DOMICILIARY GALLOWS TRACTION FOR 
FEMORAL SHAFT FRACTURES IN YOUNG CHILDREN 

FEASIBILITY, SAFETY AND ADVANTAGES

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Over 15 years (1967 to 1982) 140 uncomplicated femoral shaft fractures in children under four years of age were successfully treated using Bryant's traction. Forty of these children were treated after the introduction of the domiciliary management policy in 1976; 13 children were managed at hospital and 27 were managed at home. No significant complications occurred. The advantages to the family, and the safety and economy of domiciliary management lead us to recommend its adoption in favourable cases. Treatment at home relies on an efficient and experienced home nursing service. Possible complications of the injury and treatment with recommendations to prevent them are discussed.

Fracture of the femoral shaft is a common injury in childhood. The rapid healing and subsequent remodelling in this age group means that permanent deformity is rare. Management requires correction of the deformity, ideally by a simple method of immobilisation which is free from complications. Forms of treatment include the use of simple skin traction, a Thomas' splint with fixed or sliding skin traction, a Liston's splint, a hip spica, skeletal traction, internal fixation and Bryant's traction. For the past 20 years in the Edinburgh area fractured femora in children up to the age of four have been treated by a modification of the vertical-extension method first described by Bryant in 1884. The development of a paediatric home nursing service in 1972 led us to introduce the policy of domiciliary management.

The present study examines the efficacy and safety of the method of treatment and the practicality of domiciliary management. A specific search of our records was performed to detect the occurrence of Volkman's ischaemic contracture.

METHODS
The medical records of all children under the age of four years who presented with a fractured femur in the period 1967 to 1982 were examined. Information on complications and outcome of treatment was collected. After the introduction of the domiciliary management policy (1976) records were examined and a comparison was made between patients managed at home and in hospital. The following information was collected for each patient: age, associated injury (especially if non-accidental), time in hospital, duration of traction, visits by the home nursing service, visits to the clinic, complications, end results and difficulties in management.

Management policy
Following adequate analgesia (intramuscular diamorphine) skin traction is applied to both legs (Pollen 1973). Important points concerning application of skin traction are: the presence of felt pads to protect the malleoli, application of Benzoin Compound Spray for skin protection and enhancement of adhesion, small transverse cuts along the edges of the extension strapping to allow it to conform to the contours of the limb, absence of wrinkles or folds in the strapping and avoidance of over-tight bandaging. The procedure is performed by a senior member of the nursing staff or a doctor. The child is suspended in the manner described by Bryant from a frame fitted with handles so as to make it easily portable (Stryker Corporation, 420 Alcott Street, Kalamazoo, Michigan 49001). Traction is adjusted so that the child's buttocks are just clear of the bed surface. After application of skin traction attention is paid to circulation, sensation and the presence of pain—particularly in the calf muscles on passive stretching. Radiographs are taken after 12 hours to ensure satisfactory alignment of the fracture.

From 1976 each case has been assessed for suitability for management at home. This assessment involves an interview with the parents by medical staff, ward nursing staff and a representative of the paediatric home nursing service. The circumstances of the injury are examined closely to exclude any question of it being non-accidental.
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and the child's home is visited by the home nursing representative. Attention is paid to the stability and size of the family, the ability of at least one parent to provide constant care and the suitability of accommodation. If home management is considered appropriate the family practitioner is informed and the child sent home after a minimal stay in hospital of 48 hours.

The parents are shown how to see to the comfort of the child, and to note the size and shape of the injured leg, the colour and sensation in both feet and the presence or absence of pain in the calf on passive dorsiflexion of the affected foot. They are reminded to check each day that the buttocks remain elevated and the bandaging is undisturbed. They are also given clear, written instructions as to whom to contact should any problem arise. In addition to the normal channels for seeking medical advice, parents are encouraged to make direct contact with the supervising surgeons should they consider it necessary. The paediatric home nursing sister visits the home within 24 hours of discharge and at least twice a week thereafter. Visits to the hospital clinic are made on two occasions during the period of traction. The children continue to attend the clinic until full mobility is achieved.

RESULTS

Safety and efficacy of gallows traction. No case of ischaemic injury, significant leg length deformity or rotational deformity was detected in 100 consecutive patients with fractured femora managed as described above.

Safety, efficacy and feasibility of domiciliary gallows traction. After the introduction of the domiciliary management policy in 1976, 40 children have been treated by gallows traction and, of these, 27 were considered suitable for management at home. The mean age and duration of traction were similar in both groups (home management, 2.4 years and 25.2 days; hospital management, 1.8 years and 19.5 days respectively). Children who were subsequently managed at home spent a mean of 4.5 days in hospital compared with 24 days in those whose management was completed in hospital. The mean number of clinic visits was 3.7 in patients managed at home, compared with 1.7 in those managed in hospital. As with the first 100 patients presented above, there was no serious complication of either the fracture or the treatment in the second group. Minor skin problems developed in three patients managed at home and one managed in hospital. None of these complications interfered with the treatment or the eventual outcome. The home nursing service found it necessary to reapply the bandages on a number of occasions.

DISCUSSION

The remarkable capacity for healing and remodelling of fractures of long bones in children is well known. While this does not condone complacency in management it should be taken into account when deciding what degree of intervention is justifiable in treatment. The prime objectives of treatment are a good end result with absence of complications and minimal disturbance to both patient and those involved in management. The potential complications of fractured femur include non-union, malunion and Volkmann's ischaemic injury. (However, non-union is extremely rare in childhood fractures and need not be considered further.)

Malunion

Three types of malunion occur: angulation, rotational deformity and longitudinal deformity ("overgrowth").

Angulation deformity. This should be prevented by any of the methods of treatment in common use which provide satisfactory immobilisation.

Rotational deformity. This is a risk but the clinical significance is open to question. If the complication is regarded as a problem then the only satisfactory way of preventing it is to manage the child with the hips and knees flexed to 90 degrees. This may be achieved by a hip spica or more accurately using the Weber-Bock table and skeletal traction (Webber 1963). A number of studies have demonstrated rotational deformity after a fractured femur that had been treated by horizontal or vertical traction (Best, Verhage and Beertema 1972; Yano and Sawada 1975; Verbeek, Bender and Sawidis 1976). A recently reported comprehensive survey of patients studied up to 32 years after the injury concludes that although the early incidence of deformity is high, spontaneous correction occurs to a considerable extent and long-term effects have yet to be demonstrated. The abandoning of treatment by conventional methods in favour of Weber's technique is unwarranted (Brouwer, Molenaar and van Linge 1981).

Longitudinal deformity. This is a reflection of the overgrowth which is a physiological process associated with increased vascularity of the healing bone (Blount 1955). An overgrowth of 0.5 to 1.5 centimetres may be expected (Reynolds 1981; Shapiro 1981) and appears to be related to the fracture itself and not to the method of treatment. This phenomenon, if considered a problem, can be compensated for by allowing the fracture to heal with an appropriate overlap of the fragments.

Volkmann's ischaemia

This condition results from an acute injury of muscle and nerve and causes pain which is out of all proportion to the severity of the injury, or in a site distant from it, and which is aggravated by passive stretching of the affected muscle and associated with distal sensory and motor changes in the limb. It has been reported following treatment of fractured femur by Bryant's traction in children under the age of four (Miller, Markin and Grossman 1952; Nicholson, Foster and Heath 1955; Mubarak and Carroll 1979). The predisposing factors
are elevation of the limb with resultant reduction in intravascular hydrostatic pressure, hypovolaemic shock, tight bandaging, hyperextension of the knee and the constrictive response of blood vessels to stretching. We believe that this disastrous complication is preventable by careful application of the traction system and constant observation to allow early detection of the warning signs. We agree with Nicholson et al. (1955) that the treatment should be used with caution in children between two and fours years of age and that it is dangerous in older children. We found no evidence of this complication in any of our 140 consecutive cases over the past 15 years. Although this study was retrospective, our search included all three children's hospitals in the Edinburgh area and since the disability resulting from the complication is so severe we feel it is unlikely to have escaped detection.

The main advantage of Bryant's traction is its simplicity. Other methods using skin traction either provide less satisfactory immobilisation of the fracture or require the use of external splints which are unwieldy and difficult to manage in the small child. A hip spica is a reasonable alternative, but requires general anaesthesia for its application, may be complicated by the development of pressure sores and makes satisfactory hygiene difficult to maintain because of soiling. Skeletal traction and the rarely employed internal fixation have a small but significant risk of infective complications and again require general anaesthesia. The portability of the child in gallow's traction lends itself to management at home. In common with previous reports (Partridge 1964; Powell 1972; Axton et al. 1977) we are encouraged by our experience with this policy. Most parents are willing to undertake the active role in the care of their injured child that home management entails, provided that domestic circumstances permit it. The avoidance of prolonged separation of a child from its parents is an important benefit. The expenditure for a patient managed entirely in hospital was £3900 compared with £760 for those managed at home. Figures for the cost of an average of seven visits by the home nursing service are not available, but we believe that even taking this into account a substantial saving is achieved by the domiciliary management policy.

CONCLUSIONS

A satisfactory outcome resulted from the treatment of 140 children with fractured femur by Bryant's traction. Twenty-seven of these children were managed at home with equally good results. We submit that Bryant's traction is the treatment of choice for femoral fractures in this age group and that, provided appropriate care is taken, it may be safely continued with the child at home, thus keeping the family together and considerably reducing the cost of treatment.

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REFERENCES