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ORIGINAL ARTICLE

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Femoral shaft fractures in children – a comparison of treatment

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Abstract Between April 1986 and March 1997, 83 femoral-shaft fractures in children 4–8 years old were treated at Christian Medical College and Hospital, Ludhiana, India. Among 35 patients with a minimum of 12 months follow-up, 14 were treated with Hamilton-Russell (HR) skin traction and 14 with proximal tibial skeletal traction. The group treated with HR traction had a shorter duration of (a) hospital stay (average 16.8 days versus 29.7 days for skeletal traction, p=0.02), (b) time to fracture consolidation (average 8.8 weeks versus 10.8 weeks for skeletal traction, p=0.04), and (c) return to normal activities (average 12.2 weeks versus 17.2 weeks for skeletal traction, p=0.03). At final follow-up (minimum 1 year), there were no significant differences in functional outcomes. Conservative management is still a gold standard for treatment of closed femoral shaft fractures in children 4–8 years of age. There appears to be no advantage to skeletal traction over skin traction in this age group.

Résumé Entre avril 1986 et mars 1997, 83 fractures diaphysaires fémorales chez des enfants âgés de 4–8 ans ont été traitées dans notre institution. Parmi 35 malades avec au minimum 12 mois de suivi, 14 ont été traités avec une traction cutanée (Hamilton-Russell), et 14 avec une traction trans-tibiale. Le groupe traité avec traction cutanée avait une plus courte durée de : (a) séjour à l'hôpital (moyenne 16.8 jours contre 29.7 jours pour traction osseuse, p=0.02), (b) temps de consolidation de la fracture (moyenne 8.8 semaines contre 10.8 semaines pour traction osseuse, p=0.04), et (c) retour aux activités normales (moyenne 12.2 semaines, contre 17.2 semaines pour traction osseuse, p=0.03). Àu dernier recul (1 année minimum) il n'y avait pas de différence notable dans les résultats fonctionnels. La gestion conservatrice est encore une référence pour le traitement des fractures diaphysaires fémorales fermées chez les enfants de 4–8 ans. Il n'y a pas d'avantage de la traction osseuse sur la traction cutanée dans cette tranche d'âge.

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Introduction

All over the world, the treatment of femoral shaft fractures in children remains a controversial issue. Although there is a plethora of literature on this subject, comparison between series is often difficult because they address different age groups, types of fractures, treatment modalities, and outcomes. Prospective studies looking at the long-term outcomes of different treatment options between comparable groups are few.

The biology of fracture healing in children is quite different than in the adult. The potential for remodeling and overgrowth are unique properties of growing long bones, particularly in children 4–7 years of age, although the latter might not be quite as significant as once thought [4]. The remodeling potential is the cornerstone for the time-honored success of conservative treatment: acceptable alignment, although not necessarily anatomical, will usually lead to healing and good functional outcome. Complications such as malunion, lengthening, shortening, pressure sores, and pin-tract infections are not uncommon but only relatively rarely lead to long-term functional impairment. The success of surgical treatment of femoral shaft fractures in adults, combined with an increased awareness of cost-effectiveness and cost-benefit issues, recently has lead pediatric orthopedists in high-income countries in a more aggressive surgical direction. Early enthusiasm for internal or external fixation has been only slightly tempered by a greater recognition of their associated complications. In lower-income countries where orthopedic resources, including implants, are not as readily available, conservative treat-

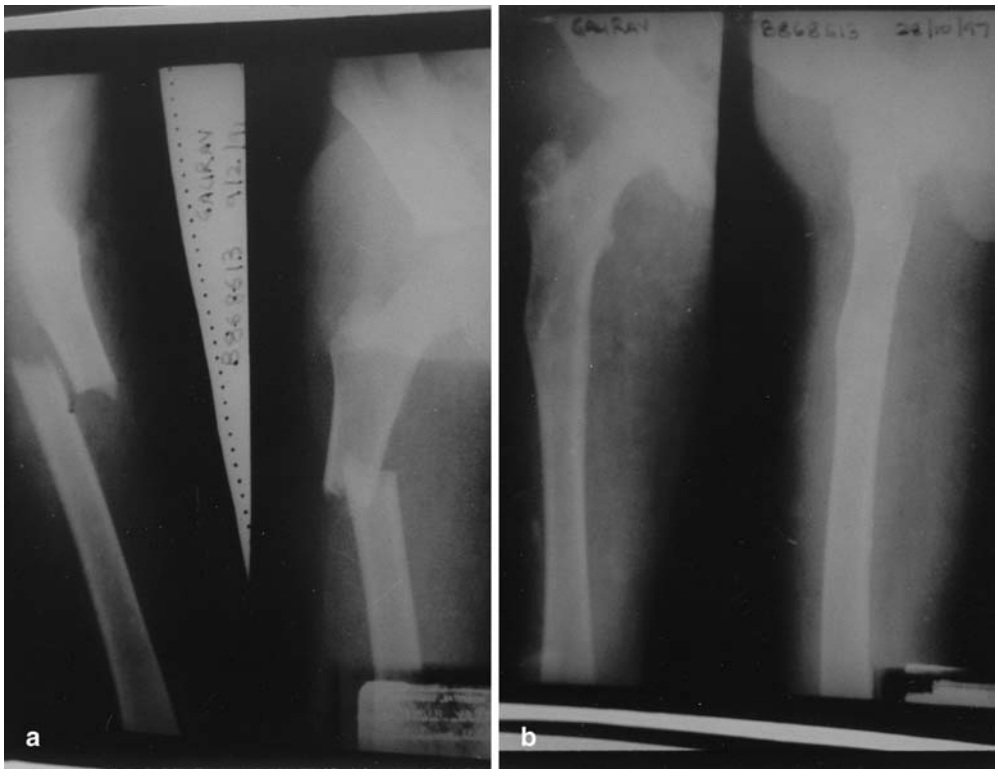

Fig. 1 Seven-year-old male with fractured left femur treated with proximal tibial pin traction (PTS): **a** at the time of presentation; **b** at 6-year follow-up

ment remains the golden standard. Even then, options are many, and there remain many unanswered questions for similar fractures in comparable age groups.

We are presenting a retrospective study of 28 children aged 4–8 years old treated over a 10-year period, with a minimum of 12 months follow-up – half of whom were treated with proximal tibial skeletal (PTS) traction and the other half with Hamilton-Russell (HR) traction.

Material and methods

Between April 1986 and March 1997, 152 femoral-shaft fractures in 143 patients were treated at Christian Medical College and Hospital, Ludhiana, India. Eighty-three of these fractures were in the age group 4–8 years, and 35 had a minimum clinical and radiological follow-up of 12 months. Twenty-eight patients received initial treatment but did not return for follow up at fracture union, while the other 20 had follow-up of less than 12 months and were excluded from analysis. Of the remaining 35 fractures, 14 were treated with PTS traction and 14 with HR skin traction. Seven were treated by other means, such as longitudinal skin traction, external fixation, and Thomas splint, and were excluded from the analysis. Treatment allocation was determined by the treating surgeon's preference. Hospital charts were reviewed to determine age at fracture, type and location of fracture, mechanism of injury, length of hospital treatment, time to clinical and radiological healing, time to return to unrestricted activities, and complications. Patients were followed up with an average of 7.6 (1–11) years for the HR group and an average of 4 (1–9) years for the PTS group. At the last outpatient follow up visit, symptoms and signs such as residual pain, stiffness, and limp were assessed, and anteroposterior and lateral projection X-rays were obtained to evaluate residual angulation in both planes, as well as femoral-length discrepancies (Figs. 1 and 2).

Statistical analysis was done with STATA (version 6.0) statistical software package, using Student's *t*-test for independent means, with a p value considered significant if less than 0.05.

Results

Both groups were found to be comparable for type and location of fractures, initial displacement, mechanism of injury, and associated injuries. The HR group had a 2.5/1 male/female ratio, whereas the PTS group had a 1/1 ratio. Significant differences are summarized in Table 1. All fractures were closed except for a 5-year-old girl with a Gustilo compound grade I fracture treated with HR traction. After the initial traction, all patients were discharged in a spica cast until fracture consolidation. The HR group was slightly younger at mean age 5.2 years than the PTS traction group at mean age of 6.4 (p=0.015). The skeletal traction group had a significantly longer hospital stay (29.7 days versus 16.8 days for HR, p=0.02), time to consolidation (10.8 weeks versus 8.8 weeks for HR, p=0.04), and time to return to unrestricted activities (17.2 weeks versus 12.2 weeks for HR, p=0.03).

No early complications such as pressure sores, pin-tract infection, or neurological injuries occurred in either group. However, two patients (2/14) treated with HR traction developed skin blisters with adhesive tape to which they were later found to be allergic. Only one patient in the PTS group reported mild residual discomfort at the knee, but there was no significant difference in the objective functional ratings for either group.

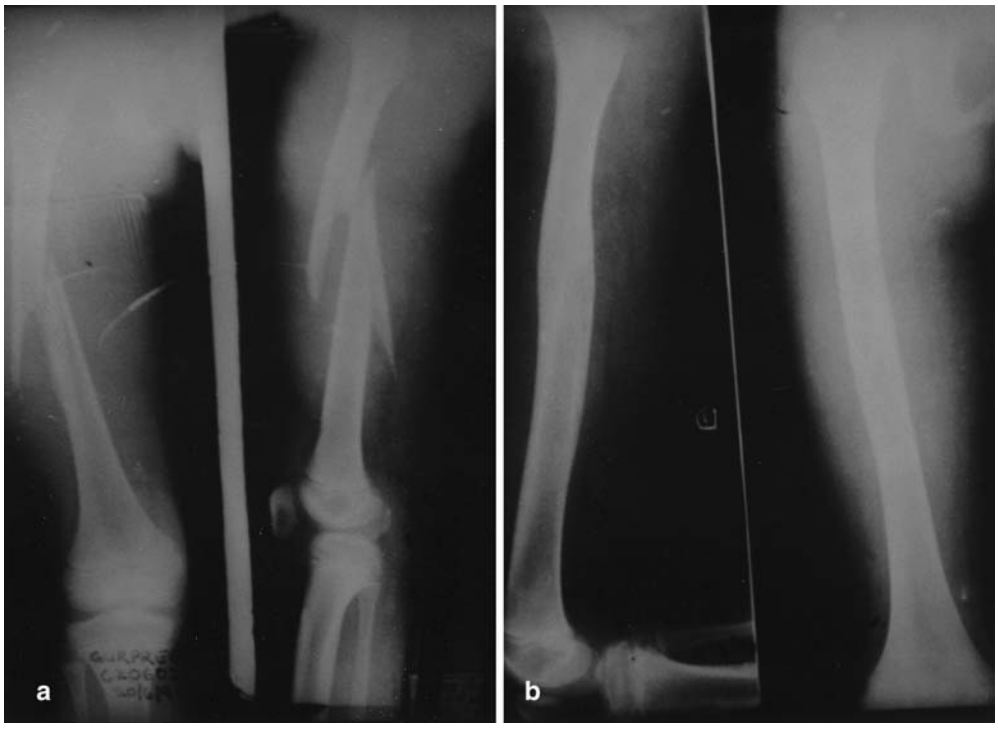

Fig. 2 Seven-year-old male with fractured left femur treated with Hamilton Russell (HR) traction: **a** at the time of presentation; **b** at 1-year follow-up

Table 1 Mode of injury and sex distribution

Mode of injury	Hamilton-Russell traction Number of patients: *n*=14		Proximal tibial pin traction Number of patients: *n*=14	
	Male	Female	Male	Female
Fall	6	2	4	1
Road traffic accident	3	2	1	4
Jamming (e.g., limb caught in a mobile part of toy/door)	0	0	1	1
Heavy object falling on patient	1	0	1	1
Total	10	4	7	7

Residual varus angulation was considered radiologically significant if equal to or greater than 5°. At final radiological evaluation, five patients in the HR group had a residual varus angulation averaging 8.6°, whereas ten patients in the PTS group had a residual varus averaging 10.2°. The difference in the amount of angulation is not significant, but the difference in the number of patients is (p=0.005). There were no significant differences in the residual valgus, anterior, or posterior angulations. Clinically relevant femoral-length discrepancies occurred in one patient in the HR group (1.5 cm shortening) and in two in the tibial traction group (1.5 and 2.5 cm lengthening) (p>0.05)

Discussion

This retrospective study identified what appear to be significant differences between HR skin traction and PTS traction in three areas. In the present study, 14 patients treated with HR traction had an average hospital stay of 16.8 days. This is in contrast to the observation of Anderson [1] who treated 39 patients of age 4 years and older with HR traction. His patients spent an average of 5 weeks in hospital. However, there is no mention of him having used a spica for immobilizing the limb, as had been the practice in our setup. The patients treated with proximal tibial pin traction spent an average of 29.7 days in our hospital. Similarly, Ryan [8] and Havrenek et al [5] reported in their studies an average hospital stay of 24.5 days and 32.3 days respectively.

It took 8.8 weeks for fracture union among our patients treated with HR traction. Anderson [1], in his study of 39 children, reported definite evidence of callus formation and no evidence of abnormal mobility after 5.5 weeks of continuous HR traction without subsequent casting. Those of our patients treated with proximal tibial pin traction united at an average of 10.8 weeks, and this is in agreement with the results of the studies of Ryan [8] and Aronson [2] who reported fracture union at 10 and 11.7 weeks respectively.

It took 12.2 weeks for patients treated with HR traction to return to normal activities. Those patients treated

by proximal tibial pin traction took 17.2 weeks, which is slightly longer than the 14 weeks reported by Humberger et al. [6].

Even in a relatively resource-poor environment, optimal treatment of femoral shaft fractures in children aged 4–8 years old remains controversial. Results of this series do not show an appreciable difference in the functional outcome at a minimum of 12 months of follow-up using one method or the other. The less invasive HR traction appears to offer some benefits over skeletal traction in terms of treatment duration, time to consolidation, and time to return to unrestricted activities.

One possible explanation is the difference in mean ages between the groups (1.2 years), the younger one appearing to do better more quickly. It is also possible, although unlikely, that the differences in sex distribution in the two groups contributed to the apparent differences in results. Although comparable in type and location of fracture and mechanism of injury, the small sample size in each group is certainly a source of bias, as is the significant number of patients lost to follow-up. The statistical significance of apparent differences between the two groups needs to be interpreted with caution. Nevertheless, in spite of the limitations of such a retrospective study, there appears to be no clear advantage of skeletal over skin traction, as suggested by Boman et al [3] and Nork et al [7]. Until the results of a well-designed, randomized, control trial comparing both methods are available, the results of this study support the use of HR traction over PTS traction for most femoral shaft fractures in this age group.

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