

Clinical and radiological outcomes after reverse shoulder arthroplasty with less medialized endoprosthesis after mean follow-up time of 45 months

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Abstract

Introduction The purpose of this study was to evaluate outcomes after reverse shoulder arthroplasty for the treatment of complex three- and four-fragment proximal humeral fractures after mean follow-up time of 45 months and to compare our results with the results published by other authors.

Materials and methods Retrospectively we have analyzed 27 consecutive patients after total arthroplasty with less medialized reverse shoulder prosthesis used for the treatment of complex proximal humeral fracture. The median age and standard deviation was 67.5 ± 7.3 years (range 55–85). The average follow-up time was 45 months. Shoulder function was evaluated using Simple Shoulder Test and Constant scale. Patient satisfaction about the treatment was evaluated using Likert-type questionnaire. All patients were investigated radiologically for possible complications using standard lateral and anterior views.

Results All patients were satisfied (74%) or highly satisfied (26%). The mean total Constant–Murley score was 57.6 pts. (range 37.4–80.2). Mean total Simple Shoulder Test score was 73.5 pts. (range 49.8–100). There were two cases with heterotopic ossification and one with greater

tubercle malposition. We found no signs of scapular notching, implant failure or loosening.

Conclusions Results after reverse arthroplasty for complex proximal humeral fractures yield good clinical, functional, and radiological outcomes after mean follow-up time of 45 months. Results are comparable to other studies published in the recent literature.

Keywords Reverse shoulder arthroplasty · Scapular notching · Proximal humeral fractures

Introduction

Proximal humeral fracture is one of the most common traumas caused by direct impact or falling [1]. Usually, nondisplaced fractures are treated conservatively, and the treatment yields good and predictable outcomes [2, 3]. On the other hand, complicated, three- and four-fragment fractures usually are treated surgically. In terms of functional outcomes, ORIF with plate gives satisfactory results; however, the complication rates are higher in comparison with arthroplasty [4, 5]. That leaves hemiarthroplasty or total shoulder arthroplasty as a preferable choice for the treatment of complex proximal humeral fractures for elderly patients. While hemiarthroplasty remains questionable method, because of high rate of tuberosity malposition and unpredictable clinical results, popularity of reverse shoulder arthroplasty (RSA) has increased in recent times [6].

The main disadvantage of RSA is scapular notching (SN) [7]. More than 40% of patients treated with Delta III[®] prosthesis suffer from SN [8]. Reduced medialization can improve range of motion and increase satisfactory results in terms of SN, when using less medialized type reverse prosthesis [9].

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The purpose of this retrospective study was to evaluate outcomes after RSA for the treatment of proximal humeral fracture and to compare our results with the results published by other authors.

Materials and methods

Thirty-nine consecutive patients with complex three- and four-part proximal humeral fractures were treated in our institution between 2011 and 2012 by four experienced shoulder surgeons. Thirty-two patients were selected for retrospective study who had surgery less than 2 weeks after trauma. Four patients were not included in this study because the operation was performed as a revision surgery after failed osteosynthesis or another trauma sequelae (pseudoarthrosis, posttraumatic arthrosis). Three more patients died during the time of follow-up because of reasons not related to their surgery. The final patient group consisted of 27 patients (84% of selected patient group) who came back for radiological and clinical evaluation. The mean follow-up time was 45 months (range 39–48 months). There were 7 males (26%) and 20 (74%) female patients. The median age and standard deviation of the patients was 67.5 ± 7.3 years (range 55–85 years). Reverse shoulder prosthesis with less medialized center of rotation (CoR) (Arrow®, Fh Orthopaedics, France) was used during all surgeries. Indications for RSA were: displaced and irreparable three- and four-fragment proximal humeral fractures. We used surgical technique described in previous publication [2].

Postoperatively, during the final follow-up, all patients were examined by an independent surgeon. All subscales of Constant–Murley score (CS) (pain, activities and movement, active flexion, external/internal rotation, and shoulder muscle strength) were evaluated and documented. Forward flexion and abduction were measured using goniometer [10, 11]. The shoulder muscle strength was measured in scapular plane with arm abducted 90° while elbow was extended using digital dynamometer (Kern & Sohn GmbH, Balingen, Germany. Weighing range Max. 15 kg, readout $d = 20$ g, reproducibility 20 g, and linearity 0.5%) following a reliable technique [12]. Five repetitive measurements of strength of both shoulders were made during examination. For statistical analysis of the shoulder strength, we used the mean values of five repetitive measurements.

After clinical examination, patients completed a self-assessment questionnaire [Simple Shoulder Test (SST)] without any assistance [13]. SST contains 12 questions which require “yes” or “no” responses and each question equally weighted at 8.3 points in a 0–100-point scale [14].

During follow-up, patients were also asked to define their satisfaction about shoulder surgery using Likert-type

questionnaire with five possible choices: highly satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, and highly dissatisfied.

Anteroposterior and mediolateral X-ray views were taken to evaluate the position of all components of the prosthesis and possible complications: implant loosening, scapular notching, implant failure, and ectopic ossification.

SPSS 21 statistical analysis software was used to evaluate obtained results. For additional calculations Microsoft Excel 2016 was used. We chose the level of significance (p) to be 0.05 when comparing two or more groups. Two-tailed t test was used when two groups were compared.

Results

All patients were satisfied with the performed surgery. 20 (74%) of them were satisfied and 7 (26%) were highly satisfied. Two patients felt moderate pain during night time. All twenty-seven patients were able to get back to their usual work and leisure time routines after the completed surgery. The mean scores of subscales of CS are shown in Table 1. All patients were able to raise their arm more than 90° . Average anterior flexion of shoulder joint was 117° . The mean CS for shoulder muscle strength was 5.8 pts. In comparison, CS for opposite shoulder which was not affected by trauma was 9.5 pts.

When patients were assessing themselves using SST questionnaire, mean score for pain was 14.2 pts. The mean SST scores for movement and strength were 29.6 and 17.8 pts., respectively. Mean total SST score was 73.5 pts. (ranged from 49.8 to 100 pts.).

One patient was found with tubercle malposition during X-ray analysis (Fig. 1a). There was no visible SN in our final patient group. There were two cases with heterotopic

Table 1 CS for each subscale

Subscale	Mean constant score (pts.)
Pain	10.8 (5–15)
Activities and movement	14.0 (8–20)
Flexion	6.8 (4–10)
Abduction	6.0 (4–10)
Rotation	
External	7.3 (4–10)
Internal	6.9 (4–10)
Muscle strength	5.8 (3.7–7.4)
Total	57.6

Range of deviation are shown in brackets

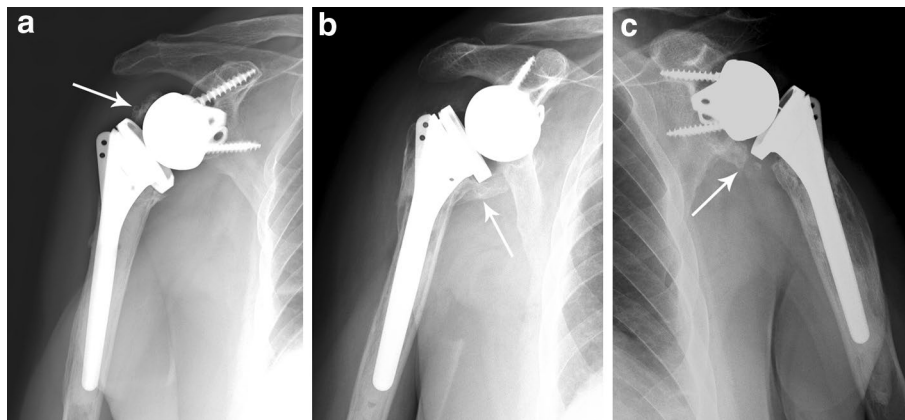


Fig. 1 **a** Case (female, 77 years) with tubercle malposition (*white arrow*). Patient is highly satisfied and gets highest CS (80.2 pts.) and SST (99.6 pts) score. Follow-up time of this patient was 47 months. **b, c** Cases (**b** female, 68 years, **c** male, 64 years) with heterotopic

ossification (*white arrow*). CS scores of these patients were 47.9 and 50.8; SST scores were 49.8 and 58.1, respectively. Follow-up time of these patients was 43 and 48 months, respectively

ossification (HO) (Fig. 1b, c). In addition, no signs of infection, loosening or break of prosthesis were recorded.

Discussion

Reverse shoulder arthroplasty has become more and more popular in recent years. Several systematic reviews showed that reverse shoulder arthroplasty has better short-term results in comparison with hemiarthroplasty [15, 16]. Grammont type reverse shoulder prostheses usually have medialized center of rotation. Such design usually ends up with contact between the polyethylene insert of the humeral component and scapular neck. This impingement results in SN which may lead to a mechanical failure of prosthesis on the long term [17, 18]. Moreover, SN may have negative impact on clinical and functional results [19]. However, there is evidence of SN manifestation during first few years after surgery, but it had no clinical significance [20]. The incidence rate of inferior SN was reported to range from 20% to more than 60% when prosthesis with medialized COR was used [21, 22]. Scapular notching is also related to glenoid component loosening which can manifest later than 7 years after operation [23]. Sirveaux et al. investigated outcomes after Delta reverse arthroplasty and reported 5 cases (out of 80) of glenoid component loosening. Twenty cases demonstrated radiolucency without malposition of prosthesis during mean follow-up of 44.5 months [17]. Lateralization of the center of rotation may solve the problem of scapular notching. In Arrow prosthesis, lateralization is achieved by two major design changes in comparison with Delta prosthesis: (1) fixing glenosphere on the metal baseplate gives 8.5-mm lateralization, (2) the metaphysis is angled at 135° and lateralized by extra 4 mm [24]. On

the other hand, excessive lateralization of the glenosphere increases the shearing forces on the implant, which eventually may lead to early glenoid component loosening [25]. The most important finding of this study was that we found no scapular notching or glenoid component loosening during the final follow-up. We think that it can be related with less medialized CoR design which is implemented in arrow prosthesis. Such design increases gap between the scapular neck and humeral component and should minimize the impingement between the scapula and the humeral component.

Other drawback of RSA is heterotopic ossification [26]. Development of this pathological process depends on several factors such as gender, soft tissue damage during trauma or surgery, and the type of implant used [27]. Usually, low-grade HO (grade 1) does not have negative effect on long-term clinical results [28]. Authors report that HO around scapular neck was observed in nearly 25% of patients treated with Grammont type prostheses [21]. In the present study, we found two cases of HO. Our results are consistent with the results in other reports where prostheses with lateralized CoR were analyzed [2, 9]. Reduced contact between scapular neck and humerus seems to be beneficial for the shoulder joint after endoprosthetic replacement as it produces less irritation to the soft tissue and bone.

Reduced medialization of CoR should increase the range of motion of external and internal rotation by more empowering anterior and posterior fibers of deltoid and rotator cuff muscles. That is in agreement with our results when Arrow prosthesis with less medialized CoR was used and the results published by other authors [22, 29, 30]. While forward flexion and abduction were comparable in our and previously mentioned papers, results of CS of external and internal rotation were better in this study.

It is worth noting that greater tubercle is in great risk of migration, because of force applied from supraspinatus and infraspinatus muscles. This migration has great impact on functional outcome for hemiarthroplasty [31]. In case of RSA, importance of greater tubercle and muscles attached to it is diminished, because of lowered and medialized CoR [32]. This matches with the results from our study. There was one case with displacement of greater tubercle in this study (Fig. 1a). CS and SST score of this patient did not significantly differ from other cases and were highest among them. Patient was able to flex his arm forward up to 140°.

Limitations of this study were that we investigated outcomes in relatively small patient group and that this study was retrospective.

Conclusions

Results after reverse arthroplasty for complex three- and four-fragment proximal humeral fractures using less medialized shoulder prosthesis yield good clinical and radiological outcomes after mean follow-up time of 3.5 years. Results are predictable and comparable with the results published in the recent literature. Nevertheless, further follow-up study is warranted to compare mid- and long-term results of prostheses with less medialized center of rotation with other prostheses used in reverse shoulder arthroplasty.

Compliance with ethical standards

Conflict of interest The authors of this study declare that they have no conflict of interest.

Ethical approval For this type of study formal consent is not required.

Informed consent Informed consent was obtained from all individual participants included in the study.

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