physical testing and isokinetic recordings were done by independent observers. The UCLA Shoulder Rating Scale (Ellmann 1987), Visual Analogue Scales (VAS),

Table 2. Pre- and postoperative recordings in two groups who underwent arthroscopic subacromial decompression (ASD) or open subacromial decompression (OSD)

	ASD (n =15)				OSD (n = 19)			
	n	Mean	SD	Range	n	Mean	SD	Range
UCLA Shoulder Rating Scale (max: 35)								
Preoperative score	15	14	3.1	7–17	19	16	4.1	9–24
Postop 1	15	19 [a]	5.5	8–29	14	18	4.9	7–29
3	15	26 [b]	7.1	7–33	17	26 [b]	5.8	18–35
6	14	28	6.0	15–35	18	27	8.3	12–35
12	15	30	5.7	20–35	16	31 [a]	6.2	14–35
96 months	15	32	6.6	10–35	19	32	4.9	21–35
Pain at rest (VAS, max 100)								
Preoperative score	15	41	25	3–87	19	37	25	0–79
Postop 1	15	16 [b]	18	0–67	15	24 [a]	24	0–79
3	15	14	24	0–85	17	13	17	0–55
6	14	3.4	5.5	0–21	18	12	18	0–53
12	15	2.4	4.6	0–14	16	5.1	9.3	0–35
96 months	15	0.0	0.0	0–0	19	1.1	4.6	0–20
Pain during activity								
Preoperative score	15	75	16	28–97	19	67	18	30–98
Postop 1	15	41 [b]	23	3–78	15	45 [b]	24	8–94
3	15	29	28	0–94	17	29	29	0–91
6	14	16	17	0–63	18	28	35	0–95
12	15	15	22	0–73	16	18	28	0–85
96 months	15	12	19	0–50	19	12	19	0–50
Overall satisfaction [d]								
Postop 1	15	72	22	32–100	15	74	19	35–100
3	15	84	26	8–100	17	88	16	43–100
6	14	88 [c]	16	40–100	18	78	31	2–100
12	15	94	11	70–100	16	85	28	18–100
96 months	15	95	16	40–100	19	93 [c]	18	25–100

[a] Significant change ($p < 0.05$) from previous test in same group
[b] Significant change ($p < 0.01$) from previous test in same group
[c] First significant change ($p < 0.05$) from test at 1 month postoperatively

described by Harms-Ringdahl et al. (1986), with the patient's assessments of pain at rest and during activity, were recorded before and after surgery at 1, 3, 6, 12, and 96 months. Subjective overall satisfaction (VAS) with surgery was recorded at 1, 3, 6, 12, and 96 months postoperatively. The study was approved by the local ethics committee, and all patients gave their informed consent before participation.

Statistics

Averages are expressed as arithmetic means and dispersion as SD or range. We used repeated measures analysis of variance (ANOVA; general linear model procedures; SAS Institute, Inc. Cary, NC) for unbalanced data, the unpaired Student's t-test, and Pearson's Chi-Square test. We pooled all the data and recorded differences in the outcome parameters from one follow-up to the next. The differences in the ASD group were then compared to the differences in the OSD group, and to the differences in the same group, using a General Linear Model for repeated measures (Mardia et al. 1983, Kleinbaum et al. 1987). All p-values equal to or below 0.05 were considered significant. All tests except the Student's t-test were two-sided.

Results

The two groups of patients had a similar age distribution, the same postoperative treatment and control regimen, and were checked at short intervals (Tables 1 and 2). The preoperative record-

Table 3. Recordings of isokinetic muscle strength in the two groups who underwent arthroscopic subacromial decompression (ASD) or open subacromial decompression(OSD)

Total work (Joule)	ASD (n = 15)				OSD (n = 19)			
	n	Mean	SD	Range	n	Mean	SD	Range
External rotation at 60°/sec								
Preoperative test	9	76	69	5–195	16	85	68	3–180
Postop								
3	11	103	51	47–220	13	110	55	38–197
6	14	116	58	46–248	17	119	61	11–210
12	13	122 [a]	62	42–250	17	137 [a]	65	18–228
96 months	13	149	54	42–231	18	128	59	31–241
External rotation at 180°/sec								
Preoperative test	9	33	45	0–111	16	49	57	0–152
Postop								
3	11	67	49	1–153	13	70	43	11–146
6	14	75 [a]	48	8–175	17	68	43	5–138
12	13	79	54	7–179	17	79	49	0–156
96 months	13	93	55	26–190	18	79	54	23–199
Internal rotation at 60°/sec								
Preoperative test	9	144	136	5–408	16	135	98	11–297
Postop								
3	11	190	99	102–438	13	174	104	43–342
6	14	198	101	81–426	17	183	89	4–316
12	13	205	98	84–384	17	195	89	41–353
96 months	13	245	110	83–423	18	188	84	98–367
Internal rotation at 180°/sec								
Preoperative test	9	56	57	1–148	16	71	79	1–224
Postop								
3	11	120	82	7–255	13	121	82	15–296
6	14	136	90	20–312	17	115	69	1–241
12	13	140	90	24–279	17	123	70	3–248
96 months	13	160	97	46–300	18	115	73	37–281

[a] First significant change ($p < 0.05$) from preoperative test

ings of the UCLA scores, pain (VAS) at rest and during activity, and the isokinetic muscle strength (Cybex) parameters were similar in the groups (Tables 1–3). The average duration of surgery, including diagnostic arthroscopy of the shoulder joint, was 82 (50–120) min in the ASD group, and 50 (27–90) min in the OSD group ($p < 0.0001$; Table 1).

Calcific deposits, present in 4 and 5 patients in the ASD and OSD groups, respectively, were left untreated. The results in these patients did not differ from those in patients without calcifications.

We had no perioperative complications. Postoperative sick-leave was similar in the groups (Table 1). Apart from external rotation 60°/s between 12 and 96 months, no statistically significant differences were detected between the UCLA Shoulder Ratings, the VAS scales, and the Cybex recordings for total work (Joule) at 60°/s and 180°/s external and internal rotation (Tables 2 and 3) in the two groups at any time. The differences from one follow-up to the next were calculated separately in the ASD and OSD groups and compared. In both groups, the average UCLA scores improved most significantly from 1–3 months after surgery, then gradually improved towards 1 year after the operation (Tables 4 and 5).

Pain decreased markedly in the first 3 months postoperatively, but additional improvement took place until the 1-year follow-up. For all observations at 3 months and later, the average VAS satisfaction rates were above 90% in both groups.

The differences in isokinetic dynamometer recordings showed the greatest improvement in both the ASD and OSD groups at 3 months, as compared to the preoperative measurements, and muscle function continued to improve until 1 year after surgery (Table 5). With a few exceptions,

Table 4. Differences between recordings at one test and a previous one in the two groups who underwent arthroscopic subacromial decompression (ASD) or open subacromial decompression (OSD). Values are mean and 95% confidence intervals

	n	A	n	B	n	C	n	D	n	E
UCLA Shoulder Rating Scale										
ASD	15	4.5 (1.9–7.2)	15	7.7 (4.5–11.0)	14	1.9 [a] (–2.8–6.7)	14	1.3 (–0.8–3.4)	15	1.8 (–1.2–4.8)
OSD	14	2.6 (–0.5–5.6)	14	8.7 [a] (5.0–13)	17	1.6 [a] (–1.2–4.3)	15	2.6 (–1.0–6.2)	16	1.5 (–1.2–4.2)
Shoulder pain at rest										
ASD	15	–25 (–34– –16)	15	–2.8 [b] (–12–6.4)	14	–11 (–26–3.6)	14	–0.8 (-3.0–1.4)	15	–2.4 (–5.0–0.2)
OSD	15	–19 (–29–-9.4)	15	–13 (–27–1.9)	17	–1.9 (–12–8.0)	15	–5.7 (–17–5.4)	16	–5.1 (–10–-0.1)
Shoulder pain during activity										
ASD	15	–34 (–46–-23)	15	–11.7 [a] (–28–4.1)	14	–14 (–33–5.0)	14	–0.1 (–12–12)	15	–3.6 (–15–7.6)
OSD	15	–19 (–33–-5.1)	15	–22 (–39–-5.7)	17	–3.7 (–20–13)	15	–7.1 (–21–6.9)	16	–6.1 (–19–6.8)
Overall satisfaction										
ASD			15	12 (–0.5–25)	14	5.2 (–12–22)	14	5.0 (–1.6–12)	15	1.5 (–5.0–8.0)
OSD			15	16 (4.6–27)	17	–4.9 (–15–5.5)	15	0.5 (–15–16)	16	7.6 (–6.2–22)

A = Difference 1 month postoperatively (p.o.)–preoperatively
B = Difference 3–1 months p.o.
C = Difference 6–3 months p.o.
D = Difference 12–6 months p.o.
E = Difference 96–12 months p.o.
[a] Significant change ($p < 0.05$) from previous test in same group
[b] Significant change ($p < 0.01$) from previous test in same group

Table 5. Differences between isokinetic recordings at one test and the previous one in the two groups who underwent arthroscopic subacromial decompression (ASD) or open subacromial decompression (OSD). Values are mean and 95% confidence intervals

Total work (Joule)	n	A	n	B	n	C	n	D
External rotation at 60°/sec								
ASD	8	11 (–28–50)	11	19 (–4.5–42)	13	2.3 (–5.8–10)	11	18 [a] (–10–45)
OSD	13	23 (1.1–44)	13	16 (1.9–29)	16	18 (9.1–28)	16	–16 [a, b] (–39–7.6)
External rotation at 180°/sec								
ASD	8	28 (13–43)	11	16 (–2.4–35)	13	1.4 (–13–15)	11	8.5 (–11–28)
OSD	13	19 (–1.2–40)	13	1.4 (–14–17)	16	11 (0.4–21)	16	–3.3 (–20–13)
Internal rotation at 60°/sec								
ASD	8	22 (–57–100)	11	17 (–19–53)	13	2.5 (–19–25)	11	36 (–3.7–75)
OSD	13	28 (–3.7–60)	13	20 (–9.1–49)	16	13 (–3.2–29)	16	–11 (–51–29)
Internal rotation at 180°/sec								
ASD	8	50 (13–86)	11	29 (–9.8–68)	13	–0.8 (–20–18)	11	16 (–16–47)
OSD	13	44 (9.6–78)	13	0.4 [b] (–24–25)	16	11 (–5.7–27)	16	–3.9 (–27–19)

A = Difference 3 months postoperatively (p.o.)–preoperatively
B = Difference 6–3 months p.o.
C = Difference 12–6 months p.o.
D = Difference 96–12 months p.o.
[a] ASD significantly ($p < 0.05$) different from OSD
[b] Significant change ($p < 0.05$) from previous recording in same group

these parameters showed no differences between or within the groups. The ASD group seemed to improve their isokinetic muscle strength during the 7-year period from 12 to 96 months unlike the OSD group, which showed no such improvement (Tables 3 and 5).

Discussion

ASD, a well-evaluated procedure, is advocated by several authors (Ellman 1987, Esch et al. 1988, Norlin 1989, Van Holsbeeck et al. 1992, Lindh and Norlin 1993, Sachs et al. 1994, Roye et al. 1995, T'Jonk et al. 1997, Stephens et al. 1998). Considerable attention has been paid to the technical aspects of the procedure (Caspari and Thal 1992), but only a few long-term studies on ASD have been done (Ellman 1987, Lindh and Norlin 1993, Roye et al. 1995, Kim et al. 1997, Stephens et al. 1998). All of them have concluded that it is a good alternative to OSD, and some assert it is better (Lindh and Norlin 1993). Most of these studies are retrospective, and only a few have been randomized and controlled. Lindh and Norlin (1993), in a randomized study, reported a shorter average operating time in the ASD group than in the OSD group (40 vs 66 min). In our study, we found the opposite to be true, and we think this is because ASD is a more demanding procedure than OSD for the nursing staff and surgeon. We performed the randomization after diagnostic arthroscopy of the shoulder joint, and this may explain the longer duration of surgery in both groups. Although improvements in technique and experience shorten the time for the ASD, we do not believe that a slight difference in operating time is an argument in favor of either operation.

Lindh and Norlin (1993) found that the rehabilitation and range of motion were better in the ASD group 3 months after surgery, and they concluded that ASD was better than OSD. However, they had only a few cases (10 patients in each group), and the rehabilitation program was different in the groups (the open Neer group immobilized for 3 weeks postoperatively). At the 2-year follow-up, Lindh and Norlin (1993) found that the active range of motion was similar in the groups, and the median UCLA score was 29 points in both groups.

T'Jonk et al. (1997) found a better short-term, but similar 1 year UCLA score in the ASD compared to the OSD group; the other clinical parameters were about the same.

In a randomized comparison of ASD and OSD, Sachs et al. (1994) reported that the former group tended to have a better rehabilitation during the first 3 months. One weakness of this study was that the patients treated with OSD did not have a diagnostic arthroscopy of the glenohumeral joint to rule out other causes of shoulder pain. Some patients in the OSD group (number not reported) also underwent a concomitant distal clavicle resection, which may have delayed their rehabilitation during the first postoperative weeks.

In our present study, the OSD group attained the same clinical result as the ASD group after 3 months.

Unlike previous studies, we found that the average UCLA scores, VAS recordings of pain and overall satisfaction were similar in the ASD and OSD groups at the short- and long-term follow-ups. The reasons why we found only minor differences in the short- and long-term results in the groups may be that the rehabilitation was exactly the same in both groups, and that patients having surgery in addition to the acromioplasty (e.g., resection of distal clavicle) were not included. We repaired the deltoid periosteum on the acromion, and the small loosening of the deltoid muscle of about 1.5 cm had no negative effect on the rehabilitation of our patients. Like Neer (1972), we do not believe that OSD patients need immobilization postoperatively.

As in other studies on impingement syndrome, we have also used isokinetic dynamometer recordings in our series (Brox et al. 1995). In the OSD group, isokinetic muscle scores decreased after 96 months, as compared to those at 12 months. During the same period, the ASD group showed some further improvement in muscle function. However, it should be borne in mind that the UCLA and subjective VAS scores were not statistically significantly different in the two groups at any time. We found a great individual variation in all measured isokinetic parameters, which may be due to the small number of patients in each group and the range in age. The oldest patients may have had a reduction in muscle strength because of normal aging during the observation period. On the other hand, the UCLA score, considered the main evaluation tool in this study, showed a consistently acceptable individual variation.

Pain is an important symptom in patients with impingement syndrome, and in prospective studies, it is essential to select methods of evaluation that the patients can tolerate both before and after treatment. In a previous study on isokinetic record-

ings, Holm et al. (1996) found that external/internal rotation was the preferable movement pattern for evaluating muscle strength per se in patients with rotator tendinosis. This movement pattern was weakly correlated to pain and most patients could perform the test both before and after treatment. The use of isokinetic muscle testing strengthens the validity of our study and supports the assumption that slight deltoid loosening does not affect the rehabilitation negatively.

Sachs et al. (1994) found shorter postoperative sick-leave in the ASD (36 days) than in the OSD group (54 days). In our study, the ASD patients returned to work at an average of 6, and the OSD patients at 10 weeks postoperatively. However, the median sick-leaves were similar, 5.5 (0–16) and 6.0 (0–61) weeks, respectively.

We conclude that the choice between arthroscopic or open subacromial decompression is a question of cosmesis and personal preference. Most surgeons who master the arthroscopic technique prefer this method, but clinically, the two treatments are equally successful.

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