

Role of Joshi's external stabilisation system fixator in the management of idiopathic clubfoot

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ABSTRACT

Purpose. To explore the role of Joshi's external stabilisation system fixator in correcting cases of clubfoot peculiar to India, we studied cases of neglected clubfoot, dropout cases of plaster-of-paris cast treatment, or failed surgical procedures that had been followed for a minimum period of 2 years.

Methods. 26 children underwent 44 Joshi's external stabilisation system procedures at the Central Institute of Orthopaedics at the Safdarjung Hospital, New Delhi, between January 1998 and December 1999 for the conditions of interest. Three-dimensional correction was achieved by use of the distractor device.

Results. Excellent results were obtained in 77% of the cases, good results in 13%, and poor results in 9% of the cases. Complications in half of the cases were pin-tract infections, which eventually healed on an out-patient basis without any residual sequelae.

Conclusion. The Joshi's external stabilisation system frame is ideally suited for the child in whom clubfoot deformities remain uncorrected by plaster-of-paris casts and manipulation, as well as for recurrent clubfoot. Casting after complete correction not only protects the osteopenic bones while the pin-tracts heal, but also maintains correction and allows gradual weightbearing.

Key words: clubfoot; external fixator

INTRODUCTION

Despite the significant improvement in the quality of health care in India, many patients, especially those from rural areas, present in city hospitals with neglected or inadequately treated congenital orthopaedic problems that were not treated in infancy because of ignorance or lack of opportunity. Neglected

cases of clubfoot that involve large callosities and skin problems, and dropout cases i.e. those who did not complete plaster-of-paris (POP) cast treatment that involve deformities provide considerable problems. Many patients with these conditions are not suitable candidates for management by soft tissue release procedures. The discovery of principles of distraction histoneogenesis by Ilizarov,¹ opened a new chapter in the management of complex deformities of limbs.²⁻⁴ While there is a wide variety of paediatric applications of the Ilizarov technique to correct lower extremity deformities,⁵⁻⁷ use of an Ilizarov fixator in patients younger than 6 years who have small feet presents considerable problems: the instrument is bulky and difficult to manage. On the basis of similar principles, Joshi et al.⁸ devised a simple external fixator (Joshi's external stabilisation system [JESS]), in the early 1990s, which is especially useful for patients with small feet. In this study, we present a series of 44 feet in 26 patients of neglected clubfoot, dropout cases

of POP cast treatment, or failed surgical procedures that had been followed up for a minimum period of 2 years by using the JESS fixators.

MATERIALS AND METHODS

This study was conducted at the Central Institute of Orthopaedics at the Safdarjung Hospital, New Delhi, India, between January 1998 and December 1999. 50 feet belonging to 30 patients aged between 10 months and 6 years were initially included in the study (mean age of patients, 2.8 years). Four patients (2 bilateral cases and 2 unilateral cases) were lost for follow-up, leaving 26 patients with 44 treated feet: 14 in girls and 30 in boys (Table 1). Only cases of non-treated clubfoot (n=20), dropout cases of POP cast treatment (n=22), and recurrent clubfoot after previous surgery (n=2) were included in this study. Neglected clubfoot was defined as a case in which either no treatment course

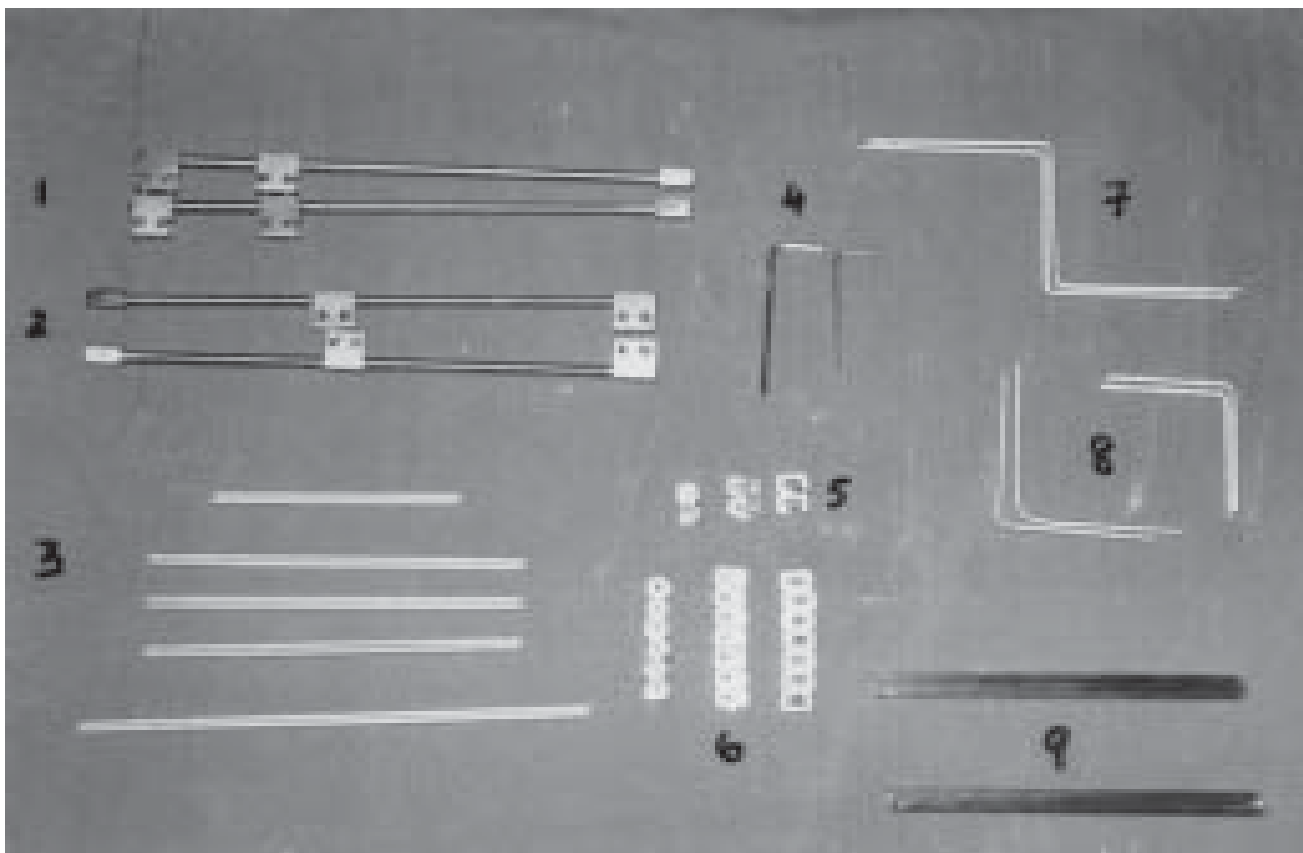


Figure 1 Components of the fixator: (1) distractors, tibio calcaneal; (2) distractors, Metatarso calcaneal; (3) knurled rods, various lengths; (4) Allen keys, large and small; (5) beta-clamps, add-on (fish-mouth type); (6) beta-clamps; (7) Z rods; (8) L rods, large and small; and (9) K-wires, 1.8 mm and 2 mm.

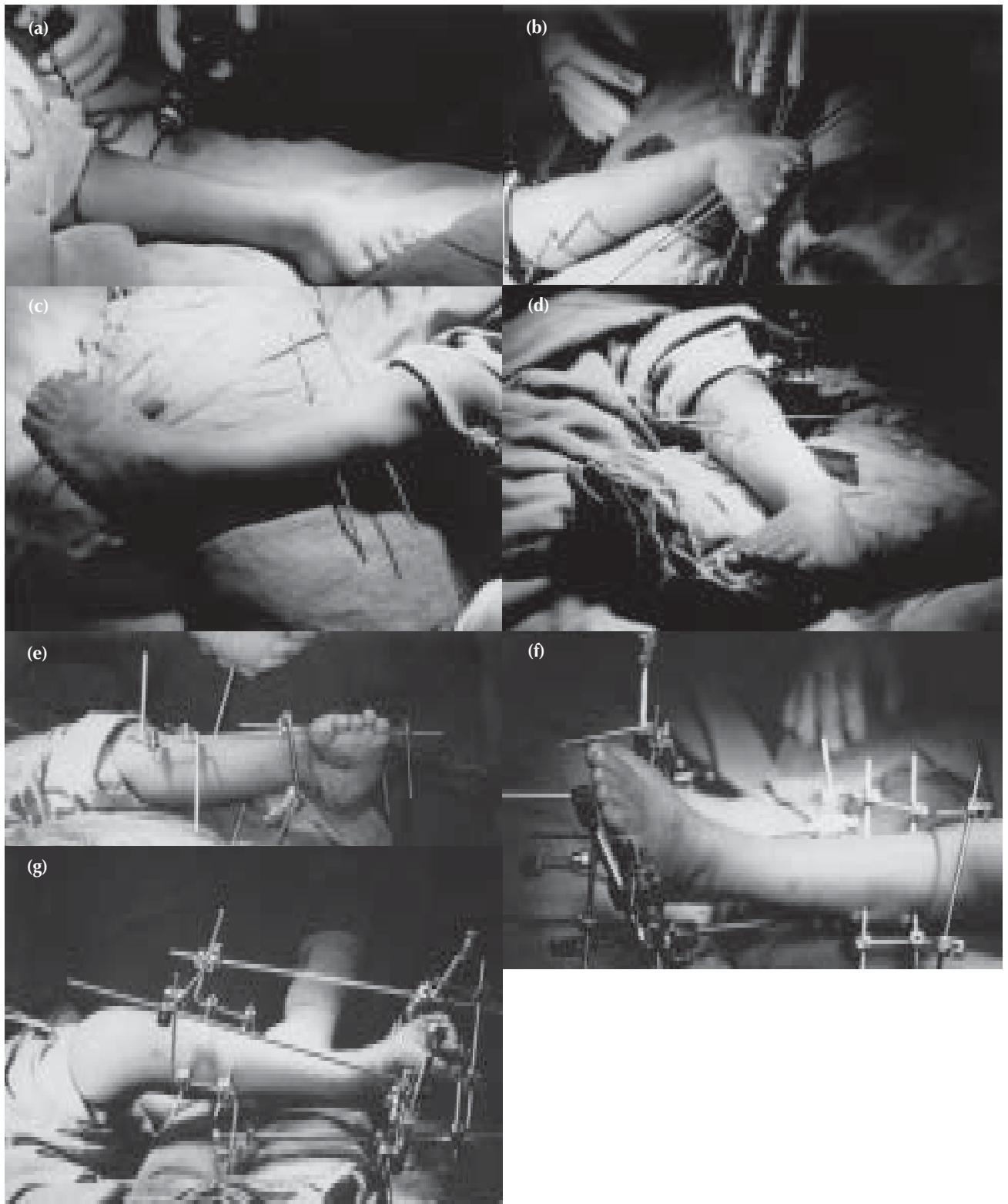


Figure 2 Operative steps (a) tibial K-wires lateromedial, (b) K-wires in position, (c) metatarsal K-wires, (d) calcaneal K-wires; (e) Z and L rods fixation, (f) distractor application, and (g) completed frame.

was taken or the patient dropped out of POP cast treatment and started walking on the deformed foot. Recurrent clubfoot was defined as a case in which deformity recurred after soft tissue release and deformity correction, either because the patient failed to return for follow-up or to follow postoperative instructions. Preoperative and postoperative clinical, radiological, and functional evaluations were performed using the Hospital for Joint Diseases Orthopaedic Institute functional rating system for clubfoot surgery.⁹ The fixator is available in 3 sizes: small (for children aged 1.5 years or younger), medium (for those aged between 1.5 and 3 years), and large (for those older than 3 years). The components of the fixator are shown in Fig. 1, and the surgical technique is shown in Fig. 2.

Postoperatively, the limb was elevated on a pillow to reduce the oedema. From postoperative day 3 onwards, medial distraction was started at the rate of 1 mm/d (4 x 0.25 turns per day) and lateral distraction at the rate of 0.5 mm/d (2 x 0.25 turns per day). Toes were passively manipulated at regular intervals. Patients were discharged on postoperative day 7, after having been taught proper distraction and care of the fixator. Patients were followed up at twice-weekly intervals until slight overcorrection was achieved. Distraction was stopped and the feet were maintained in the frame for 6 to 12 weeks in the fixator to allow tissues to adapt to the changed posture. Fixators were removed under anaesthesia, and another POP cast was fitted for 3 months, followed by pronator shoes as recommended by Joshi et al.,⁸ Galante et al.,¹⁰ and Oganessian and Istomina.¹¹

RESULTS

The mean age of patients was 2.8 years (range, 10 months to 6 years). The group of patients younger than 1.5 years contained more cases than the other age-groups (18 feet versus 16 among those patients aged 1.5–3 years, and 10 among those aged 3–6 years) [Table 1]. The right limb alone was involved in 2 cases, whereas the left limb alone was involved in 6 cases. The remainder of the cases were bilateral. Half of the cases were dropouts from POP cast treatment (Table 2). The mean duration of external fixator treatment was 13.4 weeks (range, 6–24 weeks).

The mean duration of follow-up was 3.6 years (range, 2.2–3.9 years). Using the Hospital for Joint Diseases Orthopaedic Institute functional rating system for clubfoot surgery, excellent results were obtained in 34 (77%) feet, good results in 6 (14%) feet, and poor results in 4 (9%) feet. Two illustrative cases

Table 1
Age and sex distribution of patients with unilateral and bilateral clubfoot

Patient type	Number of patients	Number of feet
1/Unilateral		
Male	2	2
Female	0	0
1/Bilateral		
Male	6	12
Female	2	4
1–3/Unilateral		
Male	4	4
Female	0	0
1–3/Bilateral		
Male	4	8
Female	2	4
3–6/Unilateral		
Male	0	0
Female	2	2
3–6/Bilateral		
Male	2	4
Female	2	4

Table 2
Distribution of cases by mode of presentation

Mode of presentation	Number of feet
Neglected/non-treated	20 (45%)
Dropouts from plaster-of-paris casting	22 (50%)
Recurrent	2 (5%)
Total	44 (100%)

Table 3
Complications

Complication	Number of patients
Pin-tract infection	12
Superficial cellulitis	4
Residual finger stiffness	1
Skin necrosis due to over distraction	2
Pin loosening leading to early removal of fixator	
Tibial pin	4
Calcaneal pin	2
Pin cut-out through bone	
Metatarsal pins	2
Calcaneal pins	2
Total	29

and some examples of complications are illustrated in Figs. 3–5, although the majority of complications were pin-tract infections (Table 3).

12 patients had superficial pin-tract infection, which recovered after administration of oral antibiotics and regular changes of dressing. Six feet developed

cellulitis and pin loosening near tibial and calcaneal pin-tracts, which necessitated removal of fixator at 5 to 7 weeks after insertion. These healed completely after administration of oral antibiotics and POP treatment.

In 4 cases with pin-tract cut-out i.e. the K-wire cut through the dorsal cortex of the metatarsals and laid in the soft tissues beneath the extensor tendons, the pin had to be removed and reinserted in an area of healthy bone and skin. Superficial skin necrosis healed after distraction was stopped and 2 to 3 turns of compression in the opposite direction. Encouragement of active and passive toe movement while the external fixator was in place prevented stiffness of the toe joint to a large extent. However, any residual finger stiffness was rectified after the fixator was removed and normal weightbearing started. No cases of osteomyelitis or pin breakage were encountered.

DISCUSSION

External fixators offer a versatile method of correcting complex 3-dimensional deformities of the foot such as clubfoot,³ more so in cases with rigid, deformed, previously operated feet that are scarred and in cases in which feet have big callosities, when chances of skin breakdown are quite high, such as following a soft tissue procedure. The basic principle of external fixation in this study was the same as that advocated by Ilizarov.¹

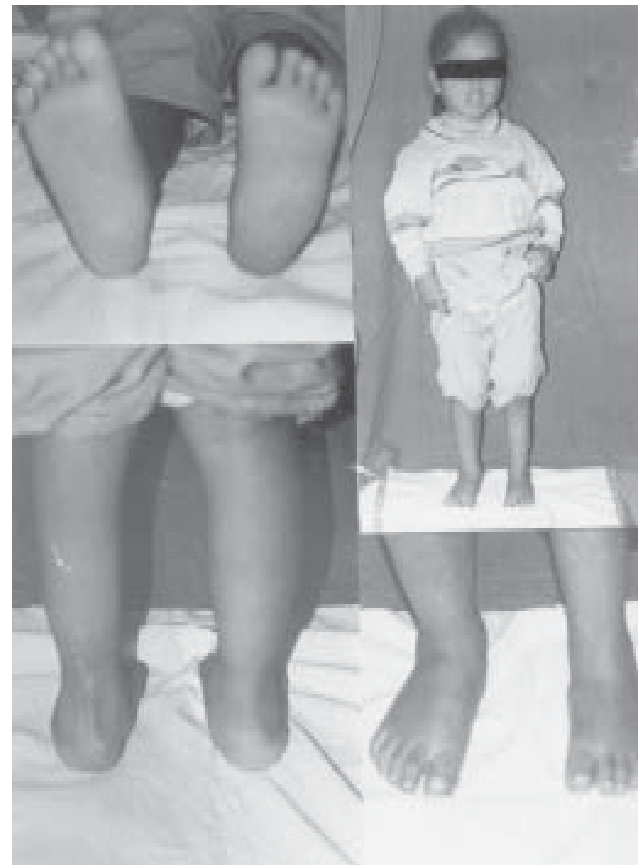
Physiological tension and stress applied to the tissue stimulates histogenesis of tissues, while controlled differential distraction gradually corrects the deformities and realigns the bones.¹⁰ Preoperative assessment revealed a poor score for all cases, but the postoperative rating yielded results that were comparable to those of Oganessian and Istomina,¹¹ and superior to those reported by Galante et al.,¹⁰ Bethem and Weiner,¹² and Turco.¹³ A comparison of our results and those of similar studies is shown in Table 4.

The results in our series are probably better than the other series because the majority of patients were younger than 3 years ($n=34$; 77.27%). In these children, it is expected that the tissues will respond in a much better way to applied stress. In addition, the younger the patient, the better is the remodelling potential, as compared with the older patient's rigid bony and soft tissue deformities.

The major difference between the fixators that we used and circular fixators described by Ilizarov is that the wires in our fixators are not tensioned but only pre-stressed, to prevent them from cutting through the soft bones. Furthermore, this fixator is an



(a)



(b)

Figure 3 Illustrative case of recurrent clubfoot: (a) (clockwise from top left) preoperative lateral, medial (surgical scar visible), posterior and weightbearing views, and (b) (clockwise from top left) postoperative end-on and weightbearing views.



(a)



(b)

Figure 4 Illustrative case of neglected bilateral clubfoot: **(a)** (clockwise from top left) preoperative weightbearing, lateral (with callosities) and plantar views; **(b)** (from left to right) postoperative squatting, full profile and weightbearing standing, passive plantar flexion, and dorsiflexion-eversion.

unconstrained device, using soft tissues as a hinge. This feature has the disadvantage of pin-tract infection which, in the majority of cases, was controlled by regular changes of dressing and oral antibiotics. Transient clawing of toes developed in 30 feet in our study, despite supervised physiotherapy; however, the clawing disappeared in all patients, except one who had developed cut-out of the metatarsal wire along with pin-tract infection, probably leading to fibrosis. This patient had minimal residual clawing with no

pain at the last follow-up. None of the complications led to a permanent disability. Four cases of superficial cellulitis with loosening of pins required premature removal of the fixator and subsequent treatment by POP casting. All these patients had poor results as expected.

Advantages of the frame were that the possibility of imminent scarring due to conventional surgery was abolished, because of distraction histoneogenesis based on sound physiological principles. In

Table 4
Comparative analysis of data

Study (year)	Number of feet	Follow-up (years)	Patient age (years)	Treatment mode
Bethem and Weiner ¹² (1978)	54	1	0.3–3	Posterior medial soft tissue release
Turco ¹³ (1979)	149	2–15	0.5–8*	Posterior medial soft tissue release
Oganesian and Istomina ¹¹ (1991)	70	1–9	12	External fixator
Galante et al. ¹⁰ (1995)	52	2	No data	External fixator
Current study (1998–1999)	44	2.2–3.9	0.83–6 [†]	External fixator

* Majority of patients were <3 years

[†] Mean age, 2.8 years

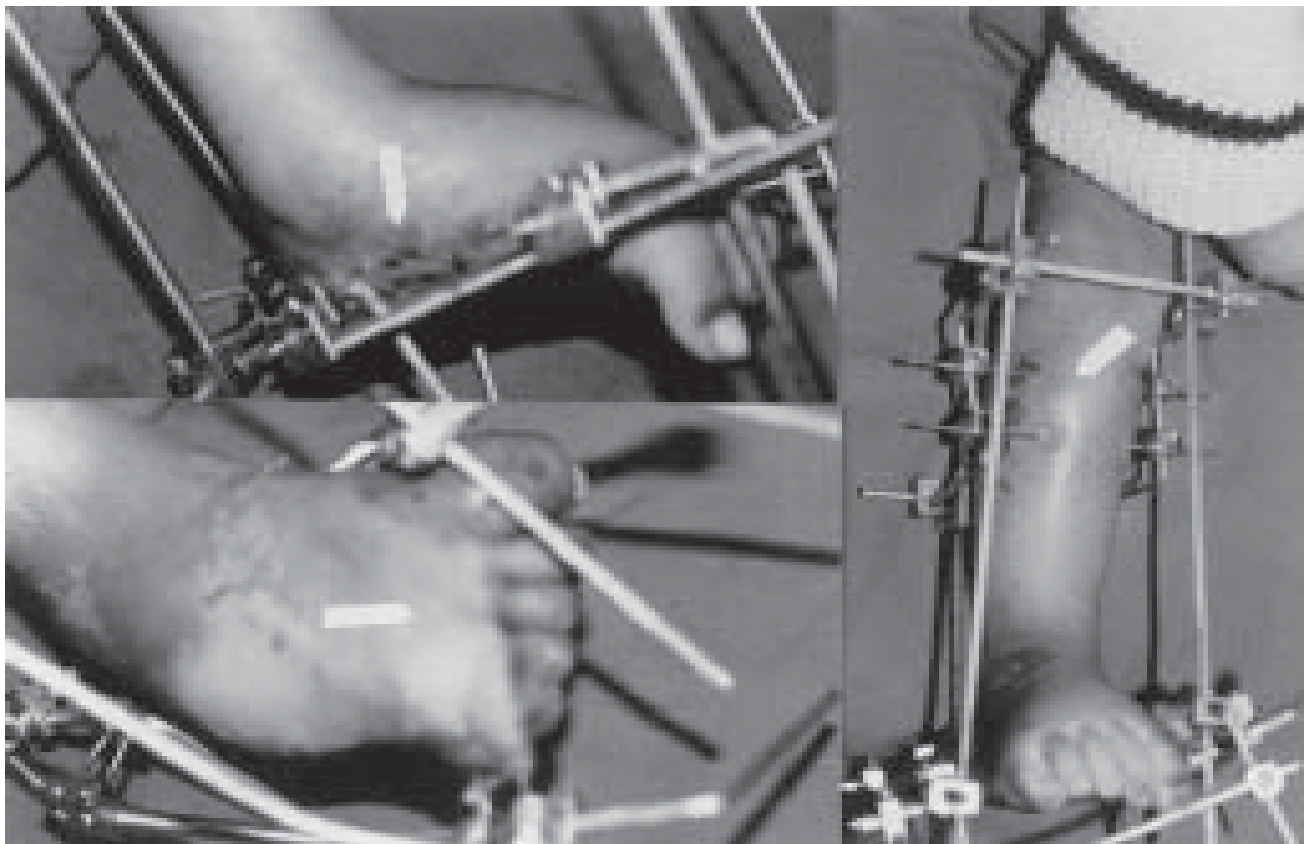


Figure 5 Complications: (clockwise from top left) medial skin necrosis, cellulitis and pin-tract infection, and metatarsal wire cut-out.

addition, foot length was maintained; a soft, supple, and plantigrade foot was achieved; and substantial deformity correction was possible. We feel that for children older than 6 months, the JESS frame is superior to the Ilizarov fixator, because of its easier application, lighter weight, shorter learning curve, less inventory, and lower cost. Casting after complete correction not only protects the osteopenic bones while the pin-tracts heal, but also maintains correction and allows gradual weightbearing.

CONCLUSION

The goal of any clubfoot surgery is to obtain a cosmetically acceptable, pliable, functional, painless, and plantigrade foot, and to spare the parent and the child from the ordeal of frequent hospitalisation and years of treatment with casts and braces. The

best treatment for clubfoot that does not respond to conventional treatment remains controversial. There has been an universal failure to reproduce the results of conservative treatment achieved by Kite.¹⁴ The procedure used in the current study holds promise for fulfilling the above-mentioned goals. This procedure is ideally suited for children in whom the clubfoot deformities remain uncorrected by POP casts and manipulation, as well as for recurrent clubfoot. If performed at around 9 months of age, the procedure enables the child to walk with a plantigrade foot by the time he or she is in the walking age group. Notwithstanding the few treatable complications, motivated and compliant parents were a pivotal factor on which the success of the study depended. Although the technique has a lot of advantages, one should not forget that injudicious and unsupervised distraction may lead to catastrophic results in the small developing foot.

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