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Original article

Four-part fractures treated with a reversed total shoulder prosthesis: Prospective and retrospective multicenter study. Results and complications



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ABSTRACT

Introduction: The reversed shoulder prosthesis is becoming the gold standard for cases of complex fracture of the proximal humerus after 70 years of age.

Material and methods: The French Society of Orthopaedic and Traumatology Surgery (SOFCOT) conducted a prospective and retrospective multicenter study to evaluate the results of the reversed shoulder prosthesis implanted in patients with a four-part fracture in nine centers. In the retrospective study ($n=41$ patients, 78 years of age, 14% ASA grade 3, 21% associated fractures) and in the prospective study ($n=32$ patients, 79 years of age, 37% ASA grade 3, 21% associated fractures) evaluation by independent surgeons was conducted to measure the QuickDASH score, the Constant score, the SSV (subjective shoulder value), and complications to correlate these measurements with radiological results.

Results: In both studies, use of an autograft (75%) to perform an osteosuture of tuberosities (90%) and no postoperative immobilization (75%) were similar. In the retrospective study at 39 months (range: 24–62 months) of follow-up, the QuickDASH reached 28 (range: 0–59), the Constant scores (raw Constant = 57, weighted Constant = 83.4%), and SSV 75 (range: 35–100). Complications after the 1st month (7%) were nonunion or ossifications. In the prospective study at 11 months (range: 5–16.5 months) of follow-up, the QuickDASH reached 40 (range: 1–75), the Constant scores 50 (raw Constant) and 74.6% (weighted Constant), and SSV 69 (range: 10–100). Complications after the 1st month (21%) were stiffness and dislocation, with two patients who underwent revision surgery. In both studies, early complications reached 6% (palsy, dislocation).

Conclusion: This double (retrospective and prospective) study confirms the good results with a low level of complications of the reversed implant in cases of fracture but with osteosuture of tuberosities.

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1. Introduction

Management of four-part fractures in the elderly subject is a veritable therapeutic challenge. The incidence of these fractures is on the rise because of the aging of the population. The functional demand of these patients has also increased. After 70 years of age and in case of a displaced four-part fracture of the proximal

humerus, hemiarthroplasty is logically preferred to osteosynthesis, but the clinical results, related to anatomic union of the tuberosities, are difficult to predict [1,2]. In these situations, age greater than or equal to 75 years, female gender, and the presence of osteoporosis are predictive factors of poor functional results [3,4]. This is why for several years the reversed prosthesis, first developed by Grammont for irreparable rotator cuff rupture, has a place in the elderly subject who presents negative prognostic factors for hemiarthroplasty. The objective of this prospective and retrospective multicenter study was to report the short- and long-term functional results of reversed shoulder prostheses implanted in patients presenting a displaced four-part fracture of the proximal humerus.

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2. Material and methods

The clinical research protocol included a prospective study and a retrospective study with the same inclusion criteria. SOFCOT (the French Society of Orthopaedic and Traumatology Surgery) promoted the study in collaboration with the Lille Regional Hospital Biostatistics unit. This was a study protocol on routine care and underwent CPP (Comité de Protection des Personnes) review with approval by the CCTIRS (Consulting committee on data processing in healthcare research) and the CNIL (national personal data protection agency) (CNIL agreement: 26/06 no. 913192). All evaluations were accessible and completed on a secure site with access to the images (KLETEL). The inclusion criteria for the retrospective study were being an adult 18 years or older presenting a four-part proximal humerus fracture (CT4), displaced or not, with a maximum time from injury of 3 weeks, occurring between 1st January 2009 and 31st December 2011. The main endpoint was the weighted Constant score, which, when it was less than 70%, was considered as a poor result. The secondary criteria were the QuickDASH and SSV scores, range of motion, complications, and revisions. The prospective study was conducted from 1st January 2013 to 31st December 2013 with the same inclusion criteria, but required a 2D and 3D CT scan. Follow-up information at 3 months, 6 months, and at the last follow-up was required. The advantage of the retrospective study was to assess the late complications. In the initial series that grouped 113 patients, 70 in the retrospective study (CT4retro) and 43 in the prospective study (CT4pro), only 73 were followed up (41 in the CT4retro study and 32 in the CT4pro study). Of the 11 investigating centers, nine implanted reversed shoulder prostheses. Five centers out of nine had implanted more than five prostheses.

2.1. The overall series

Ninety percent of the patients were female, with a mean age of 79 years \pm 5 years (range: 60–95 years) and a mean BMI of 27 \pm 9 kg/m² (range: 19–51 kg/m²); 52% of the patients presented comorbidities (diabetes, Parkinson disease, or heart disease); 70% had osteoporosis and 22% an associated fracture in the upper limb, lower limb, or spine (Tables 1 and 2).

The approach was superolateral in 75% of the cases with implantation of a reversed prosthesis manufactured by Tornier® (Saint-Ismier, France) in 90% of the cases, by FX® (Bourg-en-Bresse, France) or Depuy Synthes® (Saint-Priest, France) in 10% of cases. In 96% of the patients, a 36-mm-diameter glenoid sphere was used. Osteosuture fixation of the tuberosities was performed in 93% of the cases, tenodesis of the long head biceps brachii in 75% of the

Table 1
Epidemiological variables of the two series.

	Retrospective series (n = 41)	Prospective series (n = 32)
	1% = 2.4	1% = 3.1
	9 centers	9 centers
	5 centers > 6 poses	4 centers > 4 poses
Follow-up (months)	39 (24–62)	11.3 (5–16.5)
Age	78.2 (60–88)	79.4 (72–91)
Gender	F: 90%	F: 90.6%
Weight (kg)	70.8 (45–147)	66.3 (50–83)
Height (cm)	159.4 (146–175)	157.9 (145–167)
BMI	27 (19–51)	26.4 (20–34)
ASA > 3	14.6%	37%, <i>P</i> = 0.02
Diabetes	17%	6.2%
Parkinson	0%?	9.3%
Alcoholism	0%?	5.8%
Medical history in addition to diabetes, etc.	53.6%	50%
Osteoporosis	64%	75%

Table 2

Fracture, associated lesions, treatment, and immobilization of 2 series.

	Retrospective series (n = 41)	Prospective series (n = 32)
	1% = 2.4	1% = 3.1
	9 centers	9 centers
	5 centers > 6 poses	4 centers > 4 poses
Fracture dominant side right	89%	96.6%
Associated fractures	21.6%	21.7%
Upper limb, lower limb, spine		
Percentage of head dislocated	13%	32%
Percentage of head broken	23.7%	9.6%
Superior approach	78%	71.8%
Diameter 36	100%	91%
		3 > 40
Type of prosthesis	Tornier	Tornier except 4 FX solutions implants, 4 Depuy implants
Bone graft	65%	84.3%
Tuberosity fixation	90%	97%
Postoperative tuberosity reduction	82% (both)	85% (both)
Tenodesis	74.3%	84.3%
Acromioplasty	5.4%	3%
Intraoperative complications	2.5%	3%
	1 fracture per op	1 fissure per op
Immobilization 4S	17%	25%
Type of immobilization	Internal rotation: 63.8%	Internal rotation: 61.3%
	N rot: 16.6%	N rot: 32.2%
Return to home	39%	37.5%
Rehabilitation center	47.2%	40.6%

N rot: neutral rotation; per op: peroperative.

cases, and acromioplasty in 4%. An autologous bone graft was used in 75% of the cases. The tuberosities were deemed reduced after surgery in 83% of the cases. Two intraoperative complications were observed, one in each series: 2.5% in the retrospective series and 3% in the prospective series, a fissure or an intraoperative diaphyseal fracture.

Four-week immobilization was deemed useful in 21% of the cases, which was in internal rotation in 60% of the cases; all the other patients were mobilized immediately. Thirty-eight percent of the patients were able to return home with a self-rehabilitation program and 43% were transferred to a rehabilitation center. The remaining 20% returned home with a rehabilitation protocol to follow on an out-patient basis or with an independent physical therapist.

The CT4pro and CT4retro series were comparable except for the American Society of Anesthesiologists (ASA) score: 14% of the patients were ASA 3 or greater in the retrospective series and 37% in the prospective series (*P* = 0.02) (Table 2).

3. Results

3.1. Functional and radiographic results

3.1.1. Short-term results (prospective series)

At 3 months of follow-up, the percentage of satisfied and very satisfied patients was 79%, increasing to 87% at 11 months (Table 3). The rate of excellent and good results (weighted Constant score > 80%) was 35% at 3 months and 53% at 11 months, showing an increase from the 3rd month and the 11th month with the Constant score gaining 10 points and a weighted Constant score that gained 10%. Anterior elevation of the arm progressed by 10° and external rotation by 6°. The QuickDASH score improved slightly as did the SSV between 3 and 11 months. The failures (weighted

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