

Internal fixation or arthroplasty for displaced cervical hip fractures in the elderly

A randomised controlled trial of 208 patients

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ABSTRACT – 208 patients aged over 70 years with a displaced cervical hip fracture were admitted to a prospective randomised trial of internal fixation using 3 parallel cannulated screws or an uncemented Austin Moore hemiarthroplasty. All surviving patients were followed for a minimum of 3 years.

Functional assessment of survivors at 1, 2 and 3 years from injury showed no significant difference between groups. Patients treated by the fixation had a marginally lower mortality rate. Other outcomes which favoured internal fixation were a lower risk of wound infection, reduced length of surgery (22 minutes versus 47 minutes), lower operative blood loss (23 mL versus 172 mL), and lower transfusion requirements (4/102 patients versus 18/106). However, internal fixation had a significantly greater re-admission rate (24/102 versus 7/106) and re-operation rate. Following internal fixation, 44 re-operations were required in 36 patients, while re-operation was required in only 4 patients treated with arthroplasty.

The results of this randomised trial indicate that both procedures produce comparable final functional outcomes for the survivors.

In 1953, Nicoll described the displaced subcapital fracture as the unsolved fracture. Over 40 years later, the controversy continues, especially regarding the elderly patient with a displaced cervical fracture (Alho 1994, Lu-yao et al. 1994, Swiontkowski 1994). Different countries have particular preferences with the majority of these fractures in

Scandinavia being treated by internal fixation, while in other parts of Europe and North America, arthroplasty tends to be preferred.

This issue can be resolved only by randomised trials, for which there are only a few previous studies (Lu-yao et al. 1994). Such studies can only effectively be performed in a unit where the staff are fully experienced in the surgical practice of reduction and internal fixation and replacement arthroplasty. In Peterborough, a hip fracture unit exists for the treatment of these patients by a specialised hip fracture team (Parker et al. 1994). Therefore an accurate comparison can be made of both procedures, with a constant standard of surgical quality.

Patients and methods

Between July 1991 and March 1996, all patients aged over 70 years of age admitted with a cervical hip fracture, under the care of all the Orthopedic Consultants, were considered for inclusion in the study. The criteria for inclusion were a displaced cervical fracture (defined as having clear displacement of the fracture on both the anteroposterior and lateral radiograms). Excluded from the study were patients with rheumatoid arthritis, chronic renal failure, significant arthritis of the hip, patients unfit for either surgical procedure, delay of more than 48 hours from fracture to surgery and fractures secondary to tumour, Paget's disease and metabolic bone disease.

The method of randomisation was using sealed envelopes and occurred at the time of assessment on the orthopaedic ward. Once allocated by randomisation, all patients were considered as in this group with all results analysed on an intention to treat basis. The trial was approved by the local ethics committee and written consent was obtained from the patient or their family.

Statistical analysis between groups was done using the log rank test for mortality and the 95% confidence interval of the difference between groups was used for the remaining outcomes.

Patient assessment

For all patients, the preoperative medical conditions, mobility, activities of daily living, ASA grade (American Society of Anaesthesiologists 1963), residential status (Parker et al. 1998) and mental test score (Qureshi and Hodgkinson 1974) were recorded. The mobility score was as described by Parker and Palmer (1993). The activities of daily living score was an assessment of 13 daily activities with a maximum score of 39. Residential status was divided into 4 categories: own home, residential home, nursing home and acute hospital. Pain was assessed using a 6-point scale of Charnley (1972). The Garden (1961) grading of the fracture was noted.

Operative procedures

Surgery for all but 1 patient was performed or directly supervised by 1 surgeon (MJP). All patients received peri-operative antibiotic cover and, unless contraindicated, thromboembolic prophylaxis with unfractionated heparin for 5 days. The hemiarthroplasty used was an uncemented Austin Moore (Howmedica Ltd.), inserted by an anterolateral surgical approach with preservation of the joint capsule (Parker et al. 1997). For internal fixation, the fracture was reduced closed in a supine position (Parker et al. 1997). 3 parallel AO cancellous cannulated screws of 6.5 mm diameter with 32 mm of thread (Stratec Ltd) were passed percutaneously across the fracture.

Postoperative care

Postoperative care programmes for both groups were identical and supervised by MJP. Wherever possible patients were mobilised the day after sur-

gery with appropriate walking aids. There were no restrictions on hip movement or weight bearing for either of the groups. Early supported discharge of patients was encouraged (Parker et al. 1991). Most patients were discharged directly home from the orthopaedic ward with only a few patients being transferred to either a geriatric ward or a hospital ward in a community hospital.

All patients were assessed by MJP in a hip fracture clinic at about 6 weeks after discharge and thereafter, as indicated. Wherever possible, all patients had a 1-year assessment in this clinic. Shortening and loss of hip-joint flexion as compared to the contralateral hip were measured in all except patients with a previous fracture, replacement or arthritis of the hip. Patients unable to attend the clinic were contacted via phone or post. Annual follow-up after 1 year was by the phone, any patient who complained of substantial symptoms from the hip being invited to revisit the review clinic. All surviving patients had a minimum of 3 years' follow-up, with an average of 3.9 years for the survivors. Average radiographic follow-up of those treated by internal fixation was 0.8 years. No patient was lost to follow-up.

Cost of treatment

The cost of treatment of each patient was calculated by the method described by Hollingworth et al. (1993). These included all hospital costs related to the initial admission and any subsequent admission and operations for the hip fracture. Prices were then corrected to those for the year 1996/7 and were also quoted as ECUs, based on the exchange rate of 1.5 ECUs to the pound.

Excluded patients

205 patients with a displaced cervical hip fracture and aged over 70 years admitted during the study period were excluded from the study. The reasons were delay from fracture to surgery of more than 48 hours (148), single surgeon not available (94), rheumatoid arthritis (26), pathological fracture from metastatic tumour (21), patient considered unfit for either procedure (17), chronic renal failure (4), refusal of patient or relative to consent (2) and severe arthritis of the hip (2). In addition, in 1 case there was an intramedullary nail in place, which precluded internal fixation, and in another a

Table 1. Characteristics of patients included (percentage)

	Hemi-arthroplasty	Internal fixation
Number of patients	106	102
Mean age	82	81
Age range	71–101	71–98
Number male	23 (22)	23 (23)
Mean activities of daily living score	24	27
Mean mobility score	5.1	5.4
Prefracture use of walking aids		
none	64 (60)	62 (61)
walking stick(s)	25 (24)	30 (29)
Zimmer or other walking-frame	17 (16)	10 (10)
Mean mental test score	5.5	5.5
Mean ASA score	2.6	2.7
Prefracture residential status		
own home	75 (71)	73 (72)
residential home	14 (13)	17 (17)
nursing home	8 (8)	5 (5)
acute hospital	9 (9)	7 (7)
Pre-existing		
cardiovascular disease	31 (29)	26 (25)
respiratory disease	9 (9)	13 (13)
Mean pre-operative		
haemoglobin, g/L	130	132
Garden grade 3	41 (39)	50 (49)
Garden grade 4	65 (61)	52 (51)
Mean hours fall to surgery	28	26
Operation with spinal anaesthesia	28 (26)	22 (22)

recent amputation stump of the ipsilateral leg was unhealed which precluded arthroplasty. For some patients there was more than one reason for exclusion.

Included patients

The remaining 208 patients were entered into the study. The characteristics of these patients were similar (Table 1).

Table 2. Operative details (SD)

	Hemiarthroplasty	Internal fixation	95% confidence interval of difference	p-value
Mean length of operation in minutes	47 (9.9)	22 (5.9)	23–27	
Mean operative blood loss in mL	172 (108)	23 (11)	127–170	
Mean units blood transfused	0.33 (0.75)	0.08 (0.46)	0.42–0.08	
Number of patients transfused	18	4		0.003 ^a
Operative blood pressure fall	16	8	-0.01–0.16	
Mean dose morphine postoperatively	8 (11)	7 (8.4)	-4.9–2.1	
Mean number of co-proxamol	14 (9.5)	13 (9.3)	-4.4–2.4	

^a Fisher exact test

Results

11 patients were randomised within the trial but did not have the subsequent treatment according to the trial protocol. 5 patients in the hemi-arthroplasty group and 4 in the internal fixation group had a delay from fracture to surgery of greater than 48 hours generally because of a lack of theatre space. A further patient in each group was considered unfit for anaesthesia after randomisation and both these patients had internal fixation under local blocks. 1 of these patients had no fracture healing complications, but died at 27 days after the fracture. The other patient developed fracture non-union and this was converted to a hemiarthroplasty uneventfully at 28 days after fracture.

Operative details (Table 2)

Fall in blood pressure during the operation was defined as a reduction of more than 40 mm Hg for more than 5 minutes. The data for morphine refers to the mean dose of morphine in mg each patient received in the five days after surgery. The figure for co-proxamol (325 mg paracetamol, 32.5 mg dextropropoxyphene) relates to the number of these tablets or their equivalent, the patients received in the first 5 days after surgery.

For those patients treated by internal fixation, there were no failed reductions. Using Garden’s (1961) definition of a good reduction of 155°–180° on both the AP and lateral radiographs, only 1 reduction was poor. Using the more stringent criteria for a good reduction (Parker and Pryor 1993) of a Garden alignment index of 160°–175° on the AP view and 170°–180° on the lateral, then

Table 3. Postoperative complications

	Hemi-arthroplasty	Internal fixation
Superficial wound infection	1	0
Deep wound infection	4	0
Confusional state	11	7
Pneumonia	5	6
Urine retention	6	2
Pressure sores	2	4
Gastrointestinal bleed	3	1 + 1 ^a
Congestive cardiac failure	0	4
Cerebrovascular accident	2	0
Deep vein thrombosis	1	2
Pulmonary embolism	1	2
Gastric aspiration	1	0
Renal failure	1	1
Clostridia diarrhoea	1	1
Amputation leg ^b	1	1

^a 1 case occurred in patient at conversion of internal fixation to hemiarthroplasty.
^b For pre-existing peripheral vascular disease.

7 reductions were poor on the AP view, 3 on the lateral and 1 on both AP and lateral views.

Complications (Table 3)

In addition for the 105 hemiarthroplasty cases, 4 patients required secondary operations within the follow-up period. These were 1 excision arthroplasty for deep wound infection, 1 plating and wiring of fracture around the prosthesis and 2 cases of prosthetic loosening converted to total hip replacement. 1 of these cases was complicated by 2 dislocations, necessitating augmentation of the acetabular cup. There were no primary dislocations or cases of acetabular erosion requiring revision.

For the 102 internal fixation cases, 36 patients required 44 reoperations. 5 patients had removal of the screws for pain around the screw heads. 1 patient had a fracture at the site of the lower screw and was revised to a cemented hemiarthroplasty. 25 patients developed non-union, which was defined as displacement of the fracture following fixation necessitating revision surgery or radiographic evidence of the failure of the fracture to heal at 1 year from injury. 1 was treated conservatively and a further 2 by screw removal alone. 20 were treated by conversion to a hemiarthroplasty and 2 to a total hip replacement. Of these hemi-

arthroplasties, 6 suffered later complications (2 cases of superficial sepsis 1 of which required drainage, 1 fracture below the implant, revised to a long-stem prosthesis, 1 fracture around the implant with dislocation, which was wired but subsequently dislocated, and 2 cases of loosening converted to a total hip replacement). A further 7 patients treated with internal fixation developed radiographic evidence of avascular necrosis. 1 required no treatment, 1 had screw removal alone, 2 had screw removal, followed by arthroplasty, and 3 conversion to arthroplasty as primary treatment. 1 of these arthroplasties developed loosening and was converted to a total hip replacement.

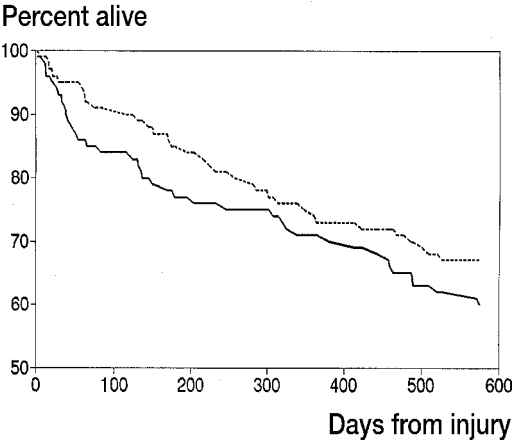
Hospital stay and cost of treatment

Following surgery, most patients remained on the orthopaedic/rehabilitation ward until discharged home. Only 17 patients were transferred to a geriatric ward and 5 to another hospital ward. 2 patients had a period of convalescence after discharge, in a nursing home for the elderly. The mean days spent on the orthopaedic ward for the initial admission was 17 days for those treated by hemiarthroplasty versus 14 days for those treated with internal fixation. The total hospital stay for the initial admission, which included time on other outlying hospital wards for rehabilitation or treatment of medical complications, was 21 days for hemiarthroplasty versus 19 days for internal fixation. The hospital stay, including that for any readmission(s) related to the hip fracture in the follow-up period, was 24 days for hemiarthroplasty and 23 days for internal fixation. 7 patients required re-admission in the follow-up period in the arthroplasty group, while 34 patients required re-admission after internal fixation.

The mean cost of treatment was GBP 4350 (6525 ECU) for hemiarthroplasty and GBP 4758 (7137 ECU) for internal fixation. This included the cost of any re-admission and additional surgery related to the hip fracture.

Final outcome measures

The actual figures for mortality at 30 days were 7/106 for hemiarthroplasty and 5/102 for internal fixation, 31/106 versus 27/102 at 1 year, 42/106 versus 35/102 at 2 years and 62/106 versus 46/102 at 3 years (Figure 1). The median survival time for



Mortality for those treated with arthroplasty (—) and internal fixation (---).

the arthroplasty group was 897 days (95% CI 672–1122 days) versus 1427 days (95% CI 884–1970 days) for internal fixation ($p = 0.08$, log rank test).

For those treated with hemiarthroplasty, the number of patients with little, if any, pain had risen to 80% at 2 years and was 87% at 3 years (Table 4). For internal fixation, the figures were 73% at 2 years and 75% at 3 years. Regarding mobility for the survivors, the mean mobility score was 3.8 at 2 years and 4.2 at 3 years for the hemiarthroplasty group, versus 4.7 and 3.9 for internal fixation. None of these differences between groups reached statistical significance.

Discussion

This study aimed to address one of the commonest treatment dilemmas for the orthopaedic surgeon:

the displaced intracapsular fracture. The implants chosen were considered to be the most prevalent methods currently used. In comparison to previous randomised trials on this subject, we used improved methodology, contemporary methods of internal fixation and surgical techniques, larger patient numbers, and a longer follow-up period. To standardise treatment factors, all operations were performed or directly supervised by one surgeon and pre- and postoperative care programmes were identical for both groups. This factor and the strict inclusion and exclusion criteria mean that a large number of patients had to be excluded from the study, but this was felt to be essential to minimise biases.

The results indicate that the final outcome measures for the survivors are essentially similar, with respect to pain, mobility, activities of daily living and return to previous residential status. Due to collapse at the fracture site, internal fixation results in about 5 mm increased shortening, compared to arthroplasty. Internal fixation is less traumatic being a quick percutaneous procedure. This is probably the reason for the trend to a lower mortality with internal fixation.

Internal fixation does, however, have some clear disadvantages related to non-union (25/102 patients) and avascular necrosis (7/102). 30 of them required revision to an arthroplasty and 5 of these required an additional surgical procedure. In addition, a further 10 patients had removal of the screws. Internal fixation being a percutaneous procedure with minimal trauma, may be associated with less pain in the postoperative period. However, we could not demonstrate this in terms of a reduced requirement for postoperative anal-

Table 4. Outcome for survivors at 1 year (percentage)

	Hemi-arthroplasty	Internal fixation	95% confidence interval of difference
Number of patients	74	74	
Number with little, if any, pain	45 (61)	47 (64)	-0.13–0.18
Mean pain score	2.2	2.2	-0.37–0.35
Mean reduction in mobility score	1.2	1.5	-0.82–0.30
Number using same walking aids	25 (34)	35 (41)	-0.02–0.29
Mean reduction in activities of daily living score	6.6	6.0	-3.9–2.8
Number at same residential status	58 (78)	64 (87)	-0.04–0.20
Mean shortening in mm	3.4	8.8	0.17–11
Mean loss of flexion	6.7°	8.3°	-3.5–6.7

gesics. The reduced surgical trauma from internal fixation may explain the slightly reduced hospital stay after internal fixation (14 versus 17 days).

The follow-up time for the surviving patients in this study was 3-7 years. It is inevitable that a number of the long-term survivors will require additional surgery related to fracture around the implant, loosening or acetabular erosion for the arthroplasties or avascular necrosis for those treated by internal fixation. Nevertheless, the difference between groups is unlikely to be significant in patients of this advanced age. In this study, only 6 re-operations were undertaken after 1 year from injury.

The few randomised trials on this question of internal fixation versus arthroplasty (Riley 1978, Söreide et al. 1979, Sikorski and Barrington 1981, Bray et al. 1988, Skinner et al. 1989, van Vugt et al. 1993, Jónsson et al. 1996) have generally been in favour of arthroplasty. None of these studies were able to demonstrate a lower mortality after internal fixation, but this may be because too few patients were included in each study. Because of the paucity of evidence of randomised trials, Lu-Yao et al. (1994) undertook a meta-analysis of 106 published randomised trials, comparative series and case series of internal fixation and arthroplasty. For internal fixation, they reported a rate of non-union of 33% and avascular necrosis of 16% with a re-operation rate of 20-36% within 2 years. This compares well with our results of 25% non-union, 7% avascular necrosis and 35% re-operation for internal fixation. For arthroplasty, Lu-Yao et al. (1994) found a re-operation rate of between 6% and 18% after hemiarthroplasty. Our lower re-operation rate of 4% was partly because there were no cases of dislocation which is a complication of surgical technique and related to the surgical approach (Keene and Parker 1993). In addition, there were no cases of revision from acetabular wear and only two cases of revision due to loosening. The main complication of arthroplasty was infection around the prosthesis. Our deep sepsis rate of 4% is similar to that of 3% in the meta-analysis of Lu-Yao et al. (1994).

A number of previous studies have tried to identify factors that are of clinical value in determining the risk of non-union. Studies of hip fracture classifications systems (Parker 1993, 1994, Blundell et al. 1998, Parker and Dynam 1998) have not

found them to be of any value. Therefore this study only excluded those patients with displaced cervical fractures in which the risk of non-union has been shown to be markedly increased, that is pathological fractures, rheumatoid arthritis, metabolic bone disease and Paget's disease. The time interval from fracture to fixation of intracapsular fractures is debatable, and we chose a time limit of 48 hours, based on the evidence of previous observational studies (Brown and Abrami 1964, Barnes et al. 1976, Holmberg et al. 1987, Parker 1994).

In conclusion, internal fixation and arthroplasty produced comparable functional results. Internal fixation is associated with a markedly increased re-operation rate, but has a tendency to a lower mortality.

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