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Clinical outcomes of anatomic total shoulder arthroplasty for primary shoulder osteoarthritis did not differ between elderly and younger Japanese patients



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Background: Few studies on the outcomes of anatomic total shoulder arthroplasty (aTSA) in Asian populations have been reported. In addition, approximately one-third of primary aTSA were performed for patients 80 years or older in Japan, but the indication of aTSA for the primary shoulder osteoarthritis in the elderly population remained unclear. The purposes of this study were (1) to investigate clinical outcomes of aTSA in Japanese patients with primary glenohumeral osteoarthritis and (2) to compare clinical outcomes between patients 80 years or older and 70 years or younger. We hypothesized that aTSA would yield favorable outcomes in Japanese patients and that the outcomes of aTSA in patients 80 years or older would be comparable to those 70 years or younger.

Methods: Patient records were retrospectively reviewed to collect patients who underwent aTSA for glenohumeral osteoarthritis between August 2011 and September 2017. The inclusion criterion of this study was aTSA performed for glenohumeral osteoarthritis. Exclusion criteria were as follows: (1) secondary osteoarthritis, (2) revision surgery, and (3) < 24-month follow-up. Range of motion (ROM) and Constant score were evaluated, and complications were investigated. Rotator cuff integrity was assessed by ultrasonography. We compared the outcomes between patients 80 years or older and 70 years or younger.

Results: Seventy-seven shoulders (72 patients) met the study criteria. There were 14 men and 58 women with a mean age of 75 years (range, 57–93 years) at the time of surgery. The mean follow-up was 40 months (range, 24–84 months). The Constant score significantly improved from preoperative 54 (range, 35–78) to postoperative 89 (range 69–100, $P = .03$). Range of motion also showed significant improvement after surgery: flexion, 90° (range, 60°–130°) to 140° (range, 90°–170°); external rotation at the side, from 7° (range, -10 to 60°) to 40° (range, 5°–70°); internal rotation, from buttock (range, buttock-L3) to L2 level (range, buttock-T8) ($P < .001$ for all). Postoperative subscapularis tendon tears were detected in 3 shoulders (5%). Complications other than rotator cuff tears were observed in 5 shoulders (6%). Postoperative Constant score and ROM significantly improved in both elderly and younger patients without significant differences.

Conclusion: The clinical outcomes after aTSA in the Japanese population demonstrated significant improvements in ROM and Constant score with a low complication rate in the mid-term follow-up. aTSA should be indicated even in elderly patients because they also demonstrated comparable outcomes to younger patients.

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This study has been approved by the Institutional Review Board of Funabashi Orthopedic Hospital (IRB:2018017).

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Primary osteoarthritis (OA) of the glenohumeral joint is a progressive disease that is associated with degeneration of the articular cartilage in the humeral head and glenoid and results in shoulder pain and loss of function. Anatomic total shoulder arthroplasty (aTSA) is indicated for moderate to severe OA with

intact rotator cuff function and with adequate bone stock and version of the glenoid.²³ Improvement of function and pain relief can be expected in aTSA shoulders if surgeries are properly indicated.⁴

Primary OA of the glenohumeral joint is relatively rare in Asians compared with Americans and Europeans.^{15,16} Therefore, there have been no reports in the English literature that report the outcomes of aTSA for glenohumeral OA in Asian populations. It remains unclear if aTSA yields good clinical outcomes in Asians similar to Americans and Europeans.^{4,12,17}

The life expectancy of Japanese people is very high, approximately 80 years for men and 90 years for women, and shoulder arthroplasty for elderly patients has recently increased in numbers. As per the Japanese Arthroplasty Registry, approximately one-third of primary aTSA were performed for patients 80 years or older.⁹ Recently, there seems to be a trend that surgeons prefer reverse shoulder arthroplasty for primary OA in elderly patients, probably owing to the reliability in functional recovery.¹⁶ Thus, indications of aTSA for elderly patients remain unclear. Several studies have reported that aTSA for patients older than 80 years of age significantly improved pain and shoulder function with fewer complications and that elderly people were more satisfied with the surgeries because of the lower demands than young people.^{2,6,8,14} On the other hand, Walch et al have reported that secondary rotator cuff dysfunction occurred in 17% of aTSA, which was significantly related to poor clinical outcomes compared to shoulders without rotator cuff dysfunction.²⁴ The rotator cuff of elderly patients may be potentially susceptible to degeneration,^{15,20} declined function with time is concerning.

The purposes of this study were (1) to investigate clinical outcomes of aTSA in Japanese patients with primary glenohumeral OA and (2) to compare clinical outcomes between patients 80 years or older and 70 years or younger. We hypothesized that aTSA would yield favorable outcomes in Japanese patients and that the outcomes of aTSA in patients 80 years or older would be comparable with those 70 years or younger.

Materials and methods

Patient selection

Patient records were retrospectively reviewed to collect patients who underwent aTSA for glenohumeral OA in our institute between August 2011 and September 2017. Our indications of aTSA for glenohumeral OA were (1) no or small (< 1 cm in mediolateral length) rotator cuff tear, (2) no severe glenoid bone loss, (3) < 25 degrees of glenoid retroversion, and (4) < 80% posterior subluxation of the humeral head.^{3,23}

Inclusion criterion of this study was aTSA performed for glenohumeral osteoarthritis. Exclusion criteria were as follows: (1) secondary osteoarthritis, (2) revision surgery, and (3) < 24-month follow-up. To evaluate the clinical outcomes in elderly patients, patients > 80 years of age were selected, and the outcomes were compared with those in patients < 70 years of age.

Surgical techniques

All surgeries were performed by one of the senior surgeons (H.S. and N.T.) under general anesthesia with an interscalene block in the beach-chair position. The deltopectoral approach was used in all cases. The subscapularis tendon was tenotomized at 1 cm medial to the lesser tuberosity, and the capsule was resected from the humeral neck to expose the glenohumeral joint. After removal of osteophytes, osteotomy of the humeral head was performed at the anatomical neck. The following three implant systems were used: Aequalis (Wright Medical, Memphis, TN, USA), Ascend Flex (Wright

Medical, Memphis, TN, USA), and Global Advantage Shoulder Arthroplasty System (Depuy Synthes, Warsaw, IN, USA). Keel or pegged glenoid component was fixed with the use of bone cement. Humeral prosthesis was usually press-fitted but fixed using bone cement for patients with osteoporotic bone. The subscapularis tendon was repaired with a minimum of three tendon-to-bone stitches using high-strength sutures.²³ In addition, rotator interval closure was performed with one or two high-strength sutures.

Postoperative rehabilitation

Shoulders were immobilized for 3 to 4 weeks using a brace. Isometric rotator-cuff exercises and relaxation of the shoulder girdle muscles were initiated from the day after surgery. After the immobilization period, passive and active-assisted exercises were initiated for forward flexion and external rotation. After 6 weeks, patients began strengthening exercises for the rotator cuff and the periscapular muscles. Full, unrestricted activities were typically permitted at postoperative 3 months as per functional recovery of each patient.

Clinical assessment

One of the senior surgeons evaluated all patients preoperatively and postoperatively. Active range of motion (ROM) including forward flexion and external rotation at the side was measured using a goniometer. Internal rotation was measured as the reachable spine level by the thumb. Constant score was assessed preoperatively and at the final follow-up. Complications including perioperative deaths or serious comorbidities, blood transfusion, fractures, infection, nerve injuries, instability, and postoperative stiffness were investigated.

Radiographic and ultrasonographic evaluation

Glenoid morphology was classified using Walch classification²² with preoperative computed tomography scans. Loosening of implants was evaluated on anteroposterior radiographs at the final follow-up by two shoulder surgeons with consensus. Loosening of glenoid components was defined as > 2-mm radiolucent lines around a keel or pegs or subsidence or tilting of the component.⁵ Radiolucency around humeral prosthesis was graded using the 8-zone system.¹⁸

Ultrasound examination was conducted after postoperative 1 year by experienced radiologists using a high-resolution ultrasonography system (EUB7500, Hitachi Medical Corporation, Tokyo, Japan). The integrity of the supraspinatus, infraspinatus, and subscapularis tendons were examined¹ using a high-frequency (14 MHz) transducer (Fig. 1).

Statistical analysis

The paired t-test was used for comparison of preoperative and postoperative data including ROM and Constant score. The student's t-test and the chi-square test were used for comparison of younger and elderly groups. All statistical analyses were performed using JMP Pro, version 15 (SAS Institute Inc., Cary, NC, USA). The significance level was set at $P < .05$.

Results

Patients

Between August 2011 and September 2017, 115 shoulders (109 patients) underwent aTSA in our institute. Eighteen shoulders were

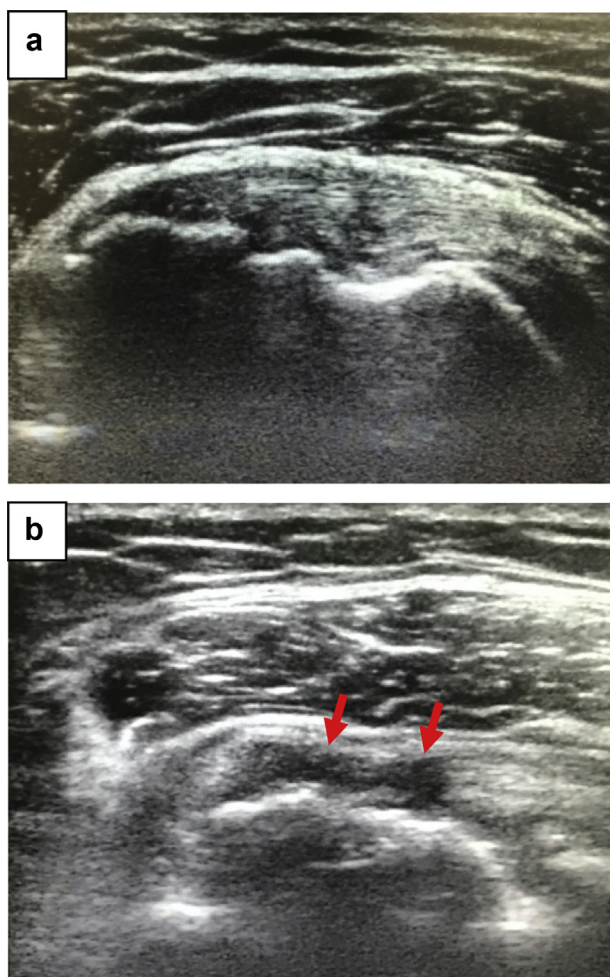


Figure 1 Postoperative ultrasonography of the subscapularis tendon (Left shoulder). (a) Successful repair; (b) Torn subscapularis tendon (✗).

excluded: secondary osteoarthritis, 17 shoulders; revision case, 1 shoulder. Among the remaining 97 shoulders, 20 shoulders were lost to follow-up before postoperative 2 years. Therefore, 77 shoulders in 72 patients were included in this study, and the follow-up rate was 79% (Fig. 2).

The patients consisted of 14 men and 58 women with a mean age of 75 years (range, 57-93) at surgery (Table I). The mean height was 153 cm (range, 138-175), and the mean body mass index was 25.1 kg/m² (range, 18.0-34.9). The mean follow-up was 38 months (range, 24–84).

Aequalis was used in 39 shoulders, Ascend Flex in 22 shoulders, and Global Advantage in 16 shoulders. A keeled-type glenoid component was used in 69 shoulders and peg type in 8 shoulders. Bone cement was used in 5 shoulders for the fixation of the humeral implant.

Clinical evaluation

The mean Constant score significantly improved from preoperative 54 (range, 35-78) to postoperative 89 (range 69-100) (Table II, *P*=.03). ROM also showed significant improvement after surgery: flexion, from 90° (range, 60°-130°) to 140° (range, 90°-170°); external rotation at the side, from 7° (range, -10° to 60°) to 40° (range, 5°-70°); internal rotation, from buttock (range, buttock-L3) to L2 level (range, buttock-T8) (Table II, *P* <.001 for all).

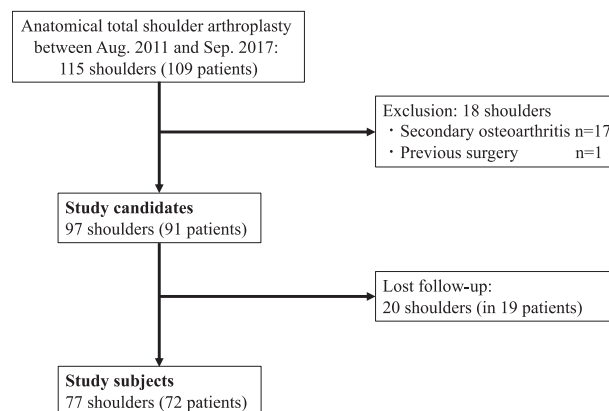


Figure 2 Patient selection.

Table I

Demographic data.

Patients (shoulders)	72 (77)
Age (yr)	75 ± 9 (57-93)
Sex (male/female)	14/58
Height (cm)	153 ± 6 (138-175)
BMI (kg/m ²)	25.1 ± 3.7 (18.0-34.9)
Follow-up (mo)	38 ± 3 (24-84)

The data were given as mean ± standard deviation (range).

Radiographic and ultrasonographic evaluation

Preoperative computed tomography demonstrated 22 (29%) A1, 20 (26%) A2, 17 (22%) B1, and 18 (23%) B2 glenoids. One shoulder demonstrated asymptomatic tilting of the glenoid component, and a different shoulder showed humerus loosening. Ultrasonography was performed in 58 shoulders at a mean of 24 months (range, 12-60) after surgery. Subscapularis tendon tears were detected in 3 shoulders (5%). One patient complained of motion pain, but the remaining two patients were asymptomatic. There were no supraspinatus and infraspinatus tears.

Complications

Complications other than rotator cuff tears were observed in 5 shoulders (6%): intraoperative humeral fracture, 1 shoulder; postoperative stiffness, 1; temporary nerve palsy, 3. A cerclage wiring was indicated for the intraoperative humeral fracture. No shoulders experienced perioperative death, serious comorbidities, blood transfusion, infection, dislocation, or revision surgery.

Comparison of younger and elderly patients

Twenty-one shoulders (27%) were included in the elderly (≥ 80 years of age) group, and 20 shoulders (26%) in the younger (≤ 70 years of age) group (Table III). The demographic data were not different between the groups except for gender and height (*P*=.02 and .003, respectively). There were no significant differences in preoperative and postoperative Constant score and ROM between the groups (Table IV). No loosening was observed in both groups. Although three temporary nerve palsy and one subscapularis tendon tear were found in the elderly group, there were no significant differences in the incidence of the complications between the groups (Table IV).

Table II
Comparison of preoperative and postoperative clinical evaluations.

	Preoperative	Postoperative	P value
Constant score	54 ± 10 (35-78)	89 ± 10 (69-100)	.03
Flexion (°)	90 ± 17 (60-130)	140 ± 18 (90-170)	<.001
External rotation (°)	7 ± 16 (-10 to 60)	40 ± 15 (5-70)	<.001
Internal rotation	Buttock (Buttock-L3)	L2 (Buttock-T8)	<.001
Loosening (n)			
Glenoid	/	1	
Humerus	/	1	
Complication (n)			
Subscapularis tear	/	8	
Fracture	/	3	
Neuropathy	/	1	
Stiffness	/	3	
		1	

The data were given as mean ± standard deviation (range).

Table III
Demographic data of elderly and younger patients.

	Elderly patients (≥80 yr)	Younger patients (≤70 yr)	P value
Patients (shoulders)	20 (21)	20 (20)	
Age (yr)	84 ± 4 (80–93)	64 ± 6 (57–69)	
Sex (male/female)	1/19	6/14	.02
Height (cm)	148 ± 4 (138-156)	166 ± 6 (149-175)	<.001
BMI (kg/m ²)	26.4 ± 3.0 (18-30)	25.2 ± 3.7 (18-30)	.4
Follow-up (mo)	36 ± 1 (24-74)	47 ± 2 (24-79)	.7

The data were given as mean ± standard deviation (range).

Table IV
Comparison of pre- and postoperative outcomes between elderly and younger patients.

	Elderly patients (≥80 yr)	Younger patients (≤70 yr)	P value
Preoperative			
Constant score	54 ± 8 (42-73)	56 ± 11 (44-79)	.9
Flexion (°)	98 ± 25 (60-120)	95 ± 24 (60-130)	.3
External rotation (°)	7 ± 11 (-10 to 25)	9 ± 15 (-10 to 40)	.8
Internal rotation	Buttock (Buttock-L3)	Buttock (Buttock-L3)	.9
Postoperative			
Constant score	86 ± 11 (69-100)	89 ± 2 (75–100)	.8
Flexion (°)	137 ± 20 (90-160)	146 ± 15 (120-170)	.9
External rotation (°)	39 ± 14 (15-70)	42 ± 17 (15-70)	.6
Internal rotation	L2 (Buttock–Th9)	L2 (Buttock–Th9)	.9
Loosening (n)			
Glenoid	0	0	-
Humerus	0	0	-
Complication (n)			
Subscapularis tear	1/13	1/14	.9
Neuropathy	3	0	.08
Stiffness	0	1	.3

The data were given as mean ± standard deviation (range).

Discussion

This study revealed that Japanese patients with glenohumeral OA showed significant improvement in ROM and Constant score after aTSA. Three shoulders (5%) had postoperative subscapularis tendon tears with ultrasonographic examination. In addition, no significant differences were detected in the clinical outcomes and complication rates between patients 80 years or older and 70 years or younger.

ROM significantly improved after surgery in all directions in this study. Many studies have reported significant ROM improvement after aTSA in American and European populations.^{4,13,17} Merolla et al¹² have reported good postoperative ROM in 40 Italians with aTSA: mean flexion, 135°; external rotation at the side, 45°; internal

rotation, T12 level. Simovitch et al¹⁷ have reported outcomes of 505 aTSA cases in French and American populations. The mean postoperative ROMs were 146° in forward flexion and 49° in external rotation at the side.¹⁷ The postoperative ROMs in this study were comparable to the previous studies. This suggested that aTSA effectively improved shoulder function of Japanese patients as well as Americans and Europeans.

A previous report demonstrated that 17% of shoulders had secondary rotator cuff dysfunction after aTSA, which was significantly related to poorer clinical outcomes than those without rotator cuff dysfunction.²⁴ Sperling et al¹⁹ found that 73% of symptomatic rotator cuff tears after arthroplasty were subscapularis tendon tears. Failure of the subscapularis tendon could cause muscle weakness and poor shoulder function after aTSA.¹⁹

Miller et al¹³ have reported that symptoms appeared in two thirds of aTSA with a subscapularis tendon tear and reflected patients' activity of daily livings. In this study, three shoulders (5%) demonstrated subscapularis tendon tears with postoperative ultrasonography, one of which patient showed relatively poor outcomes. Although the other patients did not show unfavorable outcomes in the mid-term follow-up, a longer-term follow-up may be required.

The outcomes of aTSA in elderly patients were good and showed no significant differences compared with those of younger patients in the mid-term follow-up. There have been several studies that also showed good clinical outcomes of aTSA in patients > 80 years of age.^{2,6,8} Iriberry et al⁸ studied 32 aTSA in > 80-year-old patients and reported good improvement of Constant score and ROM. Fouria et al⁶ also found good improvement of ROM in 50 aTSA > 80-year-old patients, and the mean postoperative ROMs were 138° in flexion, 48° in external rotation at the side, and T12 level in internal rotation. The elderly patients in this study demonstrated similar postoperative functional improvement to these studies. Haritnian et al⁷ compared the clinical outcomes of aTSA and reverse shoulder arthroplasty for glenohumeral osteoarthritis with intact rotator cuff in patients older than 70 years of age. Postoperative internal rotation tended to be better in aTSA than reverse shoulder arthroplasty, though the difference was not significant. Furthermore, the subscore for ROM in the Constant score was significantly better in aTSA. These findings suggest that aTSA can be the first choice for glenohumeral OA with intact rotator cuff even in patients 80 years or older.

An increased rate of complications has been reported in elderly patients that underwent elective arthroplasty of the lower limbs.²¹ However, the complication rate in this study was not significantly different between the elderly and younger patients. Interestingly, temporary neuropathy occurred only in elderly patients, though there was no significance in the incidence. The causes of neuropathy in aTSA are multifactorial, including direct nerve damage during surgical dissection, compression by retractors, and postoperative hematoma.¹¹ There may be a possibility that nerves in elderly patients were subjected to have more compression by retractors due to their smaller stature. Lädermann et al¹⁰ have implied the possibility that preexisting neurologic impairment including entrapment neuropathy or cervical radiculopathy deteriorates postoperatively. As elderly patients may have the increased incidence of these neurologic disorders, careful attention should be paid to prevent postoperative neuropathy.

Limitations

This study included several limitations. First, this was a retrospective case-series study. Second, the mean follow-up was 38 months. The outcomes and the complication rate might change with a longer-term follow-up. Third, 19 patients (20 shoulders) were lost to follow-up, and the follow-up rate was 79%. The relatively low follow-up rate might influence the outcomes. Fourth, three different implant systems were used in this study. The difference in systems could have possibly affected the clinical outcomes. Fifth, ultrasonography was not performed in all patients, and this might influence the outcomes. Finally, the elderly and younger patient groups included only 20 patients. The subgroup analyses between the two groups may be underpowered. Despite these limitations, we believe that this study may provide useful information on the outcomes of aTSA for primary OA in Asian populations and on the outcomes in elderly patients.

Conclusion

The clinical outcomes after aTSA in the Japanese population demonstrated significant improvements in ROM and Constant score with a low complication rate in the mid-term follow-up. aTSA should be indicated even in elderly patients because they demonstrate comparable outcomes to younger patients.

Disclaimers

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Conflicts of Interest: The authors declare that they have no conflicts of interest.

Patient consent: Obtained.

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