Fractures of the distal humerus in elderly patients treated with a ring fixator

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Abstract The aim of distal humerus fracture treatment is articular surface reduction and stable fixation for early mobilisation and rehabilitation. This is usually performed by open reduction and internal fixation with plates. In the elderly osteoporotic patient this treatment is difficult to achieve due to fixation failure in fragile bone. We present our experience with treatment by closed reduction and external fixation with a non-bridging ring fixator in distal humerus fractures in elderly patients. There were ten females, aged 70–89 (average 78.4). Fracture types (AO/ASIF) included three supracondylar fractures (type A) and seven intercondylar fractures (type C). All patients were treated by closed reduction and external fixation with a non-bridging ring fixator of the distal humerus and immediate postoperative mobilisation of the elbow. External fixation was removed on an average of 72 days (range 62–90). All fractures united. Average time to union was 56 days. Average range of movement at six months was 22° extension lag (range 15°–30°) and 115° flexion (range 110°–120°). Complications included one patient with transient radial palsy and one patient with a superficial decubitus ulcer on the chest wall from the hardware. Minimally invasive treatment by closed reduction and external fixation with a ring fixator is effective for

treatment of fractures of the distal humerus in elderly patients with osteoporotic bone. This treatment enables immediate mobilisation of the elbow, and allows return to function. It should be considered an alternative to open reduction and internal fixation or total elbow replacement.

Introduction

We present a novel method of surgical treatment of distal humerus fractures in the elderly population by closed reduction and an Ilizarov external fixator to achieve a mobile, functioning elbow joint. This surgical method is presented and the clinical results are discussed.

Distal humerus fractures comprise less than 0.5% of all fractures. The majority of these are type C (supra-intercondylar) [9]. The “gold standard” of care for this fracture is open reduction and internal fixation with two plates, as promoted by the AO/ASIF group [12]. This involves extensive soft tissue dissection and often an olecranon osteotomy. Elderly patients present problems reducing the success of open osteosynthesis of these fractures. These problems are reduced bone stock and strength for screw purchase, and a comminuted fracture pattern that prevents anatomical reduction of the fracture. It is the surgeon’s responsibility to supply these patients with the quickest solution for return to their activities of daily living, without subjecting them to prolonged periods of immobilisation and long rehabilitation.

There are several published and acceptable methods of treating elderly, osteoporotic patients who present with distal humerus fractures. We present our technique of fixating the fractures using minimally invasive, closed reduction and percutaneous ring fixation leaving the elbow joint free to move.

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Patients and method

There were ten patients, all females, aged 70–89 (mean 78.4). According to the AO/ASIF classification of fractures of long bones, there were three (three) type A and seven (seven) type C fractures. Fractures amenable to this treatment method are mostly type A and non comminuted type C fractures. We explained the alternatives to the patients including non-operative treatment and formal open reduction internal fixation (ORIF). Mean follow-up was nine months (range 6–18). Figure 1 shows an X-ray of a typical type C fracture in one of our patients. Table 1 shows details of the ten patients.

We used a simple ring frame comprised of two (140–160 mm) half rings, two rods (120–150 mm), three support posts, three to four olive wires and two 5-mm half pins (Fig. 2). The patient was anaesthetised with general anaesthesia, positioned supine with the arm abducted, scrubbed and draped. Intravenous administration of a first generation cephalosporin was given prophylactically. Traction was applied and fluoroscopy was used to fully understand the fracture pattern. The procedure was staged. First, the articular surface was reduced by traction and pinning with two olive wires. One is placed from the lateral to the medial epicondyle and the other in the opposite direction (Fig. 3). If needed, manipulation of a trochlear fragment is done with a K-wire percutaneously from a posterior approach. The reduction is checked fluoroscopically. The wires are secured and tightened on a posterior half ring. After its reduction and fixation, the articular surface is brought to align with the metaphysis and is fixated to another half ring. This proximal half ring is attached to the humeral shaft with two half pins. The half pins are inserted

in the proximal fragment laterally in the middle third of the humerus, protecting the radial nerve. Compression is applied between the two half rings if there is no metaphyseal comminution (Fig. 4).

The patients were allowed and encouraged to mobilise the elbow immediately postoperatively. Patients were discharged the next day. No further antibiotics were administered unless indicated. Patients were instructed on daily local care of pins. Physiotherapy with range of motion (ROM) exercises was started (Fig. 5). Radiological follow-up was performed every two weeks for the first month and then once a month until removal of the ring fixator in an outpatient clinic setting. No restrictions were imposed on patients after removal of the fixator.

Results

We accepted near anatomical reduction in all of our patients with up to 1–2 mm articular step-off. Mean follow-up was nine months (range 6–18). All fractures united. The average time to union was 56 days. The ring fixator was removed at an average of 90 days. Average range of movement at six months postoperative was 22° extension lag (range 15°–30°) and 115° flexion (range 110°–120°). Complications included one radial nerve palsy postoperatively which resolved after three months and one patient with a superficial decubitus ulcer on the chest wall from the hardware. The external fixator device was well tolerated by the patients and was removed at the outpatient clinic after union was observed radiologically. After removal of the fixator no patient required further surgery.

Fig. 1 Anteroposterior (a) and lateral (b) X-rays of a distal intraarticular humerus fracture showing displacement and osteoporotic bone

Table 1 Details of the ten patients in the study

Initials	Age (years)	Gender	Side	Fracture classification AO	Time to union (days)	Time to removal of fixator (days)	Extension	Flexion	Complications
N.R.	84	Female	Right	13-C1	59	95	15°	110°	
Y.R.	74	Female	Right	13-C1	70	100	20°	120°	Radial palsy
G.F.	70	Female	Right	13-A2	50	86	20°	110°	
D.M.	77	Female	Right	13-C1	54	80	25°	115°	Chest ulcer
K.R.	82	Female	Right	13-A2	56	90	25°	115°	
M.R.	84	Female	Left	13-C1	62	94	15°	120°	
G.M.	75	Female	Right	13-C1	60	92	25°	120°	
D.A.	72	Female	Left	13-C1	50	88	20°	110°	
S.C.	78	Female	Right	13-A2	47	80	25°	115°	
M.G.	75	Female	Left	13-C1	53	95	30°	115°	

Discussion

The goal of distal humerus fractures management in the elderly is to achieve early motion of a congruent aligned joint.

The surgical principle is anatomical reduction and fixation with absolute stability of the joint block and attachment of the anatomically aligned joint block to the diaphysis using relative or absolute stability according to the fracture pattern.

Fig. 2 Side (a) and top (b) views of an Ilizarov device as would be applied to the elbow

Fig. 3 Intraoperative fluoroscopy showing reduction by traction and percutaneous clamping (a) followed by percutaneous insertion of olive wires (b)

Fig. 4 a, b Mounting the epiphysis on the diaphysis

Distal humerus fractures in the osteoporotic patient pose a treatment challenge. The surgeon is faced with technical difficulties such as poor screw purchase and comminuted fracture fragments in soft fragile osteoporotic bone. Although some authors still advocate formal osteosynthesis with plates and report good to excellent results [4, 11], Pajarinen and Bjorkenheim found that age over 50, poor bone quality, and immobilisation were poor prognostic factors for success of ORIF [10]. In a retrospective study of 45 patients over age 60, Komer et al. found high postoperative rates, predominantly screw loosening and implant failure at the lateral column. They also found that factors negatively influencing outcome were joint immobilisation longer than 14 days and severe joint involvement. Nevertheless, they found good to excellent functional results and concluded that “open reduction and internal fixation of distal humerus fractures in elderly patients should be the main goal, since good elbow function can be achieved in the majority of patients” [6]. Jupiter and Ring recommended testing full range of motion intraoperatively, and either adding a third plate if necessary,

or removing loose screws, filling the hole with cement, and replacing the screw into the soft cement [12]. They recommend a period of cast immobilisation if these measures fail.

Nonoperative treatment methods include traction with an olecranon pin until the fractures are sufficiently “sticky” and then conversion to a cast and/or functional cast, cast brace, or hinged brace, at which point controlled motion is encouraged. Another method of treating very osteoporotic bones is the collar and cuff method, where the arm is suspended in a collar and cuff in as much flexion as possible, allowing gravity to perform the ligamentotaxis effect. The cuff is removed after six weeks and the elbow is then mobilised. Good results have been reported using this method in a “bag of bones” osteoporotic setting [1]. In contrast, other authors reported worse results on non-operated patients versus operated patients in terms of pain, function and range of motion [13]. Other authors suggested spanning hinged external fixators to allow immediate movement of the elbow joint. Stavlas et al. reported using hinged external fixators for treatment of osteoporotic fractures and fracture dislocation as a salvage procedure with good results [14]. Lerner et al. [8] reported using a hinged hybrid external fixator in seven young patients with high energy trauma and a floating elbow. They found the results to be excellent in two patients, good in one patient, and fair in four patients. Although this method is similar to our method, the indication is quite different. The external fixator, although hinged, crosses the elbow joint. Zhao et al. reported 24 patients with comminuted intra-articular fractures (type C on AO/ASIF classification) treated with crossed K-wires for the condylar metaphysis and double tension band osteosynthesis for fixation of the metaphysis block to the shaft. Excellent or good results were achieved in 83% of patients with comparable complications [15].

Another mode of treatment in severely comminuted, osteoporotic fracture is total elbow replacement (TER). Several authors have reported good to excellent results with elbow arthroplasty with none to mild pain postoperatively [7]. In a study comparing primary total elbow arthroplasty versus primary osteosynthesis of type C distal humerus fractures in female patients above age 65, 11 of 12 patients undergoing TER had excellent results, whereas only four patients of 12 treated with ORIF were excellent, and three required revision to TER [2]. No patients with TER required revision surgery. Garcia et al., after treating 19 consecutive patients, concluded that “primary total elbow arthroplasty is an acceptable option for the management of comminuted fractures of the distal humerus in elderly patients when the configuration of the fracture and the quality of the bone make reconstruction difficult” [3].

Our described method of treatment answers all the criteria of the fracture management goals. Anatomical joint

Fig. 5 Outpatient pictures showing flexion and extension of the elbow with the apparatus

surface reduction is achieved and fixed with absolute stability (olive wires for compression). The joint block is re-attached to the diaphysis with a bridging technique using the external fixator. As the assembly is very stable, early unlimited range of motion is possible. An added benefit is minimal collateral soft tissue damage, thereby preserving the fragments' blood supply and encouraging early healing.

Our study has several limitations. First and foremost, it is a cohort retrospective study describing our method of fixating this difficult fracture in a specific population. The number of patients included in the study is relatively small, yet we find the results good enough to recommend its use, especially when considering the alternatives. We did not conduct a prospective, randomised study comparing our method with ORIF, TER, or nonoperative management.

Despite the study's limitations, we believe we were able to show this method to be effective in treating an ever-growing proportion of the population. We found this method to be rewarding and can quickly and cost-effectively restore patients' function.

Conclusion

Our experience shows good results using this minimally invasive technique. The advantages of this technique are the immediate mobilisation of the elbow joint and the rapid return to activities of daily living.

To the best of our knowledge, there is no published data about results of closed reduction and external fixation of distal humerus fractures in elderly patients using Ilizarov external fixation. The only reports in the literature on using the Ilizarov external fixator on distal humerus fractures are from Komurco et al., who described this method as a treatment option for open, comminuted gunshot wound of the elbow with about 42% good results [5], and Lerner et al., who described this method on high energy, floating elbow in young adults [8].

We recommend this treatment as an alternative to ORIF or TEA in elderly, osteoporotic patients due to its simplicity, short hospitalization, low complication rate, low costs and good functional results.

References

1. Brown R, Morgan R (1971) Intercondylar T-shaped fractures of the humerus. *J Bone Jt Surg* 53B:425–428
2. Frankle MA, Herscovici D Jr, DiPasquale TG, Vasey MB, Sanders RW (2003) A comparison of open reduction and internal fixation and primary total elbow arthroplasty in the treatment of intra-articular distal humerus fractures in women older than age 65. *J Orthop Trauma* 17(7):473–480
3. Garcia JA, Mykula R, Stanley D (2002) Complex fractures of the distal humerus in the elderly. The role of total elbow replacement as primary treatment. *J Bone Jt Surg Br* 84(6):812–816
4. John H, Rosso R, Neff U, Bodoky A, Regazzoni P, Harder F (1994) Operative treatment of distal humeral fractures in the elderly. *J Bone Jt Surg Br* 76(5):793–796
5. Komurcu M, Yanmis I, Atesalp AS, Gur E (2003) Treatment results for open comminuted distal humerus intra-articular fractures with Ilizarov circular external fixator. *Mil Med* 168(9):694–697
6. Korner J, Lill H, Muller LP, Hessmann M, Kopf K, Goldhahn J, Gonschorek O, Josten C, Rommens PM (2005) Distal humerus fractures in elderly patients: results after open reduction and internal fixation. *Osteoporos Int* 16(Suppl 2):S73–S79
7. Lee KT, Lai CH, Singh S (2006) Results of total elbow arthroplasty in the treatment of distal humerus fractures in elderly Asian patients. *J Trauma* 61(4):889–892
8. Lerner A, Stahl S, Stein H (2000) Hybrid external fixation in high-energy elbow fractures: a modular system with a promising future. *J Trauma* 49(6):1017–1022
9. MacAusland W, Wyman E (1975) Fractures of the adult elbow. *Instr Course Lect* 24:165–181
10. Pajarinen J, Bjorkenheim JM (2002) Operative treatment of type C intercondylar fractures of the distal humerus: results after a mean follow-up of 2 years in a series of 18 patients. *J Shoulder Elbow Surg* 11(1):48–52
11. Pereles TR, Koval KJ, Gallagher M, Rosen H (1997) Open reduction and internal fixation of the distal humerus: functional outcome in the elderly. *J Trauma* 43(4):578–584
12. Ring D, Jupiter JB (2000) Fractures of the distal humerus. *Orthop Clin North Am* 31(1):103–113
13. Srinivasan K, Agarwal M, Matthews SJ, Giannoudis PV (2005) Fractures of the distal humerus in the elderly: is internal fixation the treatment of choice? *Clin Orthop Relat Res* 434:222–230
14. Stavlas P, Gliatis J, Polyzois V, Polyzois D (2004) Unilateral hinged external fixator of the elbow in complex elbow injuries. *Injury* 35(11):1158–1166
15. Zhao J, Wang X, Zhang Q (2000) Surgical treatment of comminuted intra-articular fractures of the distal humerus with double tension band osteosynthesis. *Orthopedics* 23(5):449–452