RESULTS OF SURGICAL TREATMENT OF DENERATIVE ARTHROPATHY OF THE ROTATOR CUFF USING HEMIARTHROPLASTY- CTA®

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ABSTRACT

Objective: To assess results of CTA® partial shoulder arthroplasty for treatment of degenerative arthropathy of the rotator cuff. Methods: Between December 2006 and June 2009, 23 shoulders of 23 patients were submitted to CTA® type partial shoulder arthroplasty for treatment of arthropathy secondary to rotator cuff injury. Post-operative follow up time ranged from 6 to 35 months. Mean age was 74.1 years. Patients were predominantly female, representing 78.3% of cases. The right limb was affected in 18 patients. All patients had undergone at least 6 months of physiotherapy without improvement of the algetic picture, and being submitted to surgery by the same surgical team. None of the patients had history of surgery on the affected shoulder. The method elected for assessing patients during post-operative follow up was based on UCLA scoring criteria. Results: Improvement in pain was observed in all patients after arthroplasty. Mean UCLA pain score was 9.22 (ranging from 10 to 8). Mean function was 6 (10 to 2). Active frontal flexion was 2.39 (highest score 4 and lowest 0). Mean frontal flexion force was 4.09, maximum was 5 and minimum 3. Mean score on the UCLA was 26.52. 95% were satisfied with the surgery. Conclusion: CTA® type partial shoulder arthroplasty produced satisfactory results in the treatment of degenerative arthropathy of the rotator cuff and had a low rate of complications.

Keywords – Arthroplasty; Replacement; Joint Diseases; Rotator Cuff

INTRODUCTION

Degenerative arthropathy of the rotator cuff consists of collapse of the glenohumeral joint secondary to massive chronic rotator cuff injury. It causes elevation of the humeral head, joint destruction, synovial fluid changes, subchondral cysts, flattening of the greater tubercle, osteophytes, acetabularization of the coracoacromial arch and osteopenia[1-3] (Figure 1). It occurs more frequently among female patients after the age of 60 years, and it manifests with pain, crepitation and diminution of the range of motion[4].

Several hypotheses for explaining the development of arthropathy due to rotator cuff lesions have been put forward. In the rheumatological literature, the term Milwaukee shoulder was introduced to describe a condition presented by four elderly women who had massive rotator cuff injuries, destructive glenohumeral arthritis and recurrent effusion in the shoulder (Geyser sign)[5]. The most accepted hypotheses suggest that accumulation of hydroxyapatite crystals inside the capsule, synovium and joint cartilage would allow these crystals to be released into the synovial fluid. The crystals would be phagocytized by synovial cells and would thus accumulate inside them and stimulate the release of proteolytic enzymes, including collagenase and protease. These enzymes would lead to joint, capsule and cuff destruction[5-7].

Neer et al[3] described a hypothesis for how mechanical and nutritional changes would occur in these

patients. Loss of the dynamic stabilizers of the gleno-humeral joint would lead to repeated trauma on the joint surface, thus causing cartilage loss. Furthermore, loss of closed joint space would lead to poor nutrient diffusion to the joint cartilage. Secondarily to shoulder disuse, the subchondral bone would then become more osteoporotic, thus resulting in erosion of the humeral head and completing the development of arthropathy.

The arthropathy classification most used is the system described by Seebauer[8] (Box 1). It assesses the integrity of the anterior shoulder stabilizers and co-racoacromial arch, the presence of dynamic stability and the upwards migration of the humeral head. In stage IA, the head is centered on the glenoid; in IB, the head migrates medially in relation to the glenoid; in IIA, the humeral head migrates upwards, but is stabilized by the coracoacromial arch; and in IIB, the humeral head migrates forwards and upwards.

Conservative treatment is initially administered to all patients, using physiotherapy and analgesics. When there is no improvement of the pain and/or range of motion, surgical procedures are chosen[9,10].

Arthroscopic debridement is an alternative when the patient's main complaint is pain, and consists of joint and bursa cleaning, tuberculoplasty and tenotomy of the biceps. The result may be a transitory improvement of pain, without interfering with the range of motion, but with frequent recurrences over the first two years[10,11].

Figure 1 – Anteroposterior radiograph on a shoulder with arthropathy due to a rotator cuff injury.

The options for replacement arthroplasty are CTA® (cuff tear arthroplasty) and a reverse prosthesis. CTA® prostheses (Figure 2) are used when the arthropathy has not compromised the stability of the glenohumeral joint, the glenoid erosion is only partial and the coracoacromial arch is complete. These are partial prostheses, with a larger humeral head so that there is greater contact with the coracoacromial arch, thus enabling better lever-arm action by the deltoid muscle on arm elevation movements. A reverse prosthesis is used when there is no stability in the glenohumeral joint and the glenoid anatomy is compromised. It is characterized by modification of the center of glenohumeral rotation medially and distally, through positioning the glenoid component (glenosphere) with the aim of boosting the acting of the deltoid muscle[9].

The aim of the present study was to assess the results obtained from CTA® partial shoulder arthroplasty to treat degenerative arthroplasty of the rotator cuff.

Figure 2 – Postoperative radiography on a shoulder, showing CTA® hemiarthroplasty.

METHODS

Between December 2006 and June 2009, 23 shoulders of 23 patients underwent CTA® partial shoulder arthroplasty to treat degenerative arthroplasty of the rotator cuff. All the patients were operated by the same surgical team from the Shoulder and Elbow Group of the Orthopedics and Traumatology Service at the Public Servants' Hospital of the State of São Paulo, and the access route used was deltopectoral. The length of the postoperative follow-up ranged from 6 to 35 months, with a mean of 20 months. The

Box 1 - Seebauer[8] classification.
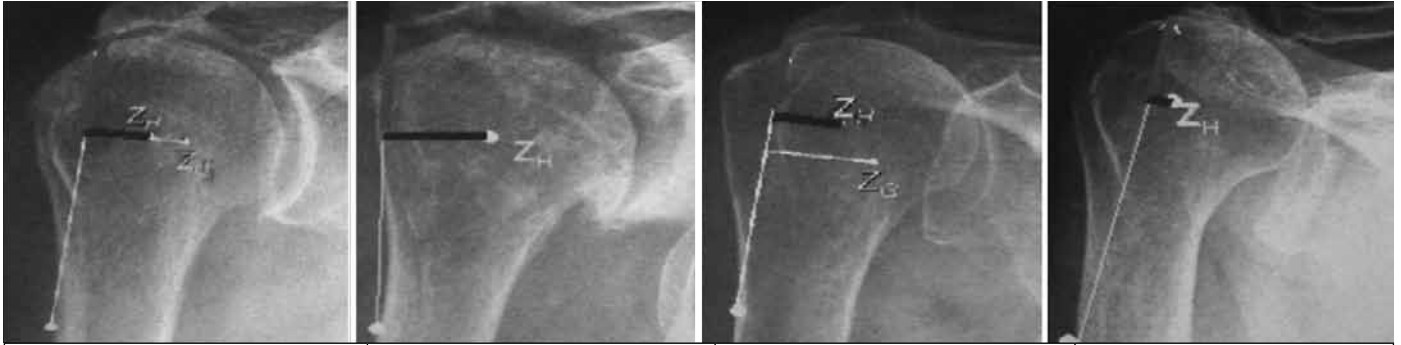
Type 1a	Type 1b	Type 2a	Type 2b
Anterior structure intact	Anterior structure intact	Compromised	Incompetent
Minimal upwards migration	Minimal upwards migration	Upwards	Forwards and upwards
Femoralization	Femoralization	Minimal	None
Mechanical stabilization	Abnormal	Insufficient	None
Acetabularization	Glenoid erosion	Glenoid and humeral erosion	None

patients' mean age was 74.1 years, ranging from 62 to 84 years. Females predominated, accounting for 78.3% of the cases (18 patients). The dominant limb was affected in 18 patients and the non-dominant limb in five patients (Table 1).

Out of the 23 patients evaluated before the operation, five were classified as type IA, nine as type IB and the remaining nine as type IIA. There were no cases of type IIB (Figure 3).

All the patients had previously undergone physiotherapy for at least six months, without improvement of their painful condition, and they all had a clinical and imaging diagnosis (radiographs and nuclear magnetic resonance) of degenerative arthropathy of the rotator cuff.

The inclusion criterion was that the patients should be symptomatic, with a Seebauer classification of IA, IB or IIA, who had not improved with rehabilitation treatment administered for a minimum of six months. The following were taken to be exclusion criteria: degenerative arthropathy of the rotator cuff that improved with clinical treatment; previous surgery or neurological lesions in the affected limb; arthropathy classified as Seebauer IIB; and insufficiency of the deltoid muscle.

The clinical assessment on the results was done using the scoring defined by the University of California at Los Angeles (UCLA), as modified by Ellman and Kay[12], which uses objective and subjective criteria,

attributing points according to the pain, degree of mobility, shoulder function, strength and patient satisfaction. The maximum score is 35 points. To measure the degree of joint range of motion, the method described by the American Academy of Orthopedic Surgeons was used[13]. To compare the pre and postoperative results regarding UCLA and the orthopedic physical examination with range of motion (OPE), the nonparametric Wilcoxon test was used[14]. The rejection level for the nullity hypothesis was 0.05 (significance level of 95%).
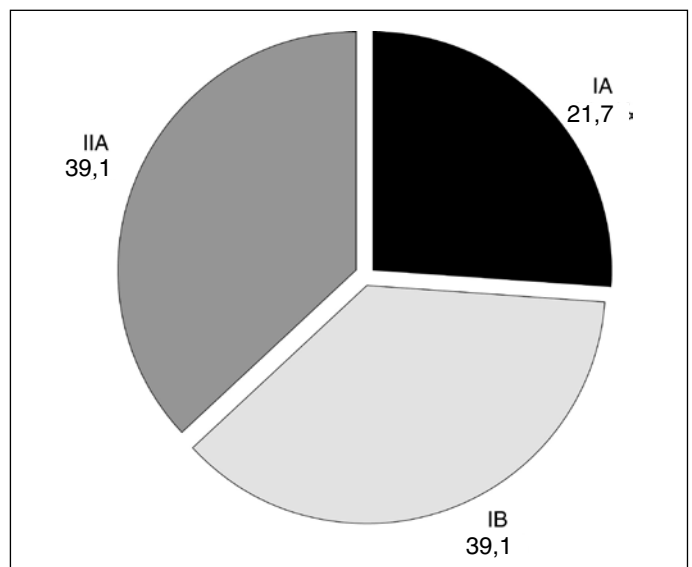
Figure 3 – Distribution of the 23 patients according to the Seebauer classification.

RESULTS

It was observed that there was a significant increase in the mean UCLA score, from 10.39 points before the operation to 26.52 points after the operation (Figure 4). The result was considered to be good in the cases of nine patients (39.1%), fair in thirteen (56.6%) and poor in one (4.3%).

With regard to joint range of motion measurements, there was an increase in mean active elevation, from 57.61º before the operation to 77.83º after the operation (Figure 5 and Table 2).

The lateral rotation increased from 19.78º before the operation to 26.09º after the operation (Figure 6 and Table 2).

The mean medial rotation did not present any change and remained at the level of the third lumbar vertebra (L3) from before to after the operation (Table 1).

It was observed that all the patients' pain improved after arthroplasty, in relation to their preoperative pain. The mean score on the UCLA table relating to pain was 9.22, with maximum of 10 and minimum of 8. Regarding function, the mean was 6, the maximum was 10 and the minimum was 2. For active frontal flexion among these patients, the mean was 2.39, the maximum was 4 and the minimum was 0. Regarding the strength of frontal flexion, the mean was 4.09, the maximum was 5 and the minimum was 3 (Figure 7 and Table 3).

Twenty-two of the 23 patients (95%) were satisfied with the surgery. The patient who presented the lowest score on the UCLA scale (15 points) and was not satisfied with the surgery presented atrophy of

Table 1. Data on patients.

Patient No.	Sex	Age	Side	Length of time with disease (years)	UCLA before operation	Final UCLA	Seebauer classification	Pre-op OPE (Elev, Rext. Rint)	Post-op OPE (Elev, Rext. Rint)
1	F	80	D	4	(2+4+3+4+0) 13	(10+8+4+4+5) 31	IB	90;30;L1	120;40;S1
2	F	76	D	5	(2+2+1+4+0) 9	(8+6+2+5+5) 26	IB	40;20;L5	70;25;L2
3	M	82	D	6	(1+2+1+3+0) 7	(10+2+0+3+0) 15	IIA	30;10;S1	15;10;S1
4	F	75	D	3	(2+4+3+3+0) 12	(10+10+4+4+5) 33	IA	90;20;T12	130;30;T10
5	F	80	D	5	(2+2+1+3+0) 8	(10+6+2+4+5) 27	IB	35;15;L5	60;20;L1
6	F	62	ND	6	(2+4+3+4+0) 13	(10+8+4+4+5) 31	IA	100;30;L1	120;40;L3
7	M	72	D	8	(2+2+2+3+0) 9	(8+6+3+3+5) 25	IIA	60;25;L5	90;30;L5
8	M	74	ND	4	(2+4+3+3+0) 12	(10+6+3+4+5) 28	IA	100;30;L1	90;40;L3
9	F	80	D	7	(2+2+2+4+0) 10	(10+6+2+4+5) 27	IIA	50;20;L3	60;20;L3
10	F	73	D	6	(2+4+3+4+0) 13	(10+6+3+4+5) 28	IB	90;20;T7	100;25;T12
11	F	70	D	4	(2+2+1+3+0) 8	(10+4+2+3+5) 24	IIA	30;10;S1	45;20;L5
12	F	84	D	7	(2+2+0+3+0) 7	(8+6+1+4+5) 24	IIA	20;10;TROC	30;10;TROC
13	F	67	D	6	(2+2+2+4+0) 10	(8+6+3+5+5) 27	IB	70;30;L1	100;30;T12
14	F	73	ND	9	(2+4+1+4+0) 11	(8+6+1+5+5) 25	IIA	40;05;L5	30;10;S1
15	M	75	D	3	(2+4+3+4+0) 13	(10+6+3+4+5) 28	IB	100;30;L1	120;35;L1
16	F	73	ND	6	(2+4+2+3+0) 11	(8+8+3+4+5) 28	IIA	60;20;S1	100;40;L4
17	M	78	D	3	(2+2+1+4+0) 9	(8+6+1+5+5) 25	IB	30;10;S1	40;15;S1
18	F	80	D	8	(2+2+2+4+0) 10	(10+6+2+4+5) 27	IA	50;20;T10	70;35;L1
19	F	70	D	4	(2+4+3+4+0) 13	(10+6+3+4+5) 28	IA	120;30;L1	100;30;T12
20	F	67	ND	3	(2+2+0+4+0) 8	(8+6+1+5+5) 25	IIA	20;0;TROC	40;10;S1
21	F	65	D	4	(2+4+3+4+0) 13	(10+6+3+4+5) 28	IB	90;40;T10	100;45;L1
22	F	71	D	6	(2+2+2+5+0) 11	(8+4+3+5+5) 25	IB	60;20;L5	100;30;L2
23	F	79	D	8	(2+2+1+4+0) 9	(10+4+2+4+5) 25	IIA	40;10;L5	60;10;S1

Source: SAME IAMSPE / medical files
M = Male; F = Female; D = dominant limb; ND = non-dominant limb; EFO = orthopedic physical examination with range of motion; UCLA = University of California at Los Angeles – method for assessing postoperative results
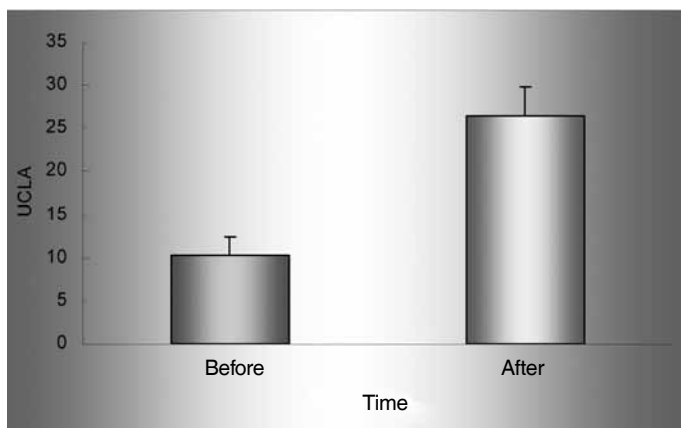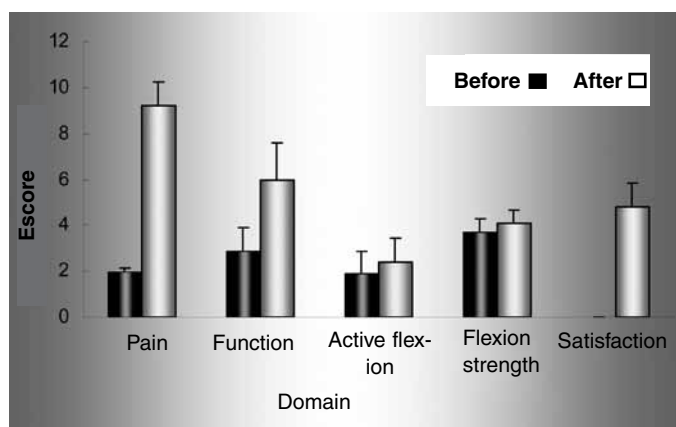
Figure 4 – Mean and standard deviation of the UCLA scores before and after the operation.
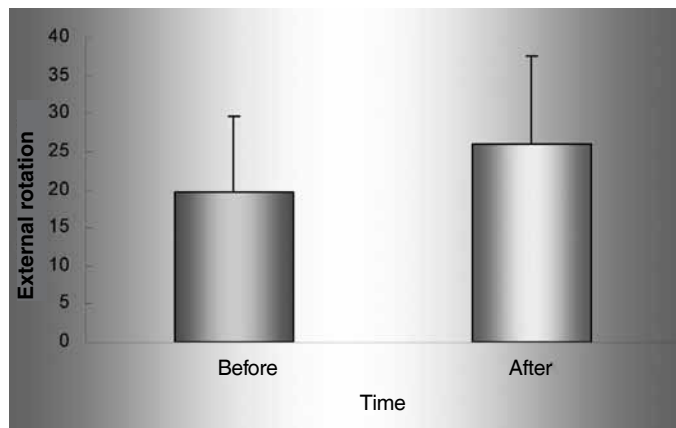
Figure 6 - Mean and standard deviation of the lateral rotation before and after the operation.
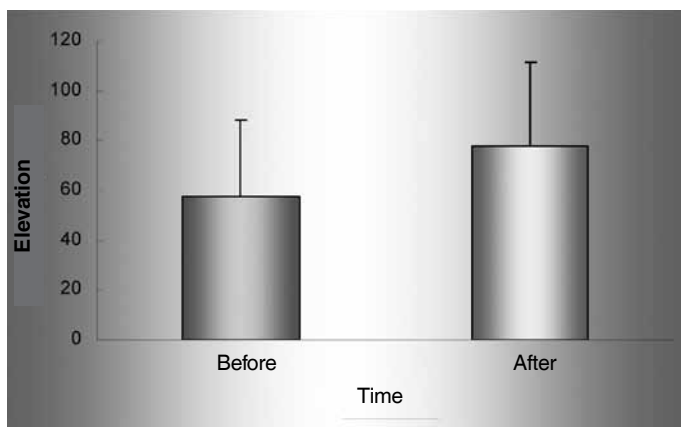
Figure 5 – Mean and standard deviation of the elevation before and after the operation.

Figure 7. Mean and standard deviation of the UCLA scores before and after the operation.

Table 2 – Elevation and external rotation values at the times evaluated.

Variable	Time	n	Mean	SD	Median	Minimum	Maximum	p*
Elevation	Before	23	57.61	30.74	50	10	120	< 0.001
	After	23	77.83	33.60	90	15	130	
External	Before	23	19.78	9.94	20	0	40	< 0.001
rotation	After	23	26.09	11.48	30	10	45	

(*) descriptive probability level from the nonparametric Wilcoxon test

the deltoid muscle, although his electroneuromyography result was normal. There was no case of prosthesis dislocation, infection or neurovascular deficit in the operated limb.

DISCUSSION

CTA® arthroplasty is used when the arthropathy has not compromised the anterosuperior stability of the glenohumeral joint, with partial erosion of the glenoid and a complete coracoacromial arch. This is a partial prosthesis with a humeral head that extends as far as the greater tuberosity, in order to provide contact with the coracoacromial arch, thereby enabling lever-arm improvement of the deltoid muscle in arm elevation movements.

Visotsky et al[2] found that 89% of their results were satisfactory, through using conventional partial arthroplasty for treating patients classified as Seebauer IA,

Table 3. Domain values for UCLA scores at the times evaluated.

Domain		Time	N	Mean	SD	Median	Minimum	Maximum	p*
Pain		Before	23	1.96	0.21	2	1	2	< 0.001
		After	23	9.22	1.00	10	8	10	
Function		Before	23	2.87	1.01	2	2	4	< 0.001
		After	23	6.00	1.60	6	2	10	
Active		Before	23	1.87	1.01	2	0	3	0.001
flexion	After	23	2.39	1.08	3	0	4	
Flexion	Before	23	3.70	0.56	4	3	5	0.003
strength	After	23	4.09	0.60	4	3	5	
Satisfaction	Before	23	0.00	0.00	0	0	0	< 0.001
	After	23	4.78	1.04	5	0	5	

(*) descriptive probability level from the nonparametric Wilcoxon test

IB and IIA. They achieved improvements in pain, elevation and lateral rotation of the shoulder. Like in our study, they did not include patients classified as Seebauer IIB. In our sample, we observed that only one case (patient no. 3; classified as type IIA) presented an unsatisfactory result. This patient achieved an improvement in pain, but with worsening of elevation movement, and was dissatisfied with the limitation on joint range of motion that was obtained. This patient also presented atrophy of the deltoid muscle, although the electroneuromyography result was normal.

Zuckerman et al[15] used the postoperative evaluation method based on the UCLA criteria to evaluate conventional partial arthroplasty, and obtained a mean of 22 points, with a mean range of motion of 86º of active elevation and 29º of active lateral rotation. They reported that 87% of the patients were satisfied in relation to improvement of pain. In our sample, the results obtained from CTA® partial shoulder arthroplasty presented a mean of 26.52 points and a satisfaction rate of 92.2% in relation to pain improvement (Table 1).

In our study, we used rigid exclusion criteria, which we believe to be very important for favorable results from CTA® arthroplasty. CTA® hemiarthroplasty requires anterior stabilizers to impede anterior subluxation of the prosthesis: this role is played by the coracoacromial arch and the subscapular muscle.

In addition, a functioning motor is required, such as the deltoid muscle, along with a complete axillary nerve. Field et al[16] evaluated 16 patients who underwent hemiarthroplasty to treat arthropathy due to rotator cuff injury, and found that four of the six patients with unsatisfactory results had undergone previous acromioplasty, with release of the coracoacromial ligament. They concluded that coracoacromial arch competence and deltoid muscle function are important components for the stability of hemiarthroplasty, when performed to treat arthropathy due to cuff injuries.

The studies by Zuckerman et al[15] and Sanchez-Sotelo et al[17] showed that hemiarthroplasty provides adequate pain improvements but only moderate gains in functional range of motion, in patients with arthropathy due to cuff injuries. On the other hand, in relation to the Delta® reverse prosthesis, studies[18-21] have shown better gains in active range of movement, which leads to functional improvement in these patients. However, the complication rates remain relatively high (> 17%), and studies with longer follow-up and greater experience with these implants are still necessary.

CONCLUSION

CTA® partial shoulder arthroplasty has satisfactory results when used to treat degenerative rotator cuff arthropathy, with a low complication rate.

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