

# HEMIARTHROPLASTY OF THE HUMERAL PROXIMAL END FOR TREATING FOUR-PART FRACTURE-DISLOCATIONS: AGE-RELATED DEGREE OF MOBILITY

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## SUMMARY

The most serious fracture of the proximal portion of the humerus is the four-part fracture-dislocation. The traditional approach is the arthroplasty of the proximal humerus. We describe a retrospective study of 20 patients submitted to partial arthroplasty of the shoulder for treating four-part fracture-dislocations of the proximal humerus. The mean postoperative follow-up time was 14 months. Patients were assessed for elevation, lateral and medial rotation. We divided the subjects into two groups: patients with higher elevation than the average (group 1) and with lower elevation than the average (group 2). The elevation average

obtained for all patients was 107.5°. The mean age of Group 1 patients was 48.5 years. The mean age of Group 2 patients was 66.3 years ( $p=0.004$ ). More favorable results were achieved for mobility in individuals in the age group of 50 years old. The mean elevation in group 1 subjects was 154.38° while, in group 2, it was 76.25° ( $p=0.0002$ ). Mean lateral rotation on group 1 patients was 31° and, on group 2 patients, 9.6° ( $p=0.002$ ). Mean medial rotation was at T10 level for group 1 patients, while this was at L4 level for group 2 subjects ( $p=0.003$ ).

**Keywords:** *Shoulder joint; Arthroplasty; Fracture fixation, internal; Shoulder fractures.*

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## INTRODUCTION

Fractures of the humeral proximal end often affect aged people<sup>(1)</sup>. The great majority does not present deviations, and 80% of the cases are conservatively treated<sup>(2,3)</sup>. Patent osteoporosis in these patients, accountable for bone weakness, even in lower intensity trauma situations, may lead to multiple-segmented fractures<sup>(1)</sup>. Neer<sup>(4,5)</sup> proposed a classification system that ultimately became the most frequently used one in cases of humeral proximal end fractures. The most severe forms are fractures and four-part fractures-dislocations<sup>(4)</sup>. The high risk of humeral head necrosis and the important tubercle shift are the factors accountable for the seriousness of these cases<sup>(4)</sup>.

The traditional treatment for the four-part fracture-dislocation is the humeral proximal arthroplasty<sup>(5,6)</sup>. At risk of head necrosis, the replacement by a metal component has been used since the early 1970's<sup>(4)</sup>. Most of the series described in literature conclude that lifting close to 100 degrees could be regarded as a good arthroplasty outcome<sup>(6-8)</sup>. As a result, even with the risk of head necrosis, many authors have published the treatment method with osteosynthesis<sup>(9-11)</sup>.

Although in a smaller number, young and mid-age adults, high-energy trauma victims, may also present with four-part fracture-dislocation<sup>(11)</sup>. This situation can be further worse, because the desired outcome in this age group is higher than among the

elderly population<sup>(11)</sup>. Here we present the results concerning the achieved mobility degree by treating four-part fractures-dislocations of the humeral proximal end with arthroplasty in patients belonging to various age groups.

## MATERIAL AND METHODS

We conducted a retrospective study with 20 patients submitted to partial arthroplasty of the shoulder to treat four-part fractures-dislocations of the humeral proximal end. We included patients operated from March 1996 to November 2005. All surgeries were performed by the same surgeon. Of the 20 cases, 14 were females and 6 males. The dominant side was involved in 8 of the 20 studied cases. The mean age was 59.9 years (range: 34 - 87 years). The average follow-up time was 14 months (ranging from 8 to 32 months).

The prosthesis employed was the partial Neer with interchangeable heads. After general anesthesia, the patients were placed seated at a "beach chair" position. The deltoid-pectoralis access way was employed, allowing a broad access to the fracture. The humeral component was inserted with 30-degree retroversion. Tuberosities were sutured with six polyester 5 threads. Aspiration drain was used in all cases. Early passive mobilization was encouraged on the first postoperative week, followed by a rehabilitation program.

Study conducted at the Orthopaedics and Traumatology Service, Santa Casa de Misericórdia de Santos, SP, Brazil  
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The patients were evaluated regarding postoperative range of motion concerning lifting, external rotation and internal rotation. We calculated the average lifting achieved by all patients. Two groups were proposed: those showing lifting levels above the average (group 1) and those with lifting below the average (group 2). We calculated the mean age of the patients included in those groups. We also statistically compared the mean lifting, internal and external rotation of the groups constituted. The mean values were compared according to the Student's t-test or to the Mann-Whitney test.

## RESULTS

With a mean postoperative follow-up of 14 months (8-32), the mean degree of lifting achieved by the 20 patients was 107.5 +/- 43 degrees. Thus, two groups were built: group 1 with lifting values above the average, which, in this case, should be above 107 degrees, and; group 2, with lifting values below 107 degrees. Group 1 patients had a mean age of 48.5 years. Group 2 patients had a mean age of 66.3 years (Tables 1 and 2). The mean ages for both groups were compared by Student's t-test and the result was significant ( $p=0.004$ ) (Graph 1).

The active mobility of the groups was significantly different. The average lifting found on group 1 was 154.38° and, on group 2, 76.25° (Mann Whitney  $p=0.0002$ ). The external rotation of group 1 patients was 31° and on group 2, 9.6° (Student's t-test  $p=0.002$ ). The internal rotation of group 1 patients was found at the level of the tenth thoracic vertebra while on group 2 patients, this was at the level of the fourth lumbar vertebra (Student's t-test  $P=0.003$ ) (Graphs 2, 3 and 4).

>107° - Group 1		<107° - Group 2	
Lifting	Age (years)	Lifting	Age (years)
155	50	90	54
130	53	100	73
140	34	80	65
160	55	90	87
180	45	75	69
130	51	30	72
160	58	90	29
180	42	90	66
		100	70
		45	68
		45	74
		80	69

Table 2 – Distribution of groups 1 and 2 based on the mean lifting value

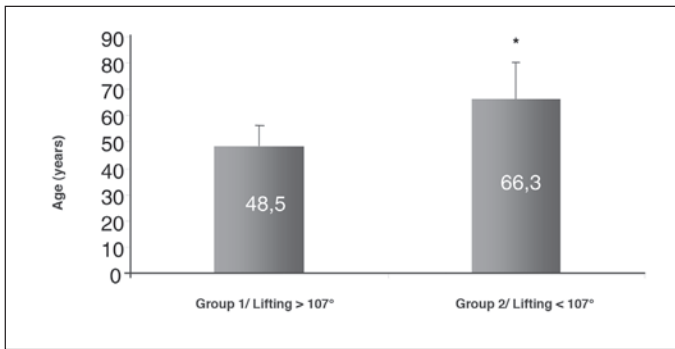
## DISCUSSION

In this retrospective study, we found that patients with four-part fractures-dislocations treated with partial shoulder prosthesis (hemiarthroplasty) can present excellent outcomes in terms of range of motion within a period of approximately one year, if they are about 50 year-old. For 10 years, we studied cases like those, in an average frequency of two four-part fractures-dislocations each year, demonstrating how uncommon these injuries are.

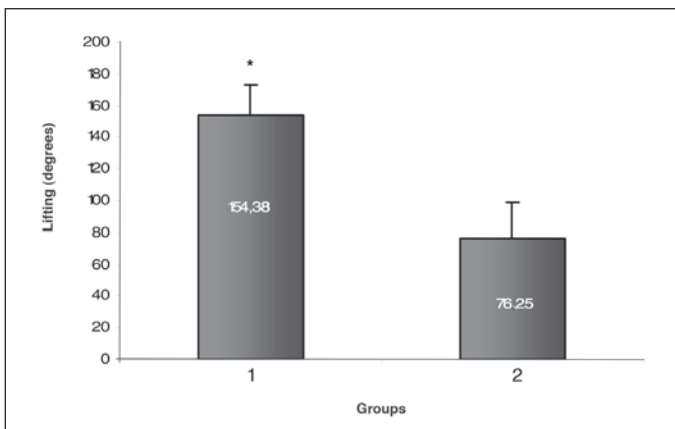
n°	Age	Involved Side	Dominant Side	Gender	Follow-up (1)	Lifting (2)	Ext. rotation (3)	Int. rotation (4)
1	45	R	R	M	8	180	45	NL
2	69	L	R	F	14	75	25	L5
3	70	R	R	F	12	100	20	T7
4	66	R	R	M	13	90	30	L3-4
5	29	L	R	M	6	90	0	L1-2
6	50	R	R	F	30	155	33	T7
7	72	L	R	F	9	30	10	L4
8	53	L	R	M	12	130	30	T4
9	58	L	L	F	12	160	30	L4
10	74	R	R	F	9	45	-10	L5
11	55	R	R	F	12	160	20	T8
12	54	L	R	F	12	90	-10	L4-5
13	65	L	L	F	32	80	10	L5
14	73	L	R	F	12	100	20	L4-5
15	87	L	R	F	26	90	5	SACRO
16	34	R	R	F	7	140	10	T12
17	51	L	R	M	11	130	35	L5
18	68	R	R	F	12	45	20	L4-5
19	42	R	L	M	24	180	45	T7
20	69	L	R	F	8	80	-5	L4

# = case number; (1) = Follow-up in months after surgery; (2) = Lifting in degrees; (3) = degrees of lateral rotation; (4) = Internal rotation measured by the vertebrae touched by the thumb

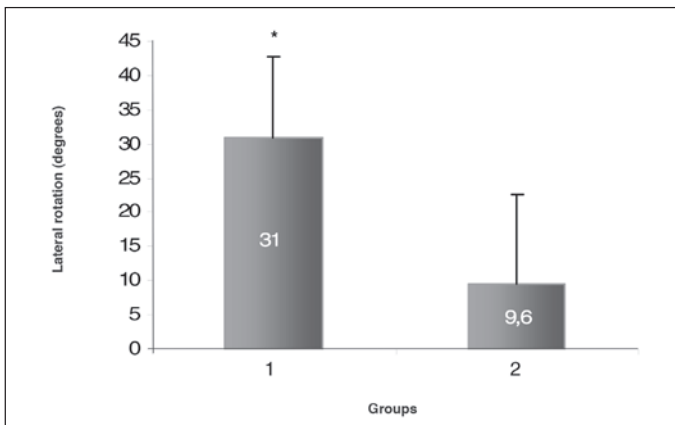
Table 1 – Characteristics and results of all patients with 4-part fractures-dislocations treated with arthroplasty



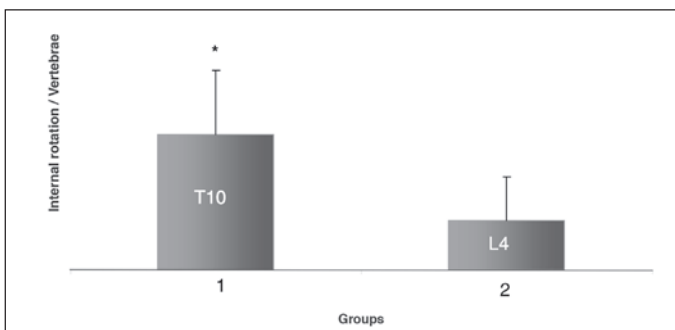
**Graph 1** – Group 1, with mean lifting value above 107°, was statistically composed by younger patients as compared to group 2, with mean lifting value below 107° (\* p=0.004).



**Graph 2** – Group 1 showed a higher lifting value when compared to group 2 (\* p=0.0002)



**Graph 3** – Group 1 showed higher mean external rotation values when compared to group 2 (\* p=0.002)



**Graph 4** – Group 1 showed higher mean external rotation values when compared to group 2 (\* p=0.003)

The treatment of four-part fracture-dislocation of the humeral proximal end evolved from humeral head resection arthroplasty, widespread by Lawrence Jones in the 1950's, followed by replacement arthroplasty with a Neer metal component in the 1970's to the current minimally invasive biological solutions with plates and metal wires<sup>(5,9,12-14)</sup>.

The basic principle of arthroplasty – both the resection and the replacement arthroplasty – is the safe reconstruction of the rotator cuff<sup>(15)</sup>. As proposed by Jones, the simple healing of cuff tendons at the proximal diaphysis may be followed by good functional outcomes even when the head and tubercles cannot be spared<sup>(12)</sup>. Similarly, with the hemiarthroplasty alternative, after the correct and precise prosthesis introduction, that is, maintaining the length of the proximal end and 30-degree retroversion, the tubercles must be rigorously sutured on the prosthesis and on the diaphysis<sup>(15)</sup>.

Despite of the excitement seen in the 1980's with Neer arthroplasty, current results described on literature regarding mobility are disappointing<sup>(6)</sup>. Four-part fractures that seemed to be solved with arthroplasty almost unanimously evolve with restricted range of motion. Published series describe mean lifting values close to 100 degrees in the best evolved cases<sup>(16)</sup>. The answer for the question about the reasons for the evolution with such important functional restraints following arthroplasty, even when using the right surgical technique and appropriate physical therapy, may lie on the characteristics of a patient presenting with a four-part fracture. In general, this is an aged patient, with osteoporosis, non-dominant side involved, caused by a fall occurred in his/ her own home<sup>(17)</sup>. In this age group, we can include as factors that supposedly negatively influence the result of the arthroplasty the low quality of the rotator cuff, particularly supra-spinal muscle and tendon<sup>(18)</sup>, the non-adhesion to the difficult and painful rehabilitation program and to the limited goals regarding the functional result to be achieved.

As a consequence of the unfavorable results with arthroplasties, the current trend is towards the use of internal fixation<sup>(11)</sup>, despite the fact that with this strategy the risk of humeral head necrosis should always be considered<sup>(19)</sup>. Some 4-part fractures are preferably operated using this technique, such as the impacted fracture in valgus described by Jakob et al.<sup>(20)</sup>. Minimally invasive techniques with indirect reduction and fixation with threaded wires, particularly with the use of fluoroscopy have been employed and introduced as an alternative with lower risk of head necrosis<sup>(3)</sup>. Authors advocating osteosynthesis say that even when evolving to necrosis, satisfactory results can be achieved<sup>(14)</sup>. Fixation with wires is not complication-free. Among these, we can mention the potential injury risks to the anterior branch of the axillary nerve, to the biceps head and tendon joint cartilage, as well as the potential head necrosis<sup>(21)</sup>. The use of a synthetic graft or iliac spongy cortex is highly valuable for filling a metaphyseal defect accompanying these fractures<sup>(22)</sup>.

The humeral proximal end fracture is characteristic of the elderly population. However, high-energy trauma – which has been increasingly frequent – accounts for important and serious fractures-dislocations in young and mid-age adults. These should be preferably treated with a biological method with osteosynthesis, sparing arthroplasty for eventual unsuccessful

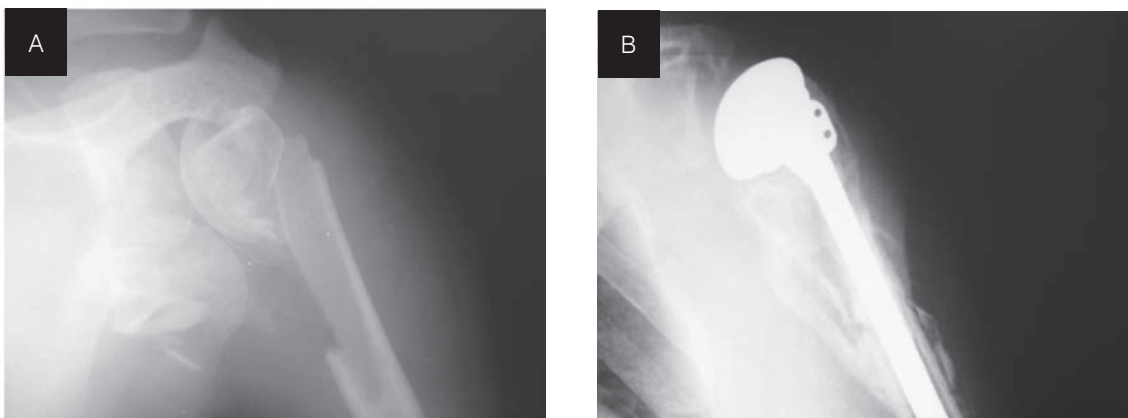
ful procedures. Today, there is a consensus towards making arthroplasty available at the moment of the surgical procedure with osteosynthesis should a failure occurs during the reconstruction of a 4-part fracture or a 4-part fracture-dislocation. In this series, osteosynthesis was initially planned to most of the cases, and the prosthesis was used when reconstruction was proven to be impossible to achieve.

In this study, we did not show simple cases of 4-part fractures, but cases with 4-part fractures-dislocations, all of these with important deviations between the dislocated head and the tubercles (Figure 1).

Arthroplasty was an alternative to the serious situations found: comminutive fracture-dislocation, head split fracture, bone loss and impossible osteosynthesis due to excessive osteoporosis on the head. The right retroversion, prosthesis height, and tubercles tie-up are factors that assured rehabilitation with passive movements as early as the first postoperative days. We found that on group 1 patients, the active lifting close to 100 degrees was possible on the third postoperative month, even in those patients who did not adequately adhere to the physical

therapy program. In contrast, among group 2 patients, even when achieving passive mobility above 130-150 degrees on the first postoperative weeks and with the proper follow-up on physical therapy, between the fourth and fifth months, the lifting value achieved was close to 60° - 90°. In our postoperative follow-up protocol on patients treated with shoulder arthroplasty, one-year follow-up was provided, resulting on the mean follow-up time reported herein, i.e., 14 months. We believe that on group-1 patients (with ages around 50 years), the characteristic factors of the elderly population mentioned above could not negatively influence the outcomes, resulting in the good range of motion found here.

As a conclusion, in the cases where we considered the use of a biological solution with osteosynthesis impossible upon a four-part fracture-dislocation of the humeral proximal end, we found good outcomes in terms of mobility of patients included in the age group of 50 years. The best the surgical technique could have been, for patients in the age group of 70 years, the outcome achieved for active motion was limited and inferior to the 50 year-old group.



**Figure 1** – Photographs of X-ray images of the shoulder of patient # 5 at anteroposterior plane. A= preoperatively, note the head split fracture, proximal metaphyseal comminution and head dislocation. B= 6 months postoperatively.

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