CLOSED UNLOCKED NAILING FOR COMMINUTED FEMORAL FRACTURES

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Fifty consecutive comminuted fractures of the femoral shaft were treated by closed unlocked intramedullary nailing. Twelve unstable fractures also had cast-bracing. There were no cases of infection or non-union, and satisfactory results were achieved in 38 fractures (76%). More severe comminution led to a higher incidence of unsatisfactory results, but malrotation deformity was seen more often in less comminuted fractures and appeared to be due to poor operative reduction. Shortening in severe comminution was the main complication and was not controlled by supplementary cast-bracing.

Closed unlocked intramedullary nailing is effective for lesser grades of comminution, but fractures with no cortical continuity at reduction should be treated with a locking nail.

The treatment of comminuted fractures of the femoral shaft remains challenging despite a wide range of treatment options. Locking* femoral nails have recently been introduced to control shortening and rotation at the fracture site, the two most common problems encountered with other modes of treatment (Connolly and King 1973; Meggitt, Juett and Smith 1981; Hardy 1983). Before locking nails were introduced we treated these fractures by early closed intramedullary nailing, using a cast-brace as an additional external splint if the fractures were unstable (Rothwell 1982).

We now report our experience with this treatment and evaluate it in the light of recent results using locking nails.

MATERIALS AND METHODS

We reviewed 50 consecutive closed, comminuted femoral fractures in 47 patients. All were followed to fracture union. Personal interview and examination was possible in 39 cases; the remainder were followed from case notes and by telephone interviews.

All fractures were classified as Grade 1, 2 or 3 comminution, corresponding to the Types II, III and IV of Winquist, Hansen and Clawson (1984). In our Grade 1 cases there was a fragment of bone greater than 1 cm but more than 50% of the circumference of the shaft was intact. Grade 2 had less than 50% of the circumference intact, but some residual cortical apposition, while Grade 3 had no cortical continuity.

Most fractures were operated on within 24 hours of admission; the average time to surgery being 1.5 days. All the procedures were performed by a closed technique using a modified Maquet table with image intensifier control. Immediately after operation the reduction was assessed for rotational stability. If unstable, skeletal traction was used until quadriceps control had been regained, when active knee movement was started. These patients remained in traction for an average period of two weeks and were then mobilised in a cast-brace taking either partial weight or none at all. Patients with a stable reduction were similarly mobilised once they had regained quadriceps control.

At follow-up patients were asked to complete a questionnaire about pain, stiffness and overall satisfaction, and were examined with respect to gait, hip and knee movement, rotational deformity and limb length discrepancy. Radiographs taken before and after operation and after fracture union were reviewed.

Objective results were graded into four groups: normal, good, fair and poor. A normal result had no leg length discrepancy, no angulation and no rotatory deformity. Those graded good had one or more of the following: leg length discrepancy of 1 cm or less, angulation of 10° or less and a rotational deformity of 15° or less. A fair result had a leg length discrepancy of 2 cm or less, angulation of 15° or less and rotation of 25° or less. A poor result had a leg length discrepancy greater than

* The term "locking" is preferred to "interlocking".

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Table I. Severity and level of 50 comminuted fractures of the femoral shaft

Grade of comminution*	Number	Proximal	Mid-shaft	Distal
1	19	1	17	1
2	20	3	14	4
3	11	1	7	2
	50	5	38	7

* See text

Table II. Shortening and deformity after union related to grade of comminution

Grade of comminution	Leg length discrepancy			Lateral rotation			Angulation		
	1–2 *cm*	2–3 *cm*	>3 *cm*	<15°	16–25°	>25°	<10°	11–15°	>15°
1	0	0	0	2	1	1	2	0	0
2	3	2	0	3	3	1	11	0	1
3	3	1	2	2	0	0	3	0	0
	6	3	2	7	4	2	16	0	1

Table III. Clinical result related to grade of comminution

Grade of comminution	Satisfactory		Unsatisfactory	
	Normal	Good	Fair	Poor
1	13	4	1	1
2	4	10	3	2
3	4	3	2	3
	21	17	6	6

Table IV. Clinical result in 12 cases treated by supplementary cast-bracing

Grade of comminution	Normal	Good	Fair	Poor
1	0	1	0	0
2	2	3	1	1
3	0	0	2	2
	2	4	3	3

2 cm, angulation greater than 15° and rotational deformity of over 25°.

RESULTS

There were 37 men and 10 women; the average follow-up was 25 months. The grade and level of fracture are shown in Table I. Twenty-one patients had other major musculoskeletal injuries, eight having ipsilateral fractures of the tibial shaft. Complications away from the fracture site included two cases of deep venous thrombosis and three of pulmonary embolus, all successfully treated by anticoagulation. There were no cases of infection or non-union.

Subjective complaints. Twenty-four patients had mild pain in the hip, thigh or knee, and 12 reported some stiffness of the knee or hip but this did not correlate with a reduced range of movement. Five patients expressed dissatisfaction with the overall result: three of them had fair or poor results, the other two were dissatisfied because of aches and pains around the fracture site and at the hip.

Objective findings. Most patients had a full range of hip and knee movement. Two had lost 15° of hip flexion and one had lost 15° of hip abduction. Four patients lost 10° to 15° of knee flexion but three of these also had ipsilateral fractures of the tibia or patella. A clinical leg-length discrepancy of over 1 cm was found in 11 patients (Table II). No patient with a Grade 1 fracture had more than 1 cm of shortening.

Lateral rotation deformity was seen in 13 patients (Table II), but only six had over 15°. Two of these six were after Grade 1 fractures, four after Grade 2 injuries. There were none after Grade 3 injuries. There was some angulation at the fracture site in 17 patients (Table II); but in only one case did this exceed 10°.

Objective gradings are shown in Table III, which shows that a normal or good result was achieved in 76%. The 24% with unsatisfactory results included two patients with Grade 1 fractures, who were so graded because of lateral rotation deformity.

DISCUSSION

The introduction of the locking femoral nail for severe fractures of the femoral shaft has been greeted with enthusiasm. However, early results have been variable, and several technical difficulties have been reported (Johnson, Johnson and Parker 1984; Kempf, Grosse and

Beck 1985; Thoresen et al. 1985). In spite of the difficulty of managing such comminuted fractures, our results are comparable to those in early reports of locking nails (Kempf et al. 1985; Thoresen et al. 1985) and certainly better than those reported for conservatively treated patients (Hardy 1983; Johnson et al. 1984).

Using our fairly rigid grading system, 24% had an unsatisfactory outcome, but in the two Grade 1 fractures with lateral rotational deformity, this was almost certainly due to incorrect reduction at the time of nailing. The absence of cases with significant rotational deformity after Grade 3 fractures suggests that this deformity in Grade 2 fractures may also be due to incorrect operative reduction rather than failure to control rotation with the nail.

Shortening of more than 2 cm was seen in five fractures (two Grade 2 and three Grade 3). One of these patients had taken weight against advice, removing his cast brace. Another patient with a poor prognosis from severe head injuries and a Grade 3 fracture had been left with no postoperative traction or support and then made a good neurological recovery. Of 12 patients who had supplementary cast-bracing, those with Grade 2 fractures had a better outcome than those with Grade 3 injuries. All four of the latter who had supplementary cast bracing had unsatisfactory results. This suggests that in severely comminuted fractures, bracing may not improve stability (Table IV).

Our functional results compared favourably with other reports of series of closed intramedullary nailing (Küntscher 1968; Rothwell 1982; Winquist et al. 1984), most of our cases obtaining a full range of movement at both the hip and knee, despite ipsilateral tibial fractures in eight of them. Thoresen et al. (1985) reported the early results of closed locked femoral nailing in 48 femoral fractures, of which approximately 50% were comminuted. A satisfactory result was achieved in only 60% as against 76% in our series.

Closed locked nailing is a demanding technique, requiring a longer operation, increased radiation exposure, and an additional operation to remove the screws before weight-bearing. It is also more expensive. Kempf et al. (1985) reported the treatment of 49 severely comminuted femoral fractures by closed locked nailing. Sixteen patients had a total of 41 complications. Locked nails certainly offer increased stability, but, as with all new techniques, enthusiasm needs to be balanced against both real and potential complications, and also against the success of other methods of treatment.

We have shown that satisfactory results can be obtained with Grade 1 and Grade 2 comminution of femoral fractures by the technique we describe, provided that great care is taken to avoid malrotation of the limb at the time of operation. The patients with more severely comminuted fractures of Grade 3, with no cortical continuity, had a less reliable result, 42% being unsatisfactory. In our opinion this grade of fracture merits treatment by locked femoral nailing.

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