THE TREATMENT OF FEMORAL FRACTURES BY CAST-BRACE AND EARLY WALKING
A REVIEW OF SEVENTY-NINE PATIENTS
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Seventy-nine cases of fracture of the femoral shaft treated by cast-brace and early walking have been reviewed. Discrepancy in femoral length was assessed by scanogram. The cases were analysed to relate the incidence of shortening greater than 2 centimetres to the type and site of the fracture, and the time which elapsed from injury until the cast-brace was applied. Such shortening was encountered most frequently when the cast-brace was applied within the first two weeks from injury or after six weeks and in those patients with comminuted fractures of the middle third of the femoral shaft.

The use of a cast-brace and early walking as a method of treatment for fractures of the femoral shaft is now widely accepted. That shortening of clinical significance need not occur when the cast-brace is applied early has been shown (Connolly, Dehne and LaFollette 1973; Hardy and Nicholson 1976) but the earliest time at which a cast-brace can be safely applied is still a matter of debate (Sarmiento 1972; Connolly et al. 1973; Wardlaw 1977; Hardy 1979). Some surgeons advocate that when cast-braces are applied within the first six weeks, provision for intermittent traction should be made (Lesin, Mooney and Ashby 1977). The aim of this study therefore was to analyse the incidence of shortening in relation to the fracture pattern and to the time of the application of the cast-brace.

MATERIAL AND METHODS
Ninety-eight fractures of the femoral shaft in adolescent and adult patients were treated by a cast-brace as a primary method of treatment at Middlemore Hospital between July 1974 and January 1977. Of these, seventy-nine presented for physical examination and scanogram in the latter half of 1977. Nineteen patients could either not be located or could not attend for review. Most of the fractures of the femoral shaft suitable for internal fixation with an intramedullary nail over the period under review had been treated in this manner; those treated by cast-brace were the fractures that were unsuitable for internal fixation.

The application of most of the cast-braces was supervised by one of us (J.W.) and the technique was similar to that described previously (Hardy and Nicholson 1976; Hardy 1979). However, a pelvic band connected to the thigh cast by a hip hinge was relatively infrequently used. Neither the traction weight nor the shortening before application of the cast-braces could be accurately analysed. Many of the cast-braces were applied with the hip in the neutral position, but in many cases no note was made of the position of the hip at the time of application.

The final clinical assessment of all patients was performed by one of us (A.E.H.). The patients were weighed and measured, their age and sex recorded together with any previous or concomitant injury or disease which could have accounted for shortening of the lower limb. The following details of treatment were noted: the time from injury until application and removal of the cast-brace, and the duration of hospitalisation; the site, type and open or closed nature of each fracture; the addition, or not, of a pelvic band; the need to wedge or replace the cast-brace, the occurrence of pressure sores and the incidence of refracture. The shortening was assessed clinically, the movement of the knee was measured with a goniometer and the final alignment of the bone was recorded. An attempt was made to assess the functional disability arising from the shortening.

The femoral scanograms were all performed by one of us (P.W.). The technique involved fluoroscopic determination of end points, using a narrow slit beam.

RESULTS
There were fifty-four males and twenty-five females. Fifteen patients were over fifty years of age. Forty-four
patients were less than twenty years of age; in ten of these, epiphysial closure was not complete but growth had virtually ceased at the time of injury (Fig. 1). Sixteen of the injuries had been open and there had been associated major injuries in thirty-five cases. Sixty of the fractures had resulted from motor vehicle accidents. Table I shows the site and type of the fractures. The majority of the forty-eight transverse or short oblique fractures not involving the knee were near the junction of the middle and distal thirds of the femoral shaft. A pelvic band and hip hinge were used on fourteen occasions.

Table I. The site and type of the seventy-nine fractures.

<table>
<thead>
<tr>
<th>Category</th>
<th>Site and type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Proximal third</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Transverse or short oblique fracture of the middle third</td>
<td>21</td>
</tr>
<tr>
<td>C</td>
<td>Long oblique fracture of the middle third</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>Comminuted fracture of the middle third</td>
<td>14</td>
</tr>
<tr>
<td>E</td>
<td>Transverse or short oblique fracture of the distal third, not involving the knee</td>
<td>27</td>
</tr>
<tr>
<td>F</td>
<td>Distal third, involving the knee</td>
<td>9</td>
</tr>
<tr>
<td>G</td>
<td>Whole shaft</td>
<td>2</td>
</tr>
</tbody>
</table>

shortening could be reasonably attributed to the fracture was 1.63 centimetres with a standard deviation of 0.93 centimetre. Figure 4 shows the incidence of shortening greater than 2 centimetres related to the pattern and level of fracture; those fifteen cases with shortening attributable to other causes are excluded. The highest incidence was in comminuted fractures of the middle third (64 per cent), many of which were characterised by severe comminution or bone loss and severe damage to the soft tissue. When shortening greater than 2 centimetres was related to the interval between the injury and the application of the cast-brace for the sixty-four cases with no other cause for shortening (Fig. 5), the incidence was 75 per cent of patients treated in the first two weeks; 20 per cent in the third week; 31 per cent in the fourth week; 27 per cent in the fifth week; 25

![Graph](https://example.com/graph1.png)

**Fig. 2**

Days from injury until the application of the cast-brace.

All cases.

Six patients were left with flexion contractures of the knee: the contracture was between 0 and 5 degrees in four and between 6 and 10 degrees in two. Seven patients were left with less than 90 degrees of flexion and of these five had fractures of the distal third (only one fracture entering the knee joint), five had the cast-brace applied more than one month after the injury and three were women over sixty. No patient had a valgus or varus deformity greater than 20 degrees. Deformity between 16 and 20 degrees occurred in four patients, between 11 and 15 degrees in nine, between 6 and 10 degrees in twenty-nine, while thirty-seven patients had less than 5 degrees of malalignment.

Figure 2 illustrates the interval between the fracture and the application of the cast-brace. Thirty-six of the seventy-nine cast-braces (46 per cent) were applied within the first twenty-eight days.

Fifteen patients had previous or concomitant injury or disease judged to account for a discrepancy of greater than 1 centimetre in the lengths of the lower limbs.

Figure 3 shows the range of femoral shortening assessed by scanogram. The mean femoral shortening for the sixty-four patients in whom all lower limb
per cent in the sixth week; and 35 per cent after the sixth week.

Fifty-four patients claimed to be aware of some shortening. Twenty-two had at some stage worn a heel raise. Fifteen patients considered they were severely handicapped as a result of shortening, but several of them had sustained other injuries. Some of those claiming severe disability were young adults who felt their ability to run and play competitive sport had been impaired by the shortening.

Comparing results of shortening measured clinically and by scanogram for the sixty-four cases in whom shortening could not be attributed to any other cause, there was a discrepancy greater than 1 centimetre in fourteen patients (25 per cent) and greater than 2 centimetres in three.

Thirty of the forty-four patients (68 per cent) who had a fractured femur as an isolated injury were hospitalised for less than six weeks (Fig. 6). These forty-four patients included six over fifty-seven years of age for whom the length of hospital stay was governed by social factors. The time of hospitalisation included any short readmission necessary when the cast-brace was altered or removed.
Four femora refractured after removal of the cast-brace, all within the first month of removal and none displaced significantly. In three cases the cast-brace had been applied within the first month after injury. Two of the cast-braces were removed after fourteen weeks, the others at sixteen and twenty weeks. One of the refractures occurred in a man weighing 117 kilograms with severe ipsilateral hip disease.

Pressure areas were encountered under the plaster on four occasions and nine cast-braces were wedged or replaced during the period of treatment.

DISCUSSION

The highest incidence of femoral shortening in the sixty-four patients who had no other cause for shortening occurred in those who had a cast-brace applied within the first two weeks after injury: three of the four patients in this group were left with shortening of more than 2 centimetres. The lowest incidence of shortening greater than 2 centimetres was noted among the fifteen patients who had the cast-braces applied in the third week after injury. The second highest incidence was in those who had a cast-brace applied six weeks or more from the time of injury. Thus, it would appear that further shortening is not prevented by waiting until six weeks.

The numbers in each group were too small to show statistically significant differences, but this evidence would seem to substantiate the suggestion (Hardy 1979) that the third week after injury may be the ideal time to apply a cast-brace in patients who are fit to start walking at this time. It was suggested in this previous report that haematoma and reactionary swelling had largely resolved by the third week and that if muscle bulk was maintained by maximum possible use, the bulk of the soft tissues of the thigh need not decrease further and that the hydraulic effect thus maintained would prevent further significant shortening.

Because of the selected nature of this group and the exclusion of fractures suitable for intramedullary fixation, conclusions of only limited value can be drawn by relating the site and type of the fracture to the resultant shortening. The comminuted fractures of the middle third of the shaft had the highest incidence of shortening greater than 2 centimetres but this group included the most grievous injuries. Most of the transverse or short oblique fractures of the middle and distal thirds occurred about the junction of these two areas and no valid distinction between them could be drawn.

In a society where substantial lump-sum compensation payments for disability after a fracture in the lower limb are made on the basis of shortening, it is recommended that scanograms should be done routinely. It is suggested that an error of more than 1 centimetre in the clinical assessment of leg lengths in as many as 25 per cent of cases is not unusual.

Mean shortening of 1.6 centimetres and a 31 per cent rate of shortening greater than 2 centimetres among the sixty-four patients in whom no other cause for shortening could be identified, emphasises the need to take all possible steps to avoid this complication. The incidence of shortening greater than 1 centimetre noted in 100 fit soldiers studied by Rush and Steiner (1946) was only 4 per cent, whereas the incidence of shortening greater than 2 centimetres among those whose cast-brace was not applied until six weeks after injury was 35 per cent; this suggests that these patients stayed in bed until the fracture was healed, the rate of shortening would not have been decreased. It is accepted that delayed union is likely to result if a fractured femur is held in distraction for prolonged periods, but it is suggested that the degree of shortening may be reduced without compromising fracture healing if the fracture is held to length or distraction until the third week after injury and a cast-brace incorporating a hinge to hold the hip in about 20 degrees of abduction is then applied while heavy skeletal traction is maintained. The cast should be made with elastic bandages impregnated with plaster of Paris so as to fit the soft tissues of the thigh as closely as possible.

REFERENCES


