Primary Hemiarthroplasty for Proximal Humeral Fractures in the Elderly: Long-Term Functional Outcome and Social Implications

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Abstract
Background: Primary shoulder hemiarthroplasty is an established treatment modality for complex fractures of the proximal humerus. Long-term functional outcome is often disappointing. However, little is known about social implications particularly in the elderly.

Methods: A single-institution case series of consecutive geriatric patients (age > 70 years) treated with shoulder hemiarthroplasty for complex fractures of the proximal humerus between 1994 and 1997 was analysed. Postoperative morbidity, long-term function, radiological outcome and social implications were evaluated.

Results: Seventy-seven patients fulfilled the study criteria. Median age at the time of operation was 80 years (range 70–93 years). Systemic and local postoperative complications were observed in 8% including 2 patients (3%) with revision surgery. Postoperative mortality was 1%. Forty-eight patients (62%) were available for follow-up (median 49 months, range 25–80 months), 22 (29%) died from causes unrelated to hemiarthroplasty before follow-up and 7 patients (9%) did not attend follow-up examination. Median Constant-Murley score was 41 points (range 17–77 points). Long-term results concerning pain were satisfying. The Oxford shoulder score ranged from 14 to 40 (median 30). Forty-one patients (85%) still lived in their original environment and managed their daily life independently despite poor shoulder function. Four patients (8%) lived in a retirement home and 3 (6%) in a nursery home. Eighty percent of our patients were still able to use public transportation, do the daily shopping and wash their whole body by themselves.

Conclusion: Most patients managed their daily life independently despite poor shoulder function.

Key Words
Hemiarthroplasty • Elderly • Shoulder • Social implications • Outcome

Introduction
The complex fracture of the proximal humerus as described by Neer is a severely disabling injury [1]. It is a typical injury of the elderly which becomes more common as the population ages and remains physiologically active. The overall incidence of these fractures is 70/100,000 people a year and raises up to 405/100,000 yearly including only the female older than 70 years of age [2].

The severity of this injury is due to the associated vascular compromise. Disruption of the major blood supply leaves the proximal humerus susceptible to avascular necrosis [3]. In addition to vascular compromise, these fractures are often associated with significant comminution, which makes stable open reduction and internal fixation extremely difficult, particularly in old patients with osteoporotic bone.

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Thus, the management of these fractures is still a challenging problem [4] and hemiarthroplasty is a widely applied technique for these fracture patterns. The reported functional results following primary hemiarthroplasty for fractures of the proximal humerus vary, whereas satisfactory pain relief can usually be achieved [1, 5–8].

Several groups reported patients with relatively pain free shoulders and good functional results after acute shoulder hemiarthroplasty for three- and four-part fractures of the proximal humerus [1, 5, 8]. However, none of these studies dealt with patients having an average age of over 80 years. Other reports showed disappointing functional results, especially when the procedure was performed in elderly patients [9, 10]. Furthermore, little is known about social implications of impaired shoulder function particularly in the elderly. It was our interest to study postoperative morbidity, long-term glenohumeral function and the social implication of primary hemiarthroplasty for displaced fractures of the proximal humerus in geriatric patients.

**Patients and Methods**

**Inclusion Criteria**
The trauma registry was reviewed for fractures of the proximal humerus treated with primary hemiarthroplasty between January 1994 and December 1997. Only patients at an age of 70 years and older were included in our study. Younger patients, preceding osteosynthesis for primary treatment and pathological fractures were all excluded from further evaluation.

**Operative Technique and Rehabilitation**
The operative technique was standardized and followed the guidelines by the manufacturer of the prosthesis model used exclusively in this study (Neer II design: Howmedica® Shoulder prosthesis, Shannon Industrial Estate, Co. Clare, Ireland). All patients were operated in beach-chair position under general anesthesia. A deltopectoral approach was performed in each case. The head fragment was removed. The tuberosities were identified, mobilised and stay sutures were placed at the bone–tendon junction. The canal was prepared by hand and drill holes placed in the shaft on either side of the biceps groove. Non-resorbable sutures (3-Ethicon®-Mersilene, Polyester, Johnson & Johnson®, UK) were pulled through the holes before cementing. A trial component was inserted to determine proper size of head and shaft and the correct height of the prosthesis. The humeral component was cemented in all cases in 25° of retro-version. The tuberosities were then reconstructed using heavy, non-absorbable 3-Mersilene sutures. The goal was to attach the tuberosity fragments to the humeral shaft, to each other, and to the fin of the prosthesis. Cancellous bone graft, taken from the removed humeral head, was placed between the tuberosities and the diaphysis to facilitate bone union.

Rehabilitation was started at the first postoperative day with exercises for wrist and elbow. Pendulum exercises of the shoulder were initiated 1 week after the intervention and followed the principles of early passive motion emphasized by Neer [1]. Free range of motion with elevation of more than 90° and strengthening was started 6 weeks after surgery.

**Outcome Measures and Follow-Up**
Clinical radiological records were reviewed for associated injuries, intra- and postoperative complications and duration of stay in hospital. Co-morbidities of these elderly patients were classified analogue the Charlson Index [11]. The initial preoperative radiographs were reviewed by one of the authors (Christoph Meier) and classified by the Neer and AO systems [12, 13].

All patients eligible for this study were contacted and called up for follow-up. At follow-up, all patients were examined by a single investigator (Michael Dietrich). Both investigators (Christoph Meier and Michael Dietrich) did not participate in any of the operations.

Assessment of the long-term result included the Constant-Murley shoulder score [14] of the operated and contra lateral side, the Oxford shoulder score [15], and radiographs of the shoulder.

Pain and shoulder function were measured using the well-established Constant-Murley shoulder score. The Oxford shoulder score was completed by the patients unaided at the time of follow-up. This questionnaire contains 12 items, each of which has five categories of response. Each item is scored from 1 to 5, from least to most difficulty or severity, and combined to produce a single score with a range from 12 (least difficulties) to 60 (most difficulties). It has been shown to be consistent and reproducible regarding the patients’ perception of shoulder problems [15, 16]. The test specifically asks for important functions of daily activities (e.g., ability to use knife and fork, to hang up clothes, to use public transportation, etc.).

Radiographic outcome was assessed on a true anteroposterior view of the shoulder in neutral rotation.