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THE TREATMENT OF FEMORAL SHAFT FRACTURES USING A CAST BRACE

by

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The current trend in the non-operative treatment of femoral shaft fractures is away from prolonged traction and towards early ambulation. The cast brace treatment involves external support to the limb in such a way that maximal use can occur during healing. Early ambulation, while a fracture is healing, provides an environment for complete bone healing as well as allowing joint movement so that the function of the limb is as near normal as possible at the completion of treatment. It is widely accepted that early ambulation of tibial fractures in plaster casts leads to union without significant complications [1 2 3]

The conventional method of treatment of femoral shaft fractures involves the use of skeletal traction in a Thomas's splint for a prolonged period. In the majority of cases this method is very satisfactory but it has certain inherent disadvantages, the major one being the long period of immobilisation required and therefore the greater difficulty in subsequent recovery of full function of the limb. The pressure of long term bed occupancy often places great strain on a hospital's resources particularly if the patent is treated in a general surgical unit.

Küntscher[4] in 1958 felt that external fixation of femoral shaft fractures was not satisfactory since complete immobilisation could not be achieved. His intramedullary nail technique has been widely accepted but has the disadvantage of introducing potential infection into a closed fracture. It is also inappropriate in distal or comminuted fractures.

Adair[5] has used a long leg quadrilateral plaster with good effect. However, in this method the knee is encased in plaster and so knee flexion returns slowly. Mooney[6] reported much better knee flexion using a cast brace instead of a traditional plaster of Paris spica and described the use of the cast brace in the treatment of distal femoral shaft fractures in 150 cases. He produced good healing in all cases with no cases of non-union or refracture in a mean healing time of 14.5 weeks. They applied the cast brace after seven weeks in traction. Connolly and King [7 8] found that the cast brace could be applied earlier at three to four weeks with no deterioration in results. Their incidence of non-union of one per cent is less than that occurring with the traditional method of Thomas's splint and traction. More recently it has been shown that the third week after injury is the best time to apply the cast brace in order to minimise ultimate shortening[9]. Brown and Preston[1] found satisfactory results in 68 out of 76 cases of fractures mainly in the middle and distal shaft. They felt that these results were sufficiently good to encourage the use of this treatment. Wardlaw[10] published a series in which 29 out of 31 (94 per cent) had a satisfactory (or

better) result compared to 30 out of 38 (79 per cent) treated by traction alone. He concluded that the cast brace method is a great advance in conservative treatment.

MATERIALS AND METHODS

Twelve cases of femoral shaft fractures have been treated with a cast brace in the Mater Hospital, Belfast between September 1978 and November 1979. During this time six other patients were treated for fractures in similar sites, one in traction until the fracture was united and five by internal fixation either as early definitive treatment or for delayed union. The details of the patients are given in

TABLE 1

Details of Patients and Treatment

	Age	*Sex*	*Fracture*	*Traction Time (wks)*	*Cast Brace Time (wks)*	*Hospital Time (wks)*	*Complication*
RA	16	F	L mid 1/3	7	8	8	—
EA	73	F	R mid 1/3	7	8	10	—
PB	16	M	R mid 1/3	5	10	7	—
WC	57	M	L low 1/3	9	6	13	f–L humerus f–L metatarsals
TC	20	M	L mid 1/3	8	8	9	DVT — PE
AG	26	M	L mid 1/3	6	12	12	Delayed union
FG	25	M	R mid 1/3*	8	15	9	Delayed union
DM	20	M	R mid 1/3	7+7	3 days	16	Refracture
AMcN	12	F	L mid 1/3	7	10	8	—
WS	42	M	L mid 1/3*	6	9	8	DVT
ER	24	F	L mid 1/3	6	10	7	—
GT	14	M	R mid 1/3	5	9	6	—

* Compound. DVT — Deep venous thrombosis. PE — Pulmonary embolus.

Table 1 and it can be seen that most ofthe fractures were closed injuries involving the mid shaft (Table 2). The anatomical definition of site was classified according to Dencker [11]. Two of the cases were compound, one as a result of a fall and one due to a gunshot injury.

TABLE 2

Anatomical Site of Fractures

Upper third	=	0
Middle third	=	9
Lower third	=	3

All patients were reviewed finally at times ranging from four to 29 months after the initial injury. Attempts were made to recall patients; the one last reviewed four months after injury had emigrated. At this time, hip, knee and ankle movements and stability were assessed; any shortening of the affected leg measured and wasting of quadriceps and calf muscles determined. The final position of the fracture was determined clinically by measuring intercondylar and intermalleolar distances and previous X-rays were reviewed.

CAST BRACE TECHNIQUE

The cast brace should be applied between three and eight weeks after the fracture has occurred. During this period conventional treatment by traction (skin or skeletal) with a Thomas's splint is applied. This delay allows for 'stickiness' to occur at the fracture site and so increases the stability of the limb when ambulation is started. It can be successfully used in femoral shaft fractures in the middle and lower thirds. It is particularly useful in comminuted fractures unsuitable for intramedullary nailing. Connolly, Dehne[8] felt that transverse fractures of the middle and upper thirds were better treated by internal fixation. The cast brace itself entails a quadrilateral plaster around the thigh hinged at knee joint level to a short leg plaster.

Application

Prior to application mild sedation is required, usually Diazepam 10 mg orally suffices. The traction apparatus is dismantled and the leg is gently held by an assistant. A special knitted cast sock is then placed from foot to groin and a stockinette bandage around the knee.

The next stage is the application of the thigh brace[10]. This part is not expected to provide ischial weight bearing though proximal total contact support of the thigh is essential. The plaster is applied and then shaped using an appropriate sized quadrilateral box. The box is open-ended and shaped at the brim and should be applied as high up the thigh as possible. The quadrilateral shape is essential to control rotation. This shape is extremely effective and it has been shown[7] that there is less rotation in the cast brace than in conventional traction apparatus. A below knee cast is then applied with the foot plantigrade..

Finally the hinge joints are positioned at the knee. These are dicentric hinges placed in parallel at the knee axis which is located two centimetres posterior to the mid line of the limb in the sagittal plane and at the level of the adductor tubercle. An alignment jig is used to hold the hinges parallel and jubilee clips are used to secure the arms of the hinges to the thigh and calf cylinders while the range of movement is tested. The arms of the hinges are malleable and so can easily be adjusted to suit any case. It is important that the hinges clear the femoral condyles by at least one centimetre. When the hinges are in the correct position they are fixed to the rest of the apparatus by plaster.

The patient is returned to the ward and the position of the fracture checked by X-ray. He is rested in bed for two days to allow the plaster to dry and then

gets up to walk. A boot is supplied for the foot and the patient is usually able to leave hospital one week after application of the cast brace.

RESULTS

Traction Time

It can be seen (Table 3) that traction time is reduced using this technique, a mean time of 8.5 weeks for all cases. Only one patient (DM), as a result of a refracture, had a traction time of greater than nine weeks.

Hospital Time

This was reduced to an average of 9.5 weeks. Three patients had a longer than average stay due to complications. One suffered a refracture, one had delayed union and a third had associated fractures of the humerus and metatarsals which hindered his mobilisation.

TABLE 3

Treatment Times

Average traction time	(weeks)	8.5 (range 5-14)
Average hospital time	(weeks)	9.5 (range 6-16)
Average treatment time	(weeks)	17.5

Fracture Healing

All patients were treated in the same way, that is, appropriate traction followed by application of the cast brace at a suitable time following injury. Three of the patients encountered problems in fracture healing.

(i) DM suffered a mid shaft fracture as a result of a road traffic accident. He seemed to have a healing fracture and after seven weeks a cast brace was applied. Three days later after vigorous straight leg-raising he complained of pain and X-ray revealed a refracture. After a further seven weeks in traction his fracture healed soundly.

(ii) AG suffered a comminuted mid shaft fracture of his left femur as a result of a road traffic accident. A cast brace was applied after six weeks. He had a varus angulation in the brace and after its removal complained of pain. A polypropylene brace was applied and the fracture healed.

(iii) FG suffered a compound mid shaft fracture of his right femur following a fall from a roof. He had a cast brace applied after eight weeks. On removal he complained of pain but no movement of the fracture was noted. His pain resolved after a further four weeks in the cast brace.

TABLE 4

Final Results

Time since accident	*(mths)*	*Shortening (cms)*	*Quadriceps wasting (cm)*	*Knee Movement Flex.*	*Ext.*	*Fracture Position*
RA	17	0	1.0	Full	Full	Good
EA	29	1.0	0	65°	Full	Valgus less than 10°
PB	4	1.0	0	120°	Full	Good
WC	19	0	1.0	110°	Full	Good
AG	24	3.0	1.0	120°	Full	Varus 18°
FG	21	1.0	0	Full	Full	Varus less than 10°
DM	23	0	0	125°	Full	Good
AMcN	7	1.0	0	Full	Full	Good
WS	10	0	1.0	Full	Full	Good
ER	7	<1.0	0	Full	Full	Good
GT	7	<1.0	0	Full	Full	Good
TC	21	0	0	120°	Full	Good

Hip and Knee Movement

All patients had a full range of hip movement at final review. Knee movements were also recorded at this time (Table 4). All patients had full extension at the knee and all but one had flexion greater than 110°. The exception (EA) was an elderly lady with a supracondylar fracture. Flexion was said to be full when it equalled that of the other normal knee. One patient (WC) demonstrated minimal colleteral ligament laxity.

Shortening

Only one patient suffered shortening greater than one centimetre. AG had three centimetres shortening as a result of his varus deformity.

Quadriceps Wasting

Four patients demonstrated some degree of wasting but none greater than one centimetre. Only one patient had calf wasting (0.5 cm) though one (TC) did have an increase of 3 centimetres as a result of his deep venous thrombosis.

Overall Results

The late results were grouped using the Dencker classification[11] which has four categories — excellent or good; satisfactory; poor; very poor. Ten of the patients

were in the good or excellent group (83 per cent) and two were in the satisfactory group (17 per cent). No patients were in the poor or very poor categories. The patients in the satisfactory group were EA with reduced knee flexion and AG with a significant varus deformity. No patients complained of pain in the affected leg at final review.

DISCUSSION

The proponents of fracture bracing cite three main advantages of this form of treatment, quicker fracture healing, earlier recovery of knee flexion and earlier discharge from hospital. Patients in the Mater Hospital are nursed in general surgical wards and therefore carry a higher risk of infection after surgery than those in a fracture unit. Mainly for this reason primary internal fixation of femoral shaft fractures in the middle and distal thirds is only occasionally undertaken. Therefore, to ease the considerable pressure on beds the cast brace technique was introduced. It is in fact possible to make a plastic brace but this requires specialised workshops and an extra delay of one week for construction and is very much more expensive. Using plaster of Paris the surgeon can apply the brace in 45 minutes and have the patient walking in two days. In none of our cases was there any structural problem with the brace and the patients were extremely happy with the treatment.

Whether or not the fractures in this series healed more quickly than they would have done with prolonged traction is difficult to know. One is reluctant to test the fracture too soon when the patient attends for follow-up, so usually the cast braces are not removed before 14 weeks after the injury. If the fractures healed any earlier we would not know.

Ultimate recovery of knee bending is easier to assess and was good in all but one of our patients. Eleven (92 per cent) had greater than 90° of knee flexion, and all had full extension. This compares favourably with Dencker's series where 12 per cent of patients with closed fractures of the femoral shaft had less than 90° of knee flexion, and Nichols' series in which 33 per cent had less than 90° of knee flexion in all types of closed femoral shaft fractures. An interesting feature of our patients was the fact that most of them were young and this probably aided the recovery of function.

Traction time and overall hospital time were both significantly reduced. The average traction time with our patients was 8.5 weeks but it is felt by others[7 8 9] that the cast brace can be safely applied much earlier than this. The shorter hospital stay (9.5 weeks) is a marked reduction as Wardlaw[10] found that conventional treatment needed an average hospital time of 15 weeks. This reduction is an obvious economic benefit and relieves the pressure on bed occupancy.

SUMMARY

In just over one year 12 patients with femoral shaft fractures were treated with a cast brace. Only one failure occurred requiring substitution of alternative

treatment and leading to a good result. We feel that fractures in the mid and distal shaft can be satisfactorily treated by plaster of Paris cast brace and would recommend this method with its advantages of shorter hospital stay and earlier ambulation.

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