



Treatment of comminuted proximal humerus fractures with shoulder hemiarthroplasty in elderly patients

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This retrospective study was done to find out the outcome of hemiarthroplasty of the shoulder following comminuted proximal humeral fractures in 20 elderly patients. Their average age was 77.6 years. The average follow-up was 33 months. All patients were reviewed in the outpatient clinic using the Constant Score.

The median Constant Score was 47.5. None of the patients had severe pain. Four had moderate and 16 had no or mild pain. Range of movement was not good. The activities of daily living were significantly reduced in patients with moderate shoulder pain.

Sixteen patients (80%) were satisfied with the outcome of the management of their shoulder injury. Radiological assessment showed malrotation of the prosthesis and ectopic ossification in one patient each. Osteolysis around the greater tuberosity was noted with three isoelastic prostheses. Seven patients showed proximal migration of the prosthesis although there was no significant difference in functional results.

Complications included fatal pulmonary embolism in one patient.

Overall, hemiarthroplasty of the shoulder gave good pain relief but there was only moderate functional improvement.

Keywords : humerus ; proximal ; fractures ; hemiarthroplasty.

Proximal humerus fractures constitute 4-5% of all fractures and they account for 45% of all humeral fractures. When considering adults over the age of 40 years, this increases to 76% (1). Osteoporosis is thought to be a contributing factor to this increased incidence. Osteoporosis is also a major factor in the increased ratio (2:1) of the proximal humeral fractures in women compared to men (1).

The majority of proximal humerus fractures are undisplaced or minimally displaced and are well treated non-operatively ; however, displaced fractures often require closed reduction or open reduction with internal fixation.

Prosthetic hemiarthroplasty is the accepted form of treatment for markedly displaced fractures and fracture-dislocations, including 4-part fractures or fracture-dislocations, head splitting fractures, and fractures with impression defects involving more than 45% of the humeral head (9, 13, 16, 19, 20).

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INTRODUCTION

Fractures of the proximal humerus are a common occurrence, especially in the elderly age group.

Table I. — Details of patients

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	EP	70	F	L	4-	12	Iso.	44	50	10	18	14	8	71
2	ER	87	F	L	3D	14	Iso.	44	20	10	2	6	2	31
3	BL	71	F	L	4-	7	Not.	31	48	10	18	12	8	70
4	AS	81	F	L	4-	11	Iso.	42	37	5	14	8	10	58
5	HH	70	F	L	4-	8	Iso.	40	51	15	12	14	10	70
6	JP	71	F	L	HS	8	Not.	40	63	10	22	16	15	90
7	GH	83	F	R	4-	7	Not.	39	48	10	18	10	10	75
8	OG	79	F	R	4-	9	Not.	32	44	10	12	14	8	64
9	KB	73	F	L	4-	6w	Not.	35	58	15	16	12	15	84
10	EW	87	F	R	4-	8	Not.	36	47	15	12	12	8	73
11	EP	90	F	L	4-	12	Iso.	24	50	10	20	12	8	78
12	IS	84	F	R	3D	7	Not.	27	34	10	10	9	5	53
13	KE	86	F	R	4-	6	Iso.	12	34	5	14	9	6	53
14	EG	83	F	R	4D	11	Iso.	43	27	10	8	5	4	42
15	AW	79	M	L	3D	10	Not.	29	17	5	4	6	2	23
16	RA	71	M	R	4-	8	Not.	12	23	5	6	8	4	26
17	KW	74	M	L	4-	14m	Neer.	50	54	10	20	14	10	72
18	BR	70	M	R	4D	10	Iso.	30	42	10	12	10	10	47
19	BH	73	M	R	3D	4	Not.	24	48	10	18	12	8	70
20	DW	70	F	R	4-	1	Not.	26	50	10	18	14	8	71

[A : Serial number ; B : Initials ; C : Age ; D : Sex ; E : Side ; F : Type of fracture ; G : Time between injury and surgery (days) ; H : Prosthesis ; I : Follow-up period (months) ; J : Constant score ; K : Pain score ; L : Range of movement score ; M : Activities of daily living score ; N : Power score ; O : Relative Constant score after considering age and sex ; (Abbreviations : Iso. : Isoelastic prosthesis, Not. : Nottingham shoulder ; Neer. : Neer Prosthesis ; 6w : 6 weeks ; 14m : 14 months)].

Some patients with 3-part fractures and fracture-dislocations should be considered for hemiarthroplasty because of advanced age, severe comminution, or poor bone stock.

This retrospective study was undertaken to evaluate the results of hemiarthroplasty for 3- and 4-part fractures and fracture dislocations of the proximal humerus in elderly patients.

MATERIAL AND METHODS

This is a retrospective study of 22 patients who underwent hemiarthroplasty of the shoulder following displaced proximal humeral fractures from June 1996 to December 2000. Twenty patients underwent surgery within two weeks of trauma and two patients were treated with hemiarthroplasty after the conservative treatment had failed. One patient died due to pulmonary embolism. One patient after surgery moved to another hospital for follow-up and could not be assessed clinically, and was excluded from the study. Thus there were

20 patients available for clinical and radiological assessment (details are shown in table I).

Two patients could not come for the assessment in clinic hence they were interviewed on telephone to assess pain and activities of daily living and the power and range of movements were recorded from their last follow-up in the medical notes. Functional assessment was done according to a proforma based on the Constant Scoring System (4).

The mean age of the patients at the time of operation was 77.6 years (range : 70 to 90). There were fifteen women and five men. The right side was involved in 10 and the left side in 10 patients. The dominant side was involved in nine patients.

The mode of injury was a fall on the outstretched hand in 20 patients who had only proximal humeral fracture. One patient had a road traffic accident and presented an open fracture of the olecranon and an undisplaced pubic ramus fracture along with a comminuted proximal humerus fracture. One patient had Colles's fracture on the same side of the proximal humerus fracture. According to Neer's classification (15), there were



Fig. 1. — Four-part fracture dislocation of the proximal humerus.

thirteen 4-part fractures, two 4-part fracture dislocations (fig 1), four 3-part fracture dislocations and one head splitting fracture. Two ladies had axillary nerve injury with sensory loss in its distribution present since the time of injury.

The mean follow-up period was 33 months (range : 12 to 50) for these twenty patients.

All patients had roentgenograms, with antero-posterior and axillary views. The operating surgeon discussed the advantages and disadvantages of the surgery and post-operative rehabilitation with the patients prior to surgery.

The patients were placed in beach chair position and prepped and draped. The procedure was carried out in a standard way.

Prosthesis

Out of twenty patients who underwent hemiarthroplasty for displaced proximal humeral fractures, 11 had



Fig. 2. — Two-year post-operative film of Nottingham Shoulder hemiarthroplasty.

Nottingham (fig 2), eight Isoelastic and one Neer II prosthetic replacement. Twelve prostheses (Nottingham-11, Neer-1) were cemented and eight isoelastic hemiarthroplasties were uncemented. The isoelastic prosthesis after insertion into the proximal humerus was fixed to the shaft using a single 4.5 mm screw to prevent rotation. The tuberosities were fixed with strong nonabsorbable sutures and further reinforced with screws if needed.

Table II. — Constant score

Constant score	Median	Range
Pain	10	(5-15)
ROM	14	(2-22)
Power	8	(2-15)
ADL	12	(5-16)

ROM : Range of movement, ADL : Activities of daily living.

Table III. — Pain

Severity	Number	Average follow-up
None	3	37 months
Mild	13	35 months
Moderate	4	24 months
Severe	0	0

Postoperative management

All patients received three doses of intravenous Cefuroxime peri-operatively. Drain was removed 24-48 hours after the surgery. Gentle assisted exercise was started from the 1st postoperative day. Pendulum exercises and passive forward elevation to 100° were continued for the first 2-3 weeks. Then gradually external rotation, abduction and internal rotation exercises were allowed. Active exercises were allowed after 4 weeks when sufficient healing of the tuberosity had occurred. Aggressive stretching exercises were initiated only after 8-10 weeks of surgery. Resistive strengthening exercises were started after 3 months. This was continued for 6 months.

This protocol was not possible in all the patients as they were old, some living in a nursing home ; for some patients, regular visit to the physiotherapy department was not feasible.

RESULTS

The median Constant score for all patients was 47.5 (range : 17 to 63). The median Constant score for the Nottingham shoulder (n : 11) was 48, for the Isoelastic shoulder (n : 8) was 39.5 and for the Neer II prosthesis (n : 1) 54. The median score for all cemented prostheses (n : 12) was 48. Clinically it appears that the Nottingham shoulder is better but on statistical analysis using two-tailed t-test, the

p value is > 0.05 at 95% confidence interval, so the difference is not statistically significant. The Constant scores for individual parameters are shown in table II.

One patient had surgery after 6 weeks and another patient after 14 months of failed conservative treatment. The Constant scores in these patients were 58 and 54 respectively.

The pain was assessed as absent, mild, moderate and severe (as shown in table III).

Sixteen (80%) patients experienced no pain or mild pain on unusual activities. Patients with longer follow-up experienced less pain. The pain improved with time. On doing statistical analysis using 2-tailed t-test, p value was > 0.05 at 95% confidence interval and the difference in the improvement of pain with longer follow-up (35 weeks) was not significant.

The power was assessed on a scale between 0 and 25 pounds. The median Constant score was 8 (range : 2 to 15). The range of movement was not very good at the time of assessment. The median score was 14 (range : 2 to 22). The activities of daily living were significantly reduced in those patients who had moderate pain in the shoulder.

Relative Constant score (5)

It has been noted in the past that the normal function deteriorates with age and this is specific to age and sex. The median relative Constant score was 70. It was 70.5 for the Nottingham prosthesis and 55.5 for the Isoelastic prosthesis. The relative Constant score is better as compared to Constant score as all patients in this study were over 70 years of age and there were 15 females.

Radiological assessment

The radiographic examination at follow-up did not show loosening of any prosthesis. One patient had malrotation of the prosthesis. The Constant score for this patient was 23. He had significant pain in the shoulder and was not satisfied with the result but never agreed for revision surgery. One patient had ectopic bone formation around the operated shoulder.



Fig. 3. — Isoelastic shoulder prosthesis showing resorption of the greater tuberosity. 6 months postoperatively.

Four patients with an Isoelastic prosthesis showed increasing osteolysis at the greater tuberosity and around the proximal screw on serial radiographs. One patient developed complete resorption of the greater tuberosity (fig 3) and the screw fixing it became prominent and painful and had to be removed. The pain improved subsequently.

In seven shoulders there was proximal migration of the humeral prosthesis as noted by obliteration of the space between acromion and prosthetic head. The patients with proximal migration of the prosthesis did not show any difference in functional results.

Complications

Early complications included fatal pulmonary embolism in one patient and in two patients the axillary nerve palsy which had been noted to occur at the time of injury persisted at the follow-up. There was no postoperative infection in this series.

Satisfaction of the patients

Sixteen (80%) patients were satisfied with the outcome of the management of their shoulder injury. Four patients who had moderate pain were not very happy with the outcome of the surgery.

DISCUSSION

Fracture of the proximal humerus is a common fracture in elderly patient with osteoporotic bones. Some of these fractures can heal without significantly impaired shoulder function. Several methods for the treatment of displaced proximal humerus fractures have been published (9, 11, 16, 17, 22). However the results are inconsistent and seem to be unpredictable (11, 12, 16, 17, 20, 22). The major problems in the conservative treatment of these fractures are the proper alignment and maintenance of reduction. Internal fixation carries an inherent risk of failure due to the osteoporotic bone stock, and the humeral head is at risk for postoperative avascular necrosis. The treatment of these disabling injuries can be further complicated by malunion of tuberosities and soft tissue contractures with nerve injuries.

Hemiarthroplasty for acute or chronic comminuted fractures of the proximal humerus is a demanding procedure that depends on the anatomic restoration of the humeral length, position of the tuberosities, and appropriate humeral head orientation to the glenoid (3, 6, 8). These provide satisfactory functional stability by restoring musculotendinous tension of the deltoid and rotator cuff. In addition to appropriate surgical technique, successful arthroplasty depends on careful patient selection and a comprehensive rehabilitation programme (3).

Moda *et al* (12) suggested open reduction and internal fixation and showed excellent and good

results in 80% of their patients with 3- and 4-part fractures of the proximal humerus. Neer (16) and Tanner and Cofield (20) advocated the use of a prosthetic replacement for all patients with four-part fractures and had results that were excellent and good in more than 80% of the patients. Leyshon (11) had 70% satisfied patients in the three-part fractures, but all patients (eight cases) in the four-part fracture group had unsatisfactory results following conservative treatment.

Neer (16) achieved outstanding results with hemiarthroplasty for severe fracture of the proximal humerus with respect to pain and range of movements. Stableforth (19) reported that the results of the treatment with hemiarthroplasty were much better than those of conservative treatment with regard to pain, power and range of movements. Tanner and Cofield (20) in a series of 49 shoulders in 48 patients treated with a Neer prosthesis for complex acute and chronic fractures of the proximal humerus achieved satisfactory pain relief and range of movements in most of the patients.

Pain relief in this series is similar to the published literature but patients had poor ROM and power in the shoulder. The activities of daily living were significantly limited.

Bosch *et al* (2) reported a mean Constant score for all patients of 54.2 (range : 23 to 87). The mean score for patients operated early (< 4 weeks) was 65.5 and for those operated late (> 4 weeks) was 45.3.

In the present study, the mean Constant score for patients operated within 2 weeks was 40.7 (range : 17 to 63), but the mean age was 77.6 years as compared to 64.5 years in Bosch *et al*'s (2) paper. There were only two patients operated late (6 weeks and 14 months) in this study and hence the late results cannot be compared. Our results are comparable to those of Zyto *et al* (21) who reviewed 27 patients, after a mean of three years, who had sustained displaced three- and four-part fractures of the proximal humerus treated with hemiarthroplasty. The median Constant score at follow-up was 46 (range : 11 to 78).

Movin *et al* (14) recently presented the functional outcome 3 years (range : 2 to 12) after arthro-

plasty in 29 proximal humerus fractures. The shoulders had marked reduction of performance with a mean Constant score of 38 (range : 16 to 69). They concluded that the treatment of severe proximal humerus fractures with hemiarthroplasty does not give complete pain relief and results in impaired shoulder function.

Most authors reported satisfactory relief of pain following shoulder hemiarthroplasty in proximal humerus fractures (2, 3, 7, 10, 13, 16, 18, 19, 20). However the methods used to assess pain vary, and satisfactory pain relief is differently defined. The fracture patients usually had no symptoms before the injury. Therefore, it can be argued that they should be pain free for a satisfactory outcome from the patient's point of view.

In Tanner and Cofield's (20) study of 44 shoulders treated with a shoulder prosthesis following fractures, the pain was categorised as absent in 14, mild in 21, moderate after unusual activity in 6, moderate in 3 and no patient had marked pain. Goldman *et al* (7) studied 22 patients with hemiarthroplasty performed for three- and four-part humeral fractures within 3 weeks. At one year follow-up, 7 patients reported no pain, 9 slight pain, 3 pain only after unusual activity and 3 moderate pain on the 0-5 scale of the American Shoulder and Elbow Surgeons evaluation form.

In our study no patient had severe pain but 13 out of 20 patients experienced mild pain in their shoulder while doing unusual activities. Four patients reported moderate pain on activities. In the 4 patients who reported moderate pain the average follow-up was 24 months and in the rest of the patients the average follow-up was 35 or more months. The intensity of pain improved with time in this study although not to a statistically significant level. Zyto *et al* (21) have reported no correlation between pain and the follow-up time.

Neer (16) has reported outstanding results with respect to range of movement. Tanner and Cofield (20) have reported an average active abduction of 101°, active external rotation of 42° and internal rotation to L2 vertebra. Goldman *et al* (7) have reported a good range of movements in their series of 26 hemiarthroplasties with an average active forward flexion of 107°, average external

rotation of 31° and average internal rotation to L2 vertebra.

In the present study, the ranges of movements are not comparable to these published results. Median active forward flexion was 65°, median active abduction was 60°, internal rotation to lumbosacral junction and median external rotation was 10°. The flexion and abduction movements are comparable to those reported by Zyto *et al*'s (21) : median flexion of 70° and median abduction of 70°.

The overall patient satisfaction was 80% in the present series. The high satisfaction despite poor functional results is due to good pain relief following hemiarthroplasty in these low-demand elderly patients. Skutek *et al* (18) presented 85% good to excellent subjective satisfaction in their series and Hawkins *et al* (10) had 80% patient satisfaction in their published results.

The two patients with persistent axillary nerve palsy had a poor outcome after hemiarthroplasty following fractures of the proximal humerus. Stableforth (19) has reported that the nerve lesions occurred with an incidence of 6.1% after four-part anterior fracture dislocations of the shoulder.

The results of this study were inferior to other published series except Zyto *et al* (21) and Movin *et al* (14), where most of the functions were comparable. The reasons could be multifactorial. The average age of the patients in our series was 77.6 years, which is comparable to Zyto *et al* (21) and Movin *et al* (14) with an average age of 71 years each. Both these series had similar functional outcomes to the present study. In other series the patients were comparatively younger in age, as in Bosch *et al* (2) with 64.5 years, Goldman *et al* (7) with 67 years, Skutek *et al* (18) with 62 years, Neer (16) with 55.3 years and Hawkins *et al* (10) with 64 years. All these series had presented better functional results. The postoperative rehabilitation is a very important factor to achieve good functional outcome (3, 7, 8). In our study although the patients were told about the long rehabilitation period and their effort needed to achieve good functional results, they were not very motivated. After discharge from the ward at two weeks, they had outpatient physiotherapy once or twice a week and during the rest of the week they were asked to do unsupervised physiotherapy. The

compliance in these elderly patients could be questionable and hence it might have been beneficial to centralise the training to ensure proper rehabilitation.

CONCLUSIONS

The pain relief following hemiarthroplasty of shoulder is satisfactory but the range of movement and restoration of function are poor in elderly patients ; however, the satisfaction rate is high due to their low demand.

The functional outcome could be improved by an intensive supervised rehabilitation programme.

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