Total elbow replacement for complex fractures of the distal humerus
AN OPTION FOR THE ELDERLY PATIENT
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The treatment of multifragmentary, intra-articular fractures of the distal humerus is difficult, even in young patients with bone of good quality, but is worse in elderly patients who have varying degrees of osteopenia. We have evaluated the functional outcome of primary total elbow replacement (TER) in the treatment of these fractures in ten elderly patients followed for a minimum of one year. There were no complications in regard to the soft tissues, bone or prosthesis. The mean range of flexion obtained was 125° (110 to 140) and loss of extension was 23.5° (0 to 50). The mean Mayo score was 94 points (80 to 100) and patient satisfaction was high. We feel that TER provides an alternative to open reduction and internal fixation in the management of these complicated fractures in the elderly.

Fractures of the distal humerus are difficult to manage.\textsuperscript{1-4} Even if extra-articular, the small size of the distal fragments and the proximity of the fracture to the joint make conservative treatment difficult. Prolonged immobilisation of the elbow while waiting for union predisposes to joint stiffness, muscle atrophy, and permanent functional impairment. Intra-articular fractures require precise anatomical reduction and fixation which will provide rigid stability in order to allow early mobilisation.\textsuperscript{5,6} The frequent multi-fragmentary nature of the fracture, with comminution of the articular surface and the metaphysis, makes accurate reduction and fixation very difficult. In younger patients with bone of good quality, a sound surgical technique often gives satisfactory results.\textsuperscript{1,2,7-10} Osteopenic bone, which is always present to some degree in the elderly population, predisposes to increased comminution and inadequate fixation. While some authors have reported good results in elderly patients,\textsuperscript{11-15} the same surgical techniques may also be less successful with a higher rate of complications.\textsuperscript{7,16,17}

Total elbow replacement (TER) is successful in patients with inflammatory arthritis,\textsuperscript{18-21} and may be used in the treatment of post-traumatic osteoarthritis, although with less favourable results.\textsuperscript{20,22} There are few reports of its utilisation in primary osteoarthritis,\textsuperscript{23} and the incidence of complications is higher. Although there are many reports of partial or total elbow arthroplasty as a reconstructive procedure for nonunited fractures of the distal humerus,\textsuperscript{24-29} there are few of the prosthetic replacement of the elbow as the primary treatment for fractures of the distal humerus. In 1993, Behrman and Bigliani\textsuperscript{30} described a 71-year-old woman who had sustained a type-C3 comminuted intercondylar fracture of the distal humerus. Non-operative treatment was unsuccessful and seven weeks after the injury she underwent distal humeral hemiarthroplasty. The largest series reported to date of the use of TER as the primary treatment for distal humeral fractures, is by Cobb and Morrey,\textsuperscript{31} in which 20 consecutive patients with 21 fractures were reviewed retrospectively. A more recent report describes favourable results in a series of seven patients.\textsuperscript{32} At our institution, the traditional management of these fractures has been either by open reduction and internal fixation or conservative treatment. We have been dissatisfied with the poor functional results and persistent pain of the latter approach, and have had difficulties at operation with attempts to stabilise osteopenic bones. We therefore considered TER as the primary treatment for these fractures and now report our results.

Patients and Methods
Between August 1997 and October 1999 we followed prospectively ten patients who had had TER for an intra-articular fracture of the distal humerus. During this period, 43 other patients had been treated by standard osteosynthesis, usually by two plates. The decision to carry out TER was made by the surgeon involved, and the indication was
a fracture which was considered not to be amenable to osteosynthesis, either because of the small size of the distal fragments or the poor quality of the bone (Table I). All the patients were women and had a mean age of 84.6 years (57 to 95). The patient aged less than 80 years suffered from chronic alcoholism and had markedly osteopenic bone. Three of the fractures involved the dominant right arm and seven the left, of which one was dominant. The fracture had followed a simple fall in all cases, with eight injuries occurring at home and two in the street. One patient (case 10) sustained an additional ipsilateral fracture of the distal radius; there were no associated injuries in the remaining nine. Comorbidities included the medical conditions associated with age such as cardiovascular disease, diabetes, poor mental function, etc. Using the AO classification, there were two type-13B and eight type-13C fractures (Table I). Figure 1 shows the radiographs of an 89-year-old woman with a type-C2 fracture.

**Operative technique.** The operation was carried out under general anaesthesia in four patients, under regional anaesthesia in two, and with a combination of both in the remaining four. The operative approach was that outlined by Cobb and Morrey, using a posterior midline incision curving medially around the olecranon and continuing in the midline along the subcutaneous border of the ulna. The ulnar nerve was identified and protected. The triceps-sparing approach of Bryan and Morrey provided excellent exposure as the triceps attachment was reflected in continuity with the periosteum. After freeing the soft tissues, all the bony fragments were excised. The medullary cavities of the humerus and ulna were prepared and cement was injected under pressure using a syringe adapted to the size of the medullary cavity. A Coonrad-Morrey prosthesis (Zimmer, Warsaw, Indiana) was used in all cases. The prosthetic components were inserted and assembled (Fig. 2). In all cases we used a humeral component of medium length (15 cm); in eight patients the implants were of the ‘small’ size, and in two the ‘regular’. After careful closure of the
wound, a standard bulky compression dressing was applied.

After operation the limb was raised, and two or three days later assessment for range-of-movement exercises was made by a physiotherapist. Three patients (cases 6, 8 and 10) went home directly after discharge, one (case 7) who had been admitted from an institution, returned to it and the remaining patients were transferred to our geriatric hospital for a brief period of continued physiotherapy and general care, including management of underlying medical problems, before being discharged home. The physiotherapist simply guided and assisted the patients in view of their advanced age. As soon as they became comfortable, usually within three or four weeks after the operation, they were able to move their arm freely without the need for further physiotherapy.

All the patients were evaluated at six weeks after operation, and then at 3, 6, 9, 12, 18 and 24 months. We used the Mayo score to assess the functional results (Table II). At each visit we recorded the range of movement of the elbow and forearm rotation. The degree of stability of the elbow was noted and we questioned each patient about pain, the ability to carry out daily activities, and the overall subjective assessment of the outcome. With this outcome score, an excellent result scored 90 points or higher, a good result between 75 and 89, fair between 60 and 74 and poor less than 60. Radiographs of the elbow were also taken at each follow-up visit.

Results

The mean interval between the time of the accident and operation was 6.6 days (3 to 12) (Table I). The mean time for the surgical procedure was 146 minutes (100 to 200). The mean length of stay in hospital was 18.9 days (13 to 32). This lengthy period of hospitalisation reflected the elderly nature of the patients and the need for management of other medical conditions. In spite of their age there were no intraoperative or immediate postoperative complications.

The mean follow-up was for 17.8 months (12 to 34) (Table III). One patient (case 4) died from a cerebrovascular accident 14 months after operation. All the elbows were stable. The mean flexion was to 125.5° (110 to 140), the mean loss of extension was 23.5° (0 to 50) and the mean arc of movement was 101°. The mean pronation and supination were 79° and 74.5°, respectively. Subjectively,
nine patients were very satisfied and one (case 10) was satisfied with their result, with eight having no pain and two minor pain. Eight patients had no limitations of daily activities; two noted some limitation in bringing their hand to their mouth. The mean Mayo score was 94 (80 to 100); eight patients had a score of 95 to 100. There were no problems with wound healing, and no neurological complications. One patient (case 2) developed heterotopic ossification which only slightly interfered with movement; she achieved flexion of 120°, extension of -30°, and pronation/supination of 70°/70°. One patient (case 1) developed a reflex sympathetic dystrophy which was noted at three months after operation, but which had resolved at follow-up at one year. Radiological review identified two patients with lucent lines around the stem of the humeral component; none were seen around the ulnar components. Subsequent radiological follow-up showed no progression of the lucency around the humeral implant.

Discussion

Our results of TER for complex fractures of the distal humerus in this selected group of elderly patients are good. Osteoporosis is the enemy of internal fixation, especially when dealing with small fragments and comminution of the artificial surface. In younger patients the results of open reduction with stable internal fixation allowing early movement are good,

\[1,2,7-9\] and TER is not an acceptable alternative. Joint arthroplasty for displaced fractures of the neck of the femur and head of the humerus in the elderly is accepted practice and primary elbow replacement in similar circumstances should be considered. We know that the results of TER are good in patients with rheumatoid arthritis,

\[19,21,22,36\] In a retrospective review of 69 patients (78 elbows) with rheumatoid disease, Gill and Morrey\[19\] reported that 69 elbows had a good or excellent result (88%) as judged by the Mayo score, with a mean follow-up of 136 months for 46 elbows, and 49 months for 32. It appears that the low demands made by patients with inflammatory arthritis mean that they fare better than those with TER for post-traumatic disorders. A report of 41 consecutive patients with post-traumatic arthritis, who were managed by TER, showed that the incidence of mechanical failure was greater and that such a procedure is relatively contra-indicated in patients with higher demands.\[36\] Similarly, a recent publication reports that the Mayo scores for TER undertaken in 18 patients (21 elbows) with inflammatory arthritis, and for 18 (18 elbows) with a fracture or with post-traumatic arthritis were 90 ± 11 and 78 ± 18 points, respectively.\[32\] The mean level of patient satisfaction, as determined by the SF-36 and the Disabilities of the Arm, Shoulder and Hand questionnaire, was also higher in the patients with inflammatory arthritis.

Our results do not imply that TER is necessarily the method of choice for such fractures, even in the older population. There are reports of good results after open reduction and internal fixation of these fractures in the elderly,

\[11-15\] and if the surgeon feels that the fracture is amenable to stable fixation and early movement it is a good form of treatment. Most of these studies were in patients considerably younger than those in our series in which the only patient aged less than 81 years of age was a chronic alcoholic. Noack et al\[14\] reported the results of open reduction and internal fixation in 16 patients with a mean age of 67.8 years; ten were under the age of 68 years. Kocher et al\[12\] described 169 patients treated by open reduction and internal fixation, of which 32 were older than 65 years and, of the 23 available for final review, the mean age was 78 years which is almost seven years younger than the mean age of our patients (84.6). Overall, the outcome in that series was good to excellent in 75%. Pereles et al\[35\] reviewed 12 patients with 12 fractures with excellent or good results; their mean age was 71 years. In an older group of patients with a mean age of 80 years, in which the outcome was based on pain, range of movement and self-assessment, there were good and very good results in 85% in regard to mobility and in 80% in terms of pain.\[11\] Other authors, however, report less satisfactory results in this elderly population,

\[7,16,17\] which has led some surgeons to consider TER to be the primary method of treatment. Cobb and Morrey\[31\] reported very good results in a retrospective review of TER in 20 patients with 21 fractures. The mean age of their patients was 72 years (48 to 92), 12 years younger than in our group. Nine of their patients had pre-existing rheumatoid arthritis, which was a significant influence on the decision to carry out a TER. In three patients there was an attempt at closed reduction, and two had unsuccessful open reduction and internal fixation before
arthroplasty. The final score gave 15 excellent and five good results.

None of our patients had a history of elbow pain before the fracture and, other than minor degenerative changes, there were no significant findings of arthritis in any of the injured elbows, other than one with preoperative radiocapital arthritis. In our series, the surgeon elected to perform the TER as the initial procedure, and as judged by the Mayo score we achieved an excellent result in eight patients and a good result in two. In a recent review of seven patients who had TER for fractures of the distal humerus, the mean age was 81.7 years. At follow-up, six patients reported no pain and one had mild pain. According to the Mayo score, there were five excellent and two good results. We agree with these authors that TER is of considerable value in selected cases of multifragmentary fractures in the elderly, particularly if the surgeon does not feel that osteosynthesis will be successful. There is little need for formal physiotherapy after TER in these patients. This has also been noted by others, and is in contrast to the reports of open reduction and internal fixation in which the emphasis is on early intensive physiotherapy.

While a mean follow-up of 17.8 months (12 to 34) may be considered to be a deficiency of our study, we feel that with the lessened demands placed upon the elbow and the increased mean age of our patient population, the good and excellent results should serve our patients well. Another limitation is that the study was not randomised, the selection of patients for TER being made on the limited possibility of securing stable fixation and starting early movement.

Our purpose was to show that very good results can be anticipated if it is decided that internal fixation is not anticipated if it is decided that internal fixation is not possible and that TER is required. We have changed our approach to the management of these difficult fractures and now view TER as our first choice in the elderly patient with a multifragmentary fracture of the distal humerus.

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References