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NEGLECTED RESISTANT RECURRENT CTEV CORRECTION WITH JESS FIXATOR

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ABSTRACT: Idiopathic club foot and its management have been the topic of keen interest to the orthopaedics field ever since time immemorial and many techniques in the successful management of these have been advocated till date. This study discusses one such technique of management in children with the Jess fixator.

KEYWORDS: Idiopathic club foot, Jess fixator.

INTRODUCTION: Idiopathic clubfoot is one of the oldest and commonest deformities of mankind, ever since man has adopted the erect posture.¹ It occurs in variable severity and some of the mobile feet are corrected well with manipulation and stretching. Nearly half the feet are rigid and do not show full correction with conservative management. In developing countries, clubfoot remains a significant problem and yields an unpredictable outcome because of late presentation and ignorance of the parents. Neglected clubfoot usually presents the unyielding rigid deformities because of the extremely contracted skin, tendons, ligaments and capsules on the postero medial aspect of the foot.²

In the earliest times there has been no limit to the indigenous devices that have been used to correct the clubfoot. The 20th century has been marked by the classification of two concepts in management of clubfoot. The first is the general acceptance of the principles of manipulation, strapping and serial correction plaster cast advocated by Kite and Dennis Browne. An impressive assay of clinical evidence was accumulated in support of their methods. The goal of treatment for clubfoot deformities is to obtain full and lasting correction, so that the patient has a functional, pain-free, plan tigrade foot with good mobility.³

The treatment of relapsed, neglected and rigid varieties of club foot is based on corrective operation in the hind foot by posteromedial release and correction of varus heel by calcaneal osteotomy (Dwyer 1959-69) as in metatarsal region by extensive medial release and cuboid osteotomy (Evans 1961). However, none of the described methods can completely achieve the goal of functional, painless and cosmetically acceptable foot. This unsatisfactory situation prompted scientists to seek a method which does not involve soft tissue trauma, bony resection etc.

The second concept is a simple versatile and light fixator system with tremendous potential was developed by Dr. B.B. Joshi⁴ of Bombay (Mumbai) INDIA in the year 1988. This method proved successful in almost all age groups ranging from 4 months to 19 years. Dr. B. B. Joshi advocated a method of controlled, differential distraction which is semi invasive, more physiological in comparison to any other technique, using Prof. Ilizarov's principles.

The intention of this discussion is to review the current thinking and address the changing spectrum of management as a poet has rightly said, "we are guilty of many errors and faults, but our worst crime is abandoning the children, neglecting the formation of life. Many of the things we need may wait, the child cannot, right now is the time his bones have been formed, his blood has been made and his senses are being developed. To him we cannot assure tomorrow, his need is today".

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OBJECTIVES:

1. To assess the efficacy of controlled differential distraction as a method of treatment in resistant and recurrent CTEV and critically assess the results based on the clinical and radiological findings.
2. To evaluate various technical problems, complications of techniques and suggest ways to overcome them.

MATERIALS AND METHODS: This study was conducted in VMMC Karaikal Pondicherry, study includes management of 20 feet in 14 patients with old neglected, recurrent or resistant cases of CTEV by JESS.

INCLUSION CRITERIA:

- Age: Patients aged between 1 to 8 years.
- Both unilateral and bilateral cases.
- Neglected, recurrent and resistant cases of clubfoot.

EXCLUSION CRITERIA:

- Age < 1 year and > 8 years.
- Patients who are unfit for surgery.
- Parents refusal for surgery.

On admission of the patient a careful history was elicited from the parents/ attendants to reveal the duration and previous treatment of the deformed foot.

The patients were then assessed clinically using Carroll assessment which Includes:

1. Calf atrophy.
2. Posterior displacement of the fibula.
3. Creases medial or posterior.
4. Curved lateral border.
5. Cavus.
6. Fixed equinus.
7. Navicular fixed to the medial malleolus.
8. OS calcis fixed to tibia.
9. No midtarsal mobility.
10. Fixed forefoot supination.

Each feature scores one point when present and no point when absent. Thus the worst foot having all the features would score ten points whereas the normal or a fully corrected foot would score zero point.

Radiological Evaluation: Radiologically evaluated with ankle and foot in AP and stress dorsiflexion views.

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The following angles are Calculated:

- Talocalcaneal angle in AP and stress dorsiflexion views.
- Talus 1st metatarsal angle in AP view.
- Tibiocalcaneal angle in lateral view.
- Talocalcaneal index.

Normal values:

- Talocalcaneal: AP – 30 to 55°, lateral- 25 to 50°.
- Tibiocalcaneal: stress lateral- 10 to 40°.
- Talus 1stmetatarsal: AP -5 to 15°.
- Talocalcaneal index: in AP and lateral, >40°.

The patient was taken up for surgery after investigations and making the patient medically fit for surgery.

OPERATIVE PROCEDURE FOR JESS: The procedure is carried out under general anesthesia with the patient in supine position. A pneumatic cuff is applied on the thigh but, the tourniquet is inflated only if need arises intraoperatively.

COMPONENTS: To suit the requirements for different age groups, three sets of assembly components are designed: small, medium and large.

COMPONENTS OF JESS FIXATOR

OPERATIVE PROCEDURE: TIBIAL WIRES: Two parallel transfixing wires are passed in the tibia, perpendicular to the longitudinal axis from lateral to medial. The length of the middle segment of the Z bar is marked below the first wire. The second wire is passed parallel to the first wire at this level.

METATARSAL WIRES: While passing the metatarsal wires the surgeon should hold the foot with one hand and drill the wires with the other, using a power drill:

- One transfixing wire is passed from the fifth to the first metatarsal engaging at least the fifth and the first metatarsal at the level of the neck. Two separate wires, one from the medial and the other from the lateral aspects are inserted parallel to the first wire. These two wires engage two or three metatarsals on their respective side at the level of the proximal shaft. The distance between the transfixing wires and these wires should correspond with the distance between

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the holes in the block in the distractor to be used. The distractor can be used as a jig. It is essential to be sure that all the metatarsals have been inserted by at least one of the wires.

- **Calcaneal wires:** Two transfixing parallel wires are passed into the tuberosity of the calcaneum from the medial side avoiding the posterior tibial artery. These wires should be perpendicular to the long axis of the calcaneum. The distance between these two wires should again be equidistant between the holes in the blocks in the distractor to be used.

AXIAL CALCANEAL WIRE: The axial calcaneal wire is passed posterior to anterior. The point of entry is just distal to the insertion to the achillis tendon. The wire is directed medially and distally to mimic the equinus and the varus of the calcaneum. This wire is passed under image intensifier control when available or should lie in the long axis of the calcaneum.

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Attachments of the 'Z' and 'L' rods:

Tibial attachment- the tibial k wires are attached to the middle segment of the Z rods by link joints on the medial and the lateral aspects. The wires are prestressed by bringing them forwards each other by few millimeters while tightening the joint. The limbs of the Z rods now lie perpendicular to the axis of the tibia.

One connecting rod is used to span the anterior limbs of Z rods and the other span the posterior limbs. Maintain a finger breadth clearance between the skin and the Z rods and all subsequent connections to the k wires.

METATARSAL ATTACHMENTS: Two small L rods are attached to the metatarsal wires on medial and lateral aspect of the foot with one limb projecting plantar wards and the angle of L is placed distally.

CALCANEAL ATTACHMENTS: Two large L rods are attached to the transfixing calcaneal wires on either side of the heel. Behind the foot these rods are connected to each other by a connecting rod to which the axial calcaneal wire is clamped.

CONNECTING THE SEGMENTAL HOLD:

- a. **Calcaneal- metatarsal connection:** A pair of appropriately sized distractors is attached to the calcaneal and metatarsal wires on either side of the foot keeping the distractor knobs interiorly for easy handling during the distraction.
- b. **Tibiocalcaneal connection:** Posterior limbs of the Z rods are attached to the L rods of the calcaneal hold by a distractor on either side. Distractors are attached near the transfixing pins (lateral and medial aspect of the calcaneum).
- c. **Tibiometatarsal connection:** The anterior limbs of the Z rods are connected by a pair of rods to the small L rods anterior to the attachment of the metatarsal wires.

POST OPERATIVE MANAGEMENT:

1. **Pin site care:** the dressings are performed twice a week with savlon, spirit and betadine lotion. Pin sites are covered with dry gauge and protective dressings are applied.
2. **Distraction:** in all hospitalized patients fractional distraction at the rate of 0.25 mm/hrs is applied. Differential distraction on the medial side is performed twice the rate than that on the lateral side. Distraction on the lateral side not only prevents crushing of the articular cartilage but also permits normal growth of epiphyseal plate on lateral side which may be affected if compression is done on the lateral side. In non-hospitalized patients parents do the distraction at the rate of 1mm/day on the medial side and ½ mm/day on the lateral side.

On the 3rd postoperative day the distraction is started as Follows:

The calcaneometatarsal Distraction:

Medial - 0.25mm every 6 hours.

Lateral - 0.25mm every 12 hours.

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The tibiocalcaneal distraction is carried out in two Positions:

1. The distractors are 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.

Distraction in this position corrects varus of the hindfoot and the equinus.

Medial - 0.25mm every 6 hours.

Lateral - 0.25mm every 12 hours.

End point - (judged clinically).

2. The tibiocalcaneal distractors are now 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 either side of the axial calcaneal pin.

Distraction in this position provides thrust force to stretch posterior structures and corrects hind foot equinus at the ankle and subtalar joints.

Both distractors - 0.25 mm every 6 hours.

End point - assessed clinically and radiologically.

Approximately 2-3 weeks of distraction (end of 6th postoperative week)

3. **Clinical and radiological assessment:** Visual correction of the deformities is noted during the distraction phase. Full correction is achieved, usually at the end of 5-6 weeks. X ray was taken finally after the removal of the fixator. The roentgenogram correlates well with the clinical picture.
4. **The static phase:** Following the correction, the assembly is held in static position for further three to six weeks to allow soft tissue maturation in elongation position.
5. **Removal of the fixator:** Single stage removal of the whole assembly was done under general anaesthesia and a plaster cast is given as follows
6. After removal of the assembly, a well moulded above knee plaster cast is applied in maximum correction for two weeks. Once the pin tracts heal completely, a below knee cast is applied with polyurethane bandage and the patient is asked to ambulate with full weight bearing in plaster. Below knee cast is removed after 4-6 weeks.
7. **Orthotic device:** Appropriate orthotic devices are absolutely essential for maintenance of correction and prevention of recurrence in long term follow up.

OBSERVATIONS AND RESULTS: The present study includes treatment of 20 feet in 14 patients with old neglected, relapsed and rigid clubfoot treated with JESS application.

The following observations were made from the data collected in our study:

Type	No. of feet	percentage
Neglected	4	20
Pop drop out	11	55
Recurrent/relapsed	5	25
Total	20	100
TABLE SHOWING TYPE OF CLUB FOOT		

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COMPLICATIONS: Temporary edema noted in 15 feet which was treated by elevation of foot and temporary stoppage of distraction.

1. Superficial pin tract infection noted in 17 feet which was treated with regular dressing and antibiotics.
2. Skin necrosis noted in 1 foot (on the lateral border of the foot) was treated with dressing and temporary cessation of distraction.
3. Flexion contracture of toes was noted in 1 patient which was treated with passive stretching and foot plate application.
4. No incidence of loosening of pins or hematoma formation or osteomyelitis.

The average follow up period was 8 months with ranging from 4 to 12 months.

RESULTS: Of the 20 feet treated by JESS 7 (35%) were excellent, 11 (55%) were good, 1 (5%) was fair and 1 (5%) was poor.

WE GRADE RESULTS AS FOLLOWS

EXCELLENT: The foot was normal in appearance and shape, equal to the other side (in unilateral cases) with well-maintained arches. The child could actively dorsiflex and evert the foot. The range of movements were full. The child could comfortably squat.

There were no permanent residual complications osteomyelitis or skin necrosis due to over permanent flexion deformities of toes needing some corrective procedure. The foot could be used for routine physical activities without any disability.

GOOD: Same as above except that the range of movements of the foot was more than 50% but not full. The child – parents were fully satisfied with the result.

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FAIR: The shape of the foot was not normal, some residual deformity persisting or mild pes planus deformity. Though active dorsiflexion and eversion was possible the foot could only be brought to plantigrade position. Further dorsiflexion or eversion was not possible.

POOR: There was incomplete correction or there was over correction giving rise to flat foot; difficulty in squatting. Some residual permanent complication.

NEGLECTED CLUB FOOT – PRE OPERATIVE PHOTOGRAPHS

DISCUSSION: Functional improvement concerns patients more than just deformity correction. The goal of any club foot surgery is to obtain a cosmetically acceptable foot, pliable, functional, painless, plant grade foot and to spare the parent and the child from frequent hospitalization and years of treatment with casts and braces.⁴ The treatment for relapsed clubfoot is usually based on corrective operations on either side of the central deformity in the form of posteromedial release, calcaneal osteotomy, medial release and cuboid osteotomy.⁵ No treatment for relapsed clubfeet can achieve normal foot function.

The goal of any club foot surgery is to obtain a cosmetically acceptable, pliable, functional, painless, plantigrade foot. Differential distraction using JESS enables long-term maintenance of correction and good function. Nonetheless, the need for the JESS procedure is likely to decline because of the worldwide shift to the Ponseti method for primary treatment. Further follow-up is needed to determine whether any degenerative changes occur and affect function in adulthood.^{6,7}

This fixator has many theoretical advantages like avoiding fibrous tissue formation, prevention of further shortening of foot as against the bony procedures and proper control of all components of corrections, with actual lengthening and histiogenesis of the soft tissues.⁸

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POST OPERATIVE PHOTOGRAPHS

CONCLUSION: JESS technique plays an excellent role in the treatment of neglected, recurrent and resistant cases of CTEV to obtain a cosmetically acceptable, pliable, functional, painless and plantigrade foot and spares the parent and the child from the ordeal of frequent hospitalization and years of treatment with casts and braces.

The main advantages of JESS being gain in length of soft tissues as that of normal foot, actual lengthening of the musculotendinous units and the soft tissues by the method of distraction histogenesis without any loss of muscle power, absence of further shortening unlike bony procedures, maintenance of normal size and shape of foot and proper control of all the components of correction including repositioning of the bones.

JESS frame is superior to Ilizarov fixator because of its easier application, lighter weight, less cumbersome, shorter learning curve, less inventory and lower cost.

JESS procedure is easy to perform, semi invasive blood less surgery avoiding postoperative complications and fibrous tissue / scar formation and doesn't require any sophisticated instrumentation or image intensification.

The chief complications of JESS technique are temporary edema, pin tract infection, skin necrosis and flexion contracture of toes which can be successfully managed by foot elevation, regular dressing and antibiotics, temporary cessation of distraction and passive stretching of toes respectively.

The drawbacks of this procedure are that it cannot be applied in a grown up child with rigid bony and soft tissue deformities and in patients previously treated with JESS and having residual deformities, it requires regular and frequent out-patient visits with long term follow up to assess the complications, correction and recurrence.

In our study the length of foot was not lost, the deformity of the foot was nearly fully corrected and the strength of the muscle was retained to normal. However long term studies are necessary to accurately assess the functional outcome of the treatment of club foot by JESS.

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