Joshi's External Stablization System (JESS) Application For Correction Of Resistant Club-Foot

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Citation

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Abstract

Aims and objectives: To assess the efficacy of the JESS method of differential distraction as a method of treatment in resistant clubfeet and the morbidity and complications of the technique and to suggest ways to overcome themMethodology: The prospective study was done in a tertiary care center involving subjects with old, recurrent and resistant cases of clubfoot deformities treated by Joshi's external stabilizing system. Results: The cosmetic and functional improvement is satisfactory, bony radiological correction comparable, and the ankle movements especially dorsiflexion better than that produced by open surgery. Conclusion: correction by an external fixator is a useful method for the management of clubfoot in neglected and resistant cases.

INTRODUCTION

Idiopathic clubfoot is of the oldest and commonest congenital deformity of mankind, ever since man has adopted the erect posture. It occurs in variable severity and some of the mobile feet are corrected well with manipulation and stretching. 30% to 50% of clubfeet will not respond to conservative treatment and will require surgery (1). Many operative techniques have been tried to achieve full correction, but the average failure rate in clubfoot surgery is 25% (1). The discovery of principles of distraction histoneogenesis by Ilizarov came like a silver lining in the dark clouds of managing complex deformities of limbs (2-4). However, application of Ilizaorov technique was complicated due to its bulky nature and complicated management (5). Joshi et al developed a lighter and simpler version of the same technique which could be easily applied to smaller feet (6). However, there exist only few studies reporting the efficacy of this technique (7, 8). Hence, the present study was done to assess the efficacy of JESS method of differential distraction as a method of treatment in resistant clubfeet and the morbidity and complications of the technique and to suggest ways to over come them.

MATERIALS AND METHODOLOGY

This study was conducted at Sri Adichunchanagiri Institute of Medical Sciences, B.G.Nagara between November 2003 and March 2005 following clearance from the institution's ethical committee. The study included 11 patients with 15 old, recurrent and resistant cases of clubfoot deformities treated by Joshi's external stabilizing system.

All cases were assessed pre-operatively by thorough clinical and radiological assessment of each foot. All patients had preoperative talocalcaneal index measured on X-ray and the deformity was assessed using Carroll clinical criteria (9). The criteria uses a simple 10-point scoring system for the preoperative evaluation based on anatomic criteria (Table 1). Each feature score one point when present or no point when absent. Thus worst foot having all the features would score 10 points and a normal as well as corrected foot score 0 points.

Out of 4 bilateral cases, three patients were operated simultaneously for both feet. For other patient, one foot was operated which had severe deformity. The time taken for correction by distraction ranged from 4 weeks to 10 weeks with an average of 6 weeks. The fixator frame was further retained for 6 weeks.

PROCEDURE

The operation performed under general anaesthesia. Hand drill or a hand chuck used in smaller children and in older children, power drill is used. The procedure involved two major steps- insertion of K- wires and creation of hold and connection between the hold (6).

INSERTION OF K-WIRES

Tibial K-wire placement: With the patient in supine position and extended limb, two parallel K-wires were passed in the proximal tibial diaphyses from the lateral to the medial side. The wires were about 3 to 4 cm apart and run parallel to the axis of the knee joint one finger breadth distal to tibial tuberosity. In older children 3 wires were passed to increase the stability.

Calcaneal K-wire placement: Two parallel K-wire were passed through the tuber of calcaneum from medial to lateral side taking care that they were well away from the course of the neurovascular structures on the medial side. One additional half pin K-wire was passed from the posterior aspect of the calcaneum along the long axis. The entry point was below the insertion of the tendo-achilles in the midline using distractor as the guide.

Metatarsal K-wire placement: One transfixing K-wire was passed through the necks of first and fifth metatarsal from lateral to medial side in such a way that the K-wire engaged the two metatarsals. Two additional wires were passed parallel to and 10 to 12 mm apart from either side engaging three metatarsals each so that the third metatarsal has engaging half pins from either side through it.

CREATION OF HOLDS AND CONNECTING BETWEEN THE HOLDS

Two 'Z' bars were attached to the tibial pins, one on either side. The wires were prestressed before the link joints were tightened. Two transverse bars were attached to the 'Z' rods, one anteriorly and one posteriorly. Calacaneometatarsal distractors were then attached to the K-wires. Two 'L' rods were attached to calcaneal K-wires and two other 'L' rods were attached to the metatarsal K-wires one on either side with the arms of the 'L' rods facing posteriorly and inferiorly. One posterior transverse bar was attached to the posterior calcaneal half pin and the posterior arms of the 'L' rods.

Tibiocalcaneal distractors were applied, one on each side connecting the corresponding transverse rods. Two additional transverse rods were attached to the inferior arms of the 'L' rods which took the toe sling which provided dynamic traction to prevent flexion contracture of the toes as the deformity was being corrected. All four distractors were distracted till resistance was felt. Extra lengths of the K-wires were cut, and no tension was created in them.

The transverse anterior rod of the tibial hold and metatarsal hold was connected on either side static tibiometatarsal connecting rod. This provided tension force and kept the anterior portion of the joint open. It also prevented crushing of the articular cartilage and provided better glidage to the talus while correcting the equinus.

Adequate skin release was made at the pin entry sites. Haemostasis at the pin entry wounds was achieved with pressure. Dry dressing of the pin entry wounds was done after cleaning. The sharp cut ends of the Kirshner wires were protected. The operative time was on an average one hour.

DISTRACTION SCHEDULE

In all hospitalized patients, fractional calcaneo-metatarsal distraction was applied from third post-operative day at the rate of 0.25 mm/hrs. Differential distraction on medial side was performed twice the rate than that on the lateral side (0.25 mm every 6 hours medially and 0.25 mm every 12 hours laterally). In non-hospitalized patients parents do the distraction at the rate of 1 mm/daily on medial side and ½ mm/daily on lateral side. By calcaneo-metatarsal distraction, we achieved correction of forefoot adduction at tarso-metatarsal joints, stretching the socket for head of talus and reduction of calcaneocuboid joint.

The tibio-calcaneal distraction is carried out in two positions. Initially, the distractors were mounted between the inferior limbs of the 'Z' rods and posterior limbs of the calcaneal 'L' rods. The distractors lie parallel to the leg and just posterior to the transfixing calcaneal wires. The distraction was applied at the rate of 0.25 mm every 6 hours medially and 0.25 mm every 12 hours laterally and the end-point was judged clinically. Distraction in this position corrected varus of the hindfoot and equinus. The tibio calcaneal distractors were then shifted posteriorly and connected above to the transverse bar connecting the posterior limbs of 'Z' rods and below to the posterior calcaneal bars connecting the posterior limbs of 'L' rods and axial calcaneal pin. The distractors lie on the either side of the axial calcaneal pin. Distraction in this position provided thrust force to stretch posterior structures and corrected hind food equinus at the ankle and subtalar joints. Both distractors were applied at the rate of 0.25 mm every sixth hourly and the end point assessed clinically and radiologically.

Visual correction of the deformities was noted during the distraction phase. Full correction was achieved, usually at the end of 5 to 6 weeks. X-ray was taken finally after the removal of the fixator. Following the correction, assembly is

held in static position for further three to six weeks to allow soft tissue maturation in elongation position. Single stage removal of the whole assembly was done under general anaesthesia. After removal of the assembly, a well moulded below knee plaster cast was applied in maximum correction. The child was allowed to ambulated full weight bearing in the plaster. Later, a short plaster boot was applied which not only acted as an orthotic device but also allowed mobilization of ankle joint and strengthening of tendoachilles. Squatting was encouraged to achieve dorsiflexion of the foot. Plaster was changed for 2-3 times at an interval of 15 days.

The overall results were assessed according to George Simons criteria summarized in Table 2 (10). They are classified into Satisfactory (Excellent, Good) and Unsatisfactory (Poor).

RESULTS

The mean age of the study subjects was 5 years and 10 months. Of the 11 cases, 9 were male and 2 were female. While four cases were bilateral resistant clubfeet, seven were unilateral of which four involved right feet and three involved the left.

Equinus at the Ankle: The feet showed well-corrected mobile ankle joints. The post-operative range of motion at the ankle was an average 40o with 25o of plantar flexion and 15o of dorsiflexion.

Fore Foot Varus: This was assessed clinically and radiologically. Out of 15 feet, four feet showed varus deformity of less than 10o.

Hind foot varus: All nine patients had a good correction of heel varus.

Radiological Findings: The talo-calcaneal index was measured both preoperatively and post-operatively. Radiologically the talocalcaneal angle in stress or weight bearing antero-posterior and lateral views should be more than 15o to call a result to be satisfactory. The findings are shown in table 3.

In our series we had 14 satisfactory and one unsatisfactory result as per Simon's criteria. It was common to observe significant edema of the foot during the distraction phase. However, pin-tract infection was noticed in only one case and there were no cases with skin necrosis.

Figure 1

Table1: Carroll criteria for clinical assessment of severity of Club-foot

1. Calf atrophy	6. Navicular fixed to medial malleolus
2. Posterior fibula	7. Calcaneus fixed to fibula
3. Creases	8. Fixed equinus
4. Curved lateral border	9. Fixed adductus
5. Cavus	10. Fixed forefoot supination

Figure 2

Table 2: Simons criteria for clinical assessment of outcome of Club-foot surgery

No.	Parameters	Satisfactory	Unsatisfactory
1.	Symptoms	None	Minimal to Moderate pain with activity
2.	Appearance of hindfoot	Normal to mild deformity	Moderate to significant residual deformity
3.	Fore foot adduction	Mild	Severe
4.	Functional weakness of triceps surae	None or mild	Cannot support weight on toes
5.	Range of motion at ankle	Dorsiflexion greater than 10^0, plantar flexion greater than 15^o	Dorsiflexion less than 10^0, plantar flexion less than 15^0
6.	Range of motion at subtalar joint	Present	Nil
7.	Additional treatment	None, cast or minor surgery	Freq., treatment with cast or major surgery
8.	Complications	Minor	Major

Figure 3

Table 3: Radiological findings of the outcome of JESS fixator surgery for resistant clubfeet

View	Average Pre-Operative	Average Post-Operative	Normal Values
Antero-posterior	13^0	20^0	30^0-35^0
Lateral	20^0	35^0	25^0-50^0
Talo-calcaneal Index	33^0	55^0	$>40^0$

DISCUSSION

Operative options in the club foot deformity treatment are many with nearly the same sort of results. In the absence of universally acceptable grading of the deformity or assessment of the results no two studies can really be compared. Correction by distraction has distinct advantage of histoneogenesis, lack of scar tissue formation and the absence of further shortening of the foot. There are many reports of the fixators distractor correction of clubfoot with variations in the technique with good outcome (3-8). Suresh et al found JESS to be ideal for correction of residual and relapse clubfoot in their study involving 26 children with 44 clubfeet (7). Similar results were found by Oganesian and Istomina (11). Short-term assessment of results of clubfeet

correction with JESS distractor by Anwar and Arun showed excellent and good results in 59.7% of cases (8).

Suresh et al studied the difference between Ilizarov technique and JESS method and found that the wires in JESS fixators were pre-stressed and not-tensioned, preventing the chance of cutting through bone and soft tissue. Also, the procedure of JESS fixator is less costing and simple when compared to Ilizarov technique. Overall, they reported JESS fixators are superior in comparison to Ilizarov fixator, especially in older children with neglected clubfeet (7).

Although the follow-up in this series was relatively short (16 months), the results were comparable with the best results in open soft tissue and/or bone surgery. The cosmetic and functional improvement was satisfactory, bony radiological correction comparable, and the ankle movements especially dorsiflexion better than that produced by open surgery.

The better results in the present study can be attributed to enthusiastic and compliant parents and longer hospitalisation during post-operative period. Anwar and Arun found a strong correlation between better results and children who strictly follow the distraction-static phase protocol and the final outcome, stressing the fact that parent involvement is an essential component in treating neglected clubfeet (8). A longer period of post-operative stay provided a controlled environment for the static period and reduced the risk of pin-tract infection and other complication. The evidence from other studies and the present study shows that correction by JESS fixator is an useful method for the management of clubfoot in neglected and resistant cases.

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