ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2014;48(1):25-31
doi: 10.3944/AOTT.2014.3072

Reverse shoulder arthroplasty: radiological and clinical short–term results

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Objective: The aim of this study was to examine the radiological and clinical short term results of the patients who underwent reverse shoulder arthroplasty for rotator cuff arthropathy.

Methods: The study included 14 (2 male, 12 female) patients who underwent reverse shoulder arthroplasty for rotator cuff arthropathy between 2009 and 2010. The mean age of the patients was 74 (57–80) years and the mean follow–up period was 32 (21–40) months. Radiological methods as well as the range of motion, Quick DASH, Constant and VAS scores were used for the evaluation of patients preoperatively and at last the follow–up.

Results: Mean active forward flexion, abduction and external rotation increased respectively from 44, 41 and 21 degrees preoperatively to 149, 105 and 37 degrees at the last follow–up. The mean Quick-Dash score was 59.1 degrees preoperatively, and 36.1 degrees at the last follow–up visit. The mean Constant score increased from 20.7 preoperatively to 58.9 at the last follow–up visit. The mean VAS score decreased from 7 preoperatively to 1.2 at the last follow–up visit. The mean acromion–humeral head distance increased from 5.3 mm preoperatively to 23.1 mm postoperatively. None of the patients had major complications.

Conclusion: Reverse shoulder arthroplasty in patients with advanced stage rotator cuff tear arthropathy ensure significant improvement in terms of pain and function with the help of an appropriate rehabilitation protocol.

Key words: Reverse shoulder arthroplasty; rotator cuff tear.

Arthropathy due to massive rotator cuff tear is among the diseases which are challenging to treat in orthopaedics.[1,2] Treatment options for this condition are conservative treatment, arthroscopic debridement, hemiarthroplasty, shoulder fusion and resection arthroplasty.[3-8] Standard hemiarthroplasty and total shoulder prosthesis are only a solution for pain, because they don't change the center of rotation.[5-7,9-11] Reverse shoulder prosthesis is now used as a satisfactory treatment option for patients over 70 years of age, with a low functional expectation.[12] Reverse shoulder prosthesis, which was first designed in the 1980s by Paul Grammont in France, lengthens the moment arm of the deltoid muscle by displacing the shoulder center of rotation medially and inferiorly.

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Submitted: October 15, 2012 **Accepted:** November 20, 2013

Available online at
www.aott.org.tr
doi: 10.3944/AOTT.2014.3072
QR (Quick Response) Code

In this way, active forward flexion and abduction movements are provided by deltoid mucle force.[13] Reverse shoulder prosthesis has a more stable design than standard shoulder prosthesis.[14] In addition to cuff tear arthropathy, reverse shoulder prosthesis has been used for shoulder arthroplasty revisions, shoulder involvement in rheumatic diseases, following tumor resection, and comminuted fractures of the proximal humerus.[12,14-18]

The aim of this study was to examine the radiological and clinical short term results of the patients who underwent reverse shoulder arthroplasty for rotator cuff arthropathy.

Patients and methods

Between 2009 and 2010, reverse shoulder prosthesis was applied to 14 patients (2 male, 12 female) with cuff tear arthropathy and painful pseudoparalysis of the shoulder. The etiological diagnosis was arthropathy due to rotator cuff tear in all patients. One patient had a history of open instability surgery performed for recurrent shoulder dislocation. Patients included in the study had received at least 6 months of physical therapy and conservative pain control treatment without favorable results in the end. Mean age of the patients was 74 (57–80) years and the mean follow–up duration was 32 (21–40) months. Right hand was the dominant hand in all patients, and 3 patients were operated on their left side while 11 patients were operated on their right side. Passive and active range of motion was measured preoperatively in the standing position with a goniometer. Standard shoul-

Fig. 1. Components of reverse shoulder arthroplasty. (Pictures were taken from surgical technique brochure of DePuy, DELTA Xtend Reverse Shoulder System) [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

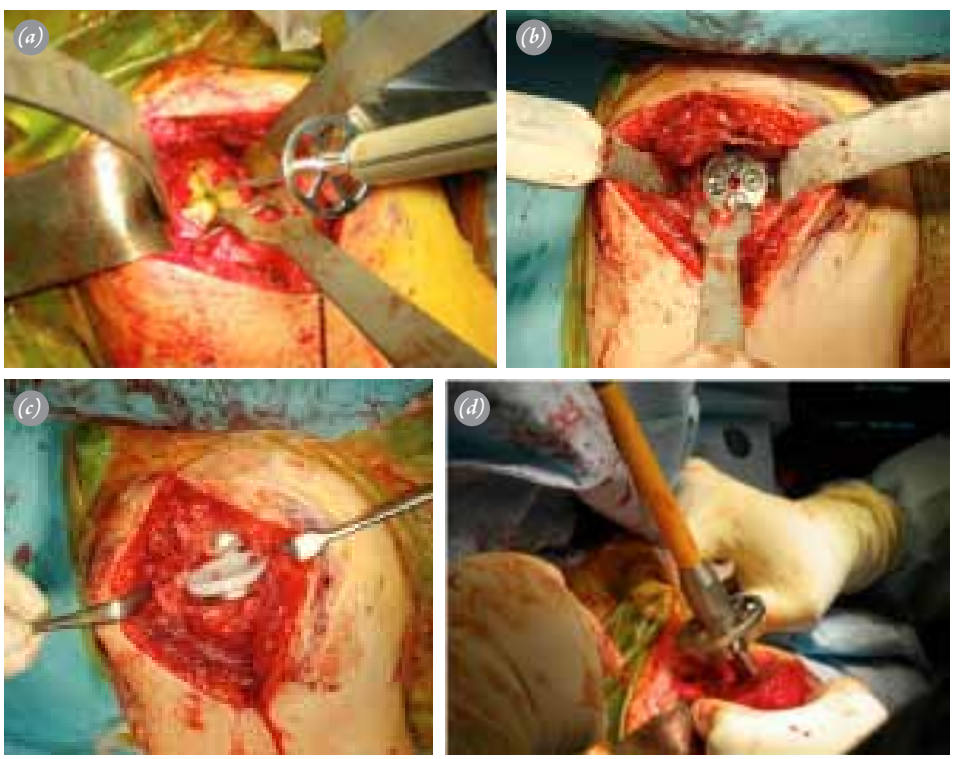

Fig. 2. Surgical technique. **(a, b)** Preparation of glenoid; **(c, d)** Preparation of humerus. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

der AP, oblique and outlet views, MRI and CT were obtained for preoperative evaluation. stage 4 or 5 cuff tear arthropathy was found in all patients, according to the classification method described by Hamada et al.[19] The patients were evaluated with shoulder range of motion, plain X-ray, and Quick DASH, Constant and VAS scores at their final follow–up visit. The distance between the acromion and the humeral head was measured on preoperative and postoperative X-rays. For statistical assessment, preoperative and final follow–up data were evaluated using student's t test for paired samples. The p values less than 0.05 was considered significant.

Surgical technique

Deltopectoral incision was used in 3 patients and superolateral incision was used in 11 patients. In patients having a deltopectoral incision, subscapularis tendon was elevated from its humeral attachment. In patients having a superolateral incision, anterior third of the deltoid muscle was elevated from the acromion. Fibrous remnants covering the humeral head were debrided. Humeral head cut was performed using a special guide system at an angle of 155° with the diaphysis. Fibrous remnants around the glenoid were debrided. The center of the glenoid was found and a guide wire was placed in parallel with the scapular body. The glenoid was prepared by debriding only the superficial subchondral bone with a reamer. Metaglene was placed on the glenoid at the lowest possible position, and fixed to the scapula with four screws, at least two of which were locking screws (Delta XTEND Reverse Shoulder System, DePuy, USA) (Figure 1). Humeral diaphysis was reamed with appropriate reamers and metaphysis was prepared by broaching. Humeral component of appropriate size was placed in 10° retroversion. Glenosphere was fixed to the metaglene component with a screw. A polyethylene cup was inserted on the humeral component. Shoulder joint was reduced and stability was checked (Figure 2).

Mean physical therapy time was 8 (6–12) weeks. Supine active assistive exercises were performed during the first 6 weeks. Standing active exercises were introduced

Fig. 3. **(a-c)** Preoperative functional status and shoulder radiograph of a 73-year-old female patient; **(d-f)** Functional status and shoulder radiograph of the same patient at 34 months postoperatively.
[Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Table 1. Demographic properties and measurement data.

Patient No	Patient demographic properties				Pre–op							Follow–up						
	Age	Gender	Side	Follow up-time (month)	Forward flexion (°)	Abduction (°)	External rotation (°)	Constant	Quick DASH	VAS	A–H distance (mm)	Forward flexion (°)	Abduction (°)	External rotation (°)	Constant	Quick DASH	VAS	A–H distance (mm)
1	77	Female	R	21	80	45	30	32	50	7	9	140	120	30	74	22.7	1	32
2*	80	Female	R	36	10	10	5	46	50	6	1	140	90	60	45	47.7	0	24
3	62	Male	R	28	70	45	30	20	55	5	13	130	100	10	69	18.2	0	25
4	77	Female	L	21	80	45	45	15	65	5	5	140	110	40	63	34.1	0	23
5	79	Female	L	33	20	40	20	10	65	7	16	150	100	35	46	40.9	5	35
6	57	Female	R	29	30	30	20	22	70	8	3	175	90	60	56	34.1	1	17
7	73	Female	R	34	20	30	20	20	60	9	2	170	100	70	58	45.5	5	20
8	74	Female	L	28	90	70	5	10	60	9	10	150	120	60	52	43.2	4	26
9	75	Female	R	39	20	40	20	15	55	8	2	160	120	30	63	25	0	19
10	79	Male	R	40	20	45	20	15	50	7	7	110	90	10	61	88.3	0	28
11	76	Female	R	32	15	30	10	20	60	7	2	150	110	20	65	13.6	0	17
12**	76	Female	R	35	10	15	10	25	65	5	2	170	90	10	59	25	0	23
13	79	Female	R	36	75	45	20	20	60	9	1	160	130	50	55	31.8	0	15
14	76	Female	R	32	80	90	35	20	63	8	2	150	98	40	59	36	1	19

A–H distance: Distance between acromion and humerus. At post–op X-rays, this distance was measured between acromion and greatest tubercle.
*: Os acromiale detachment was observed in patient no. 2 at the second postoperative month, and was treated conservatively. **: History of shoulder instability surgery was present in patient no. 12.

after the sixth week, and muscle strengthening exercises were started after 12 weeks.

Results

Mean follow–up period was 34 (22–42) months. Major finding at the final follow–up visit was improvement in pain and shoulder elevation. Mean preoperative pain score (VAS) decreased from 7 preoperatively to 1.2 at the final follow–up visit. Active forward flexion, abduction and external rotation increased from a preoperative value of 44°, 41° and 21° to 149°, 105° and 37° at the final follow–up, respectively. Mean internal rotation improved from sacrum (gluteal–T12) level preoperatively to L3 (gluteal–T12) level postoperatively. Mean Quick DASH score was 59.1 preoperatively and 36.1 at the final follow–up visit. Mean Constant score increased from 20.7 preoperatively to 58.9 at the final follow–up visit (Figure 3) (Table 1). None of the patients had a complication such as hematoma, dislocation, nerve injury, signs of loosening or glenoid notching. Acromiohumeral distance, as measured from preoperative and postoperative shoulder AP views, increased significantly from a mean of 5.3 (1–16) preoperatively to 23.1 (15–32) after the operation ($p<0.05$) (Figure 4). In one patient, a preoperatively asymptomatic mesoacromion was fixed with fiberwire sutures during the operation. Two months after the operation, a control X–ray showed that mesoacromion had detached. Physical therapy was suspended and the patient was observed conservatively; and there was a painless and adequate range of motion and an adequate deltoid muscle strength at the sixth month postoperatively (Table 2).

Discussion

For unrepairable rotator cuff tear that is not accompanied by arthritis, techniques such as margin convergence and tendon transfer have been defined. While tendon transfer is recommended for young patients having masssive rotator cuff tear without arthropathy; reverse shoulder prosthesis is favored as a good option for elderly patients with unrepairable massive rotator cuff tear and pseudoparalysis.[2,18,20] Although reverse shoulder prosthesis was developed for cuff tear arthropathy initially, in time, its indications expanded to include complex proximal humerus fractures in the elderly, arthrosis which developed after proximal humerus fracture, shoulder reconstruction after tumor resection, shoulder involvement in rheumatologic diseases, and revision of primary shoulder arthroplasty.[12,14-18,21] In a study by Boileau et al.,[20]

Fig. 4. Radiographs of a 76-year-old female patient, **(a)** before and **(b)** after the surgery. A significant increase was shown in the acromiohumeral distance. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

reverse shoulder prosthesis improved functional results in patients who had undergone unsuccessful cuff repair. Successful results have also been reported in various series after approximately 4 years of follow–up.[22-23] Guery et al. reported %84 survival of reverse shoulder prosthesis in a series of 77 patients with at least 5 years of follow–up.[12] In a study by Boileau et al., reverse shoulder prosthesis was combined with latissimus dorsi and teres major tendon transfer in order to improve external rotation.[24]

While good results have been reported for reverse shoulder prostheses performed for cuff tear with arthropathy, better results have been reported in patients with massive cuff tear without arthropathy and pseudoparalysis than those with other indications such as fracture, revision surgery or tumor resection.[2,18,20]

In our study, patients with cuff tear arthropathy were selected and early results of reverse shoulder prosthesis were found to be good. Analysis of pain, function and satisfaction rates showed a significant improvement, especially in forward elevation and abduction. Significant improvement was found in external rotation, as well. This situation was thought to be related with the normal function of an intact teres minor muscle after the mechanical obstacle created by shoulder arthrosis has been removed.

There were reports of deltopectoral, superolateral, anterosuperior, and transacromial incisions in the literature, deltopectoral incision being the most popular.[9,21,25-26] Superolateral incision has been used in various studies as a less invasive choice.[12,17,22,26] Likewise, we mostly preferred superolateral approach in our surgical technique, because it allows to preserve subscapularis attachment and also allows a direct approach to the glenoid. However, deltopectoral incision may be preferred in patients who had undergone previous operations, such as instability surgery.

In the literature, complications like glenoid loosening, dislocation, infection, glenoid notching, periprosthetic fracture, neurologic problems, acromion fracture, and hematoma have been reported.[2,16,18,20,22,27] Complication rates have been found to be higher in reverse shoulder arthroplasty cases which were performed as a revision procedure.[16] In order to prevent glenoid notching, the use of eccentric glenosphere, inferior placement of the glenoid component and avoiding superior tilt have been recommended.[28,29] Taking this experience into consideration, we placed the metaglene at the most possible inferior location on the glenoid. In addition, we used an eccentric glenosphere component and placed it inferiorly so as to avoid the contact of the humeral component and inferior glenoid. In a study by Klein et al. which assessed the outcome of 143 reverse prostheses after a minimum of 2 years of follow–up, glenoid grafting in patients with a glenoid defect was shown to have good results.[30] In a series of 240 reverse shoulder prosthesis cases, Walch et al.[23] stressed the fact that complication rates decrease with increasing experience. In our series, after follow–up for a mean duration of 32 months, there was no early or late complication requiring revision. One patient suffered from os acromiale detachment, which was treated conservatively. Our patients received postop-

Table 2. Clinical data of the patients preoperatively and at the final follow–up visit.

	Pre–op	Final follow-up	p
Constant	20.7 (10–46)	58.9 (46–74)	<0.05
Quick DASH	59.1 (50–70)	36.1 (13.6–47.7)	<0.05
Active flexion	44.2° (10–90)	149.6° (110–170)	<0.05
Active abduction	41.4° (10–90)	104.8° (90–130)	<0.05
External rotation	21° (5–45)	37.5° (10–70)	<0.05
VAS	7 (5–9)	1.2 (0–5)	<0.05
Acromion-humerus distance (mm)	5.3 (1–16)	23.1 (15–32)	<0.05

erative rehabilitation for a mean duration of 8 weeks. It was observed that rehabilitation went more quickly after wound healing. As the old age of the patients and difficulty in adapting a fast-track rehabilitation program may increase dislocation risk, a slow rehabilitation program was considered to be more appropriate.

Reverse shoulder arthroplasty in patients with advanced stage rotator cuff tear arthropathy ensure significant improvement in terms of pain and function with the help of an appropriate rehabilitation protocol.

Conflicts of Interest: No conflicts declared.

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