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Original Article

Evaluation of the results from partial arthroplasty for treating shoulder osteoarthrosis

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ABSTRACT

Objective: In this study we aim at statistically evaluating the results of the surgical treatment of the osteoarthrosis of the shoulder (OAS) with partial shoulder arthroplasty (PSA) and at correlating them with the several variables involved. *Methods:* In this study we evaluated 36 shoulders of 31 patients with OAS who underwent treatment with PSA in the Grupo de Ombro e Cotovelo (Group of Shoulders and Elbows) of the Department of Traumatology and Orthopedics of the Faculdade de Ciências Médicas da Santa Casa de São Paulo – Pavillion Fernandinho Simonsen between January, 1989 and November, 2010. Patients who underwent PSA and who had a post-operative follow-up of at least 12 months were included in the study. *Results:* After the surgery the range of elevation, external rotation, internal rotation and the UCLA scale improved (with average differences of 35º, 27º, 4º and 17 points, respectively), with a significant level of 5% ($p < 0.05$). For the same level of significance, the relation between a satisfactory UCLA and two variables was found: patients with maximum age of 60 years old at the moment of the surgery and patients that underwent tenotomy of the long head of biceps. *Conclusion:* Patients under 60 who underwent surgery and patients who underwent tenotomy of the long head of biceps achieved better results.

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Introduction

Shoulder osteoarthrosis is a painful and often incapacitating condition that occurs less frequently than in other joints such as the hip and knee.[1] It may be primary or secondary to a series of events such as trauma, instability or avascular necrosis of the humeral head. Independent of its etiology, it leads to a clinical condition of pain, diminished range of motion and functional limitation of the arm affected.[1]

Total shoulder arthroplasty has been widely accepted as a successful treatment for severe shoulder osteoarthrosis since the start of the 1970s.[2] According to Cofield, Neer, Morrisson, Hawkins et al, the results from this procedure have been extremely positive.[3-8] Glenoid components made of cemented polyethylene were introduced with the aim of enabling anatomical reconstruction of the shoulder and thereby providing pain relief, while increasing the range of motion of the shoulder. However, loosening of this component is the main cause of lack of success in total shoulder arthroplasty, as proven in the study by Hill and Norris (2001), for example.[9]

The difficulties in the implantation technique for the glenoid component and difficulties with bone stock, in which the glenoid cavity does not tolerate a polyethylene component because of excessive wear, or in cases of younger individuals (with the likelihood of requiring revision arthroplasty procedures), have led some authors to recommend partial shoulder arthroplasty instead of total shoulder arthroplasty, for treating shoulder osteoarthrosis.

According to Levine et al.,[1] partial shoulder arthroplasty provides pain relief and improvements in function, range of motion and capacity to perform activities of daily living, for shoulders presenting osteoarthrosis. In a recent study, Saltzman demonstrated that partial shoulder arthroplasty with concentric milling of the glenoid cavity, in patients under the age of 55 years, led to improvements in pain and shoulder function.[10] The study by Bonnevialle, published in 2011, demonstrated that partial shoulder arthroplasty is a reliable procedure in shoulders with osteoarthrosis and dysplastic morphology, thus leading to satisfactory clinical results.[11]

Along general lines, indications for total shoulder arthroplasty are reserved for cases in which the patients are older, are less demanding with regard to physical activity and have adequate bone stock for implantation of a glenoid component,[12,13] always with an intact rotator cuff. Indications for partial shoulder arthroplasty are reserved for cases of younger patients with higher physical demands or cases presenting glenoid abnormalities in which implantation of a component becomes impossible[14] (Fig. 1). There is still no consensus in the literature with regard to using or not using a glenoid component in cases of shoulder osteoarthrosis, and thus, surgeons have the task of choosing between performing partial and total shoulder arthroplasty.[15]

The present study had the aim of evaluating the results obtained by the Shoulder and Elbow Group of Santa Casa de Misericórdia de São Paulo from treating shoulder osteoarthrosis with partial shoulder arthroplasty.

Materials and methods

Thirty-six shoulders from 31 patients (five with bilateral disease) who were treated for shoulder osteoarthrosis using partial shoulder arthroplasty were retrospectively assessed (Table 1). The operations were performed by the Shoulder and Elbow Group, Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de São Paulo, between January 1989 and November 2010. This study was approved by the Research Ethics Committee.

The patients included in this study underwent partial shoulder arthroplasty to treat shoulder osteoarthrosis, with a minimum follow-up duration of one year.

The following patients were excluded: those who underwent partial shoulder arthroplasty due to any humeral head disease without the presence of arthrosis (due to fractures, for example) or due to arthropathy of the rotator cuff; individuals with arthrosis classified as B2 or C according to Walch et al.[16] (Fig. 2); those who underwent treatment with surface prostheses; and those with length of follow-up less than one year.

The postoperative follow-up ranged from 12 to 132 months (mean of 43.8 months) and these patients' ages ranged from 22 to 85 years (mean of 57.2 years). Twenty-six patients were female, of whom four were bilateral cases (83.3% of the total number of shoulders were female), and five patients were male, of whom one was a bilateral case (16.7% of the total number of shoulders were male). In 17 situations (47.2%), the shoulder of the dominant arm was operated, while in another 17 (47.2%), the shoulder of the non-dominant arm was operated. Two patients (5.6%) who were ambidextrous were operated on the right shoulder (Table 1).

In relation to etiology, 21 cases of arthrosis were primary (58.34%) and seven resulted from necrosis (19.44%), of which four were idiopathic necrosis (11.11%), two were necrosis secondary to fractures (5.55%) and one was necrosis secondary to sickle-cell anemia (2.78%). Four cases were arthrosis secondary to rheumatoid arthritis (11.11%), one was secondary to Reiter's syndrome (2.78%), two were secondary to instability (5.55%) and one was secondary to trauma (wound caused by white arms) (2.78%) (Table 2).

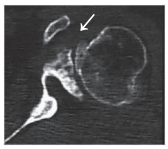

Fig. 1 - Image of a glenoid cavity (arrow) with insufficient bone stock, in which it would be possible to insert an implant.

The arthrosis were classified in accordance with Walch et al.[16] (Fig. 2) as A1 (four shoulders), A2 (31 shoulders) and B1 (one shoulder) (Table 3).

Regarding cementation, five prostheses were not cemented and the other 31 were cemented. In five cases, a technique of interposition of the glenoid cavity was performed, in which in four cases the individual's own joint capsule was used and in one case a graft from a tissue bank (calcaneal tendon) was used.

In order to measure the degree of joint mobility, we used the AAOS method[17] (American Academy of Orthopedic Surgeons).

Table 1 - Patients' clinical data.

N	Sex	Age	Dominance	Duration of symptoms (months)	Physiotherapy (duration in months)	Length of follow-up (in months)
1	F	70	+	24	3	12
2	M	59	-	6	3	13
3	F	70	-	36	3	28
4	F	68	-	96	6	72
5	F	47	+	24	3	132
6	F	71	-	144	4	36
7	F	44	+	120	36	42
8	F	70	-	18	6	60
9	F	61	ambidextrous RS	12	4	24
10	F	46	-	48	6	72
11	F	85	+	5	7	29
12	F	63	+	60	6	90
13	F	65	-	72	3	72
14	F	79	+	48	6	24
15	F	74	-	30	5	72
16	F	36	-	60	9	24
17	F	74	+	108	6	12
18	F	77	+	30	6	84
19	F	49	+	42	7	24
20	F	72	-	30	18	60
21	F	69	+	48	12	24
22	M	51	-	120	5	24
23	F	41	+	18	6	16
24	F	41	-	18	6	13
25	M	51	+	36	12	54
26	F	22	+	24	24	24
27	F	37	+	36	36	36
28	F	85	-	3	2	24
29	F	75	ambidextrous RS	6	4	84
30	M	31	+	108	7	30
31	F	46	-	48	18	24
32	F	66	+	60	6	12
33	F	39	-	36	3	108
34	F	26	-	60	3	36
35	M	48	+	60	6	72
36	M	53	-	36	3	16

+: dominant side operated; F: female; M: male; N: number; RS: right shoulder.

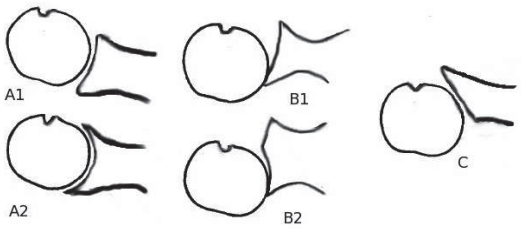

Fig. 2 -Walch classification in relation to the different types of glenoid morphology in cases of glenohumeral arthrosis. A1 = centered head with minimal erosion. A2 = centered head with greater erosion. B1 = posteriorly subluxated head with sclerosis and posterior osteophytes. B2 = posteriorly subluxated head with biconcave appearance of the glenoid. C = glenoid retroversion greater than 25°, independent of its erosion.

Table 2 - Etiology of shoulder arthrosis.

Etiology of shoulder arthrosis.	Number of cases
Primary arthrosis	21 (58.34%)
Primary avascular necrosis	4 (11.11%)
Avascular necrosis secondary to fracture	2 (5.55%)
Avascular necrosis due to sickle-cell anemia	1 (2.78%)
Rheumatoid arthritis	4 (11.11%)
Post-instability arthrosis	2 (5.55%)
Arthrosis following Reiter's syndrome	1 (2.78%)
Post-traumatic arthrosis	1 (2.78%)
Total	36 (100%)

Source: Hospital medical files.

Table 3 - Walch classification for shoulder arthrosis.

Walch classification	Number of cases
A1	4 (11.11%)
A2	31 (86.12%)
B1	1 (2.77%)
B2	0
C	0

Source: Hospital medical files. Anteversion of the second measurement.

The preoperative averages were elevation of 88° (from 20° to 150°), lateral rotation of 16° (from -30° to 60°) and medial rotation of L4 level (from T9 to the gluteal region) (Table 4). The mean duration of postoperative physiotherapy was 8.38 months (from two to 36 months).

The associated procedures during the transoperative period are shown in Table 5.

To evaluate the results, we used the UCLA method (University of California at Los Angeles),[18] with statistical comparisons of the following variables: age, gender, etiology, side operated, dominance, bilaterality, length of time with symptoms and ranges of elevation, lateral rotation and medial rotation (before and after the operation). The partial UCLA variables relating to pain, function, active anterior flexion, active anterior flexion strength and satisfaction were also gathered, along with the preoperative and postoperative UCLA scores (Table 4).

With regard to radiographs, it was ascertained whether the arthrosis was concentric or eccentric. The state of the rotator cuff was evaluated, along with whether the individual had undergone osteotomy of the lesser tubercle, stretching of the subscapularis and cementation of the prosthesis. It was also noted whether the individual had undergone procedures of tenotomy of the tendon of the long head of the biceps (all the individuals who underwent tenotomy also underwent tenodesis), repair of the rotator cuff or interposition of the glenoid cavity.

Following this, a descriptive analysis was conducted on the abovementioned variables, and we verified the hypotheses relating to whether the differences in mean ranges of motion and UCLA scores improved after the surgery or not. Each of the variables was divided into two groups in order to facilitate the analysis, because of the small sample size. These groups were then analyzed using the Mann-Whitney test.

The UCLA variable was divided into two categories: unsatisfactory (from 0 to 27) and satisfactory (from 28 to 35): the range of elevation was divided into unsatisfactory (less than 90°) and satisfactory (at least 90°); and the range of lateral rotation was divided into unsatisfactory (less than 20°) and satisfactory (greater than or equal to 20°).

To construct the confidence intervals and to perform Student's t test, respectively, a confidence interval of 95% and a significance level of 5% were used. The data analysis was done using the Minitab® software, version 16.

Results

We found that 21 shoulders (58.3%) had a satisfactory final result and 15 shoulders (41.7%) had an unsatisfactory result.

Regarding the ranges of elevation, lateral rotation and medial rotation and the UCLA score, all of these increased after the surgery (mean differences of 35°, 27°, 4° and 17 points, respectively). At the significance level of 5%, it was observed that there were gains in all these variables (Table 4).

According to the Mann-Whitney test for the variables of gender, age group, side operated, duration of postoperative physiotherapy, length of follow-up, dominance and bilaterality, there were no differences in the means for the differences in range of elevation, lateral rotation or medial rotation. There were also no differences in UCLA and postoperative UCLA ($p < 0.05$).

In relation to the duration of symptoms, there was no difference in the means for the ranges of elevation and medial

Table 4 - Mobility evaluation and UCLA score.

N	Range of motion in degrees before operation			UCLA before operation	Range of motion in degrees			UCLA after operation
	ELV	LR	MR (level)		ELV	LR	MR	
1	90	0	Gluteus	15	120	45	L2	25
2	120	-30	L3	13	145	35	T10	29
3	80	0	Gluteus	11	130	40	L5	31
4	80	10	Gluteus	9	135	40	T9	33
5	90	-45	Gluteus	6	120	0	Sacrum	27
6	30	30	Gluteus	8	130	80	Gluteus	34
7	130	60	T9	11	115	40	T9	22
8	130	45	L1	12	150	60	T12	27
9	70	60	T12	6	160	45	T12	31
10	20	45	L5	8	130	45	L1	17
11	30	0	Gluteus	11	150	20	L4	32
12	150	45	L2	15	130	45	L3	31
13	110	0	S1	13	130	45	L3	29
14	130	40	L5	13	150	45	T8	34
15	140	45	L3	13	150	45	T7	32
16	100	45	L3	14	130	60	L1	29
17	100	45	L5	13	150	60	T12	30
18	90	10	Greater trochanter	10	150	70	T8	30
19	90	30	L5	11	140	60	T12	31
20	30	-10	L3	6	150	60	T8	35
21	90	10	L5	10	130	20	T12	27
22	100	10	L5	19	130	30	L1	27
23	90	-15	L2	9	90	40	T12	24
24	90	-15	L4	9	100	45	T12	24
25	100	20	L2	13	160	70	T11	33
26	50	0	Gluteus	9	30	0	Gluteus	4
27	100	20	Gluteus	10	80	35	L4	14
28	80	10	L5	13	140	60	L1	31
29	100	10	S1	11	140	60	T7	15
30	110	-10	L5	16	150	45	T12	35
31	105	10	T9	17	80	20	L2	10
32	80	0	L5	9	110	25	L2	32
33	80	10	L5	11	80	15	L5	17
34	20	30	L3	3	130	45	T7	29
35	100	20	L5	12	110	55	Sacrum	30
36	70	20	Sacrum	11	70	30	Gluteus	24

Source: Hospital medical files; ELV: elevation; L: lumbar vertebra followed by its number; LR: lateral rotation; MR: medial rotation; N: number; T: thoracic vertebra followed by its number.

Table 5 - Associated procedures.

Walch classification	Number of cases
Associated procedures	4 (11.11%)
Stretching of the subscapularis	31 (86.12%)
Tenotomy of the long head of the biceps	1 (2.77%)
Repair of the rotator cuff	0
Osteotomy of the lesser tubercle	0
Glenoid interposition	

Source: Hospital medical files.

rotation, or for the postoperative UCLA score. In relation to the range of lateral rotation, the difference was greater when the duration of symptoms was up to three years. The mean for the difference in lateral rotation in patients with symptoms of duration up to three years was 35° and with duration greater than three years, 20°.

We also tested whether there was any difference in relation to the range of postoperative lateral rotation in groups that had and had not undergone stretching of the subscapularis, but the difference between the means was not significant.

We also took into consideration the possible complications of infection, loosening, fractures and nerve lesions, but none of these occurred in any of our patients.

At the significance level of 5% ($p < 0.05$), no relationship was found between the UCLA score and the following variables: gender ($p = 1.000$), side operated ($p = 0.864$), dominance ($p = 1.000$), bilaterality ($p = 0.309$), concentric arthrosis ($p = 0.417$), eccentric arthrosis ($p = 0.417$), state of the rotator cuff ($p = 1.000$), presence of osteotomy of the lesser tubercle ($p = 0.705$), presence of cementation ($p = 0.630$), presence of repairs to the rotator cuff ($p = 1.000$), presence of interposition ($p = 1.000$), symptom duration of up to three years ($p = 0.155$), physiotherapy duration of up to six months ($p = 1.000$), length of follow-up of up to two years ($p = 0.364$), lateral rotation of at least 20° ($p = 0.064$), elevation of at least 90° ($p = 0.063$) and having undergone stretching of the subscapularis ($p = 0.082$).

For the same significance level of 5% ($p < 0.05$), relationships were found between satisfactory UCLA score and two variables: patients with maximum age of 60 years at the time of the surgery ($p = 0.016$); and patients who underwent tenotomy of the long head of the biceps ($p = 0.046$).

Discussion

In the literature, arthroplasty for treating shoulder osteoarthrosis has presented excellent results in most patients, regardless of whether this is partial or total arthroplasty. Nevertheless, controversy still continues in relation to coverage of the glenoid cavity or not.[19]

Neer[2] first described partial shoulder arthroplasty for treating shoulder arthrosis in 1974. In his series of 46 patients, 20 had excellent results, 20 had satisfactory results and six had unsatisfactory results. The results were encouraging, but many patients reported that their strength was slow to return and that they had difficulty in doing activities above head height. With the aim of improving these patients' function, total shoulder arthroplasty was developed, in which the glenoid component was cemented, and the results were considered to be favorable.[1] High incidence of radiolucent lines was observed on the cement-bone interface,[3-5,7,20-23] and this reached 100% in patients with rheumatoid arthritis.[24] Even though several subsequent studies have demonstrated that the great majority of these lines do not progress to symptomatic loosening,[3-5,20,22,24,25] many authors have recommended partial shoulder arthroplasty for treating shoulder osteoarthrosis, in order to minimize the chance of needing glenoid component revision because of its loosening,[26-28] which is the main complication of this type of prosthesis.

Many studies[6,19,29-31] comparing the results from total and partial shoulder arthroplasty for treating shoulder osteoarthrosis have shown slightly better results from using total shoulder arthroplasty, in relation to long-term pain relief. However, in terms of patients' strength, function, range of motion and general satisfaction, the results remain unclear.[19] Among our results, we observed that there was a notable improvement in UCLA score through using partial shoulder arthroplasty for treating shoulder osteoarthrosis.

In 2002, a study by Godenèche et al.[32] demonstrated good and excellent results in 77% of the individuals who underwent shoulder arthroplasty to treat shoulder osteoarthrosis, without any statistically significant difference in the results between total and partial prostheses, but with greater pain relief among individuals who underwent tenotomy of the tendon of the long head of the biceps, which is compatible with our study. Levine et al.[1] demonstrated in 1997 that partial shoulder arthroplasty may be an effective treatment for shoulder osteoarthrosis, albeit in selected cases in which the result was dependent on the preoperative state of the glenoid cavity. In our study, we were unable to find any relationship between the preoperative state of the glenoid and the final result. On the other hand, we did not indicate partial shoulder arthroplasty for glenoid cases classified by Walch et al.[16] as B2 or C.

With regard to correlating the surgical results with the individuals' ages, the study by Saltzman et al.[10] demonstrated that partial shoulder arthroplasty in patients with glenohumeral arthrosis who were under 55 years of age led to improvements in pain and shoulder function. Likewise, the study by Bartelt et al.[29] demonstrated improvement of range of motion in patients under the age of 55 years with shoulder osteoarthrosis who underwent partial shoulder arthroplasty. In our study, we had a result similar to these, in which we observed better results in the patients operated at ages of less than 60 years (Fig. 3 A-D).

We can also cite the study by Burkhead and Hutton (1995),[33] who described the technique of glenoid interposition of the fascia lata or the anterior joint capsule combined with arthroplastic replacement of the humeral head, with good results. We applied this technique in five cases, but we were unable to demonstrate any relationship between this and the UCLA score.

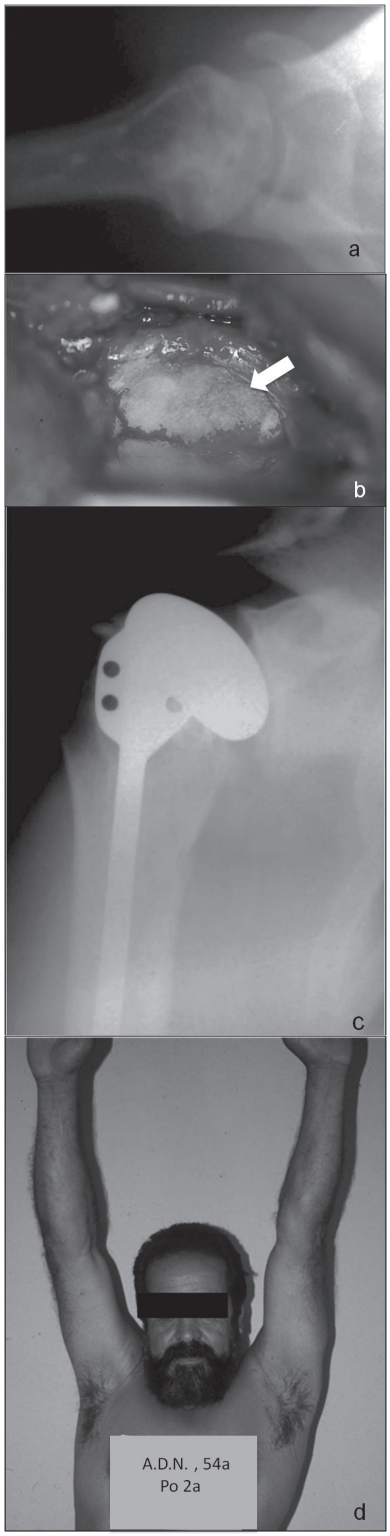

Fig. 3 - Case 25: Patient with osteoarthrosis of the right shoulder secondary to primary avascular necrosis, who underwent partial arthroplasty at the age of 51 years. (a) axillary lateral radiograph showing signs of osteoarthrosis; (b) transoperative image showing appearance of the glenoid cavity (arrow); and two years after the operation, (c) frontal-view radiograph; (d) clinical image of the patient performing elevation.

Given the known possible complications from revision of total shoulder arthroplasty and the possible difficulties in implanting the glenoid component (Fig. 1), we demonstrated in our study that partial shoulder arthroplasty is a viable option for treating shoulder osteoarthrosis in cases in which there is a contraindication against implantation of a glenoid component. The results were shown to be better in patients under the age of 60 years who underwent surgery, and also in those who underwent tenotomy of the tendon of the long head of the biceps.

Conclusion

We found that the patients with shoulder osteoarthrosis who underwent partial shoulder arthroplasty achieved better results if they underwent the operation under the age of 60 years and if tenotomy with tenodesis of the long head of the biceps was performed as an associated procedure, independent of age.

Conflicts of interest

The authors declare that there was no conflict of interests in conducting this study.

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