Results of Using Reversed Ponseti Technique in Treatment of Congenital Vertical Talus

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Abstract

Introduction: Congenital vertical talus is a rare anomaly that causes a rocker bottom deformity of the foot. The foot is abducted with the heel in valgus & equinus deformity. Surgery was the main stay of treatment. Reversed ponseti technique of manipulation and serial casting of the foot is a new modality of minimal treatment of the deformity.

Patients and Methods: Forty six feet with congenital vertical talus were treated using weekly manipulation and serial casting followed by minimally invasive open talonavicular reduction with percutaneous pinning and Achilles tenotomy.

Results: Forty four out of forty six feet show excellent results with deformity correction and talonavicular reduction at 4 years follow-up with no recurrence of deformity.

Conclusion: Reversed ponseti technique of manipulation and serial casting followed by minimally invasive open talonavicular reduction give excellent results in treatment of congenital vertical talus.

Key Words: Vertical – Rockerbottom – Valgus – Equinus – Ponseti.

Introduction

VERTICAL talus, a rare condition produces a rocker-bottom deformity of the foot [1,2]. The navicular is dislocated dorsolaterally on the head of the talus, associated with hindfoot equinus, dorsal cuboid dislocation, and soft-tissue contracture including toe extensors, peroneals, anterior tibial tendons and Achilles tendon. The exact etiology of vertical talus is unknown, possible causes include muscle imbalance, especially over pull of the anterior tibial tendon [2,3].

It may occur as an isolated congenital abnormality in about 50% of cases [4,5,6]. It may be also associated with genetic disorders including trisomy 13, 18 or neuromuscular disorders in patients with myelomeningocele, arthrogryposis [7,8,9]. It has been suggested that the deformity represents an arrest of fetal development of the foot occurring between the 7th and 12th weeks of gestation [10].

Clinically, the dorsum of the foot is concave with convex plantar surface. The ankle appears in equinus and valgus deformity. The head of the talus is marked by a lump at the posteromedial border of the sole of the foot. The deformity is usually stiff and irreducible [2].

Radiologically, vertical talus can be diagnosed with a lateral view of the foot in planter flexion which shows fixed dorsal dislocation of the navicular on the head of the talus and a vertically standing talus [11]. Treatment options include one-stage or two-stage releases, talectomy, naviculectomy, subtalar arthrodesis, and triple arthrodesis [12].

Conservative treatment with reversed ponseti technique using serial manipulation and casting followed by minimal surgical intervention could give favorable results and deformity correction [13].

Patients and Methods

The purpose of this prospective study is to evaluate the results of using reversed Ponseti technique with manipulation and serial casting followed by minimally invasive surgical intervention for treatment of idiopathic congenital vertical talus. The study was done at the National Institute of Neuromotor system in Cairo, Egypt between 2010 till 2015. Thirty patients (46 feet) were included in our study, 22 patients were males and 8 patients were female. Sixteen patients have bilateral while 14 have unilateral vertical talus. The youngest
was 4 months and the oldest was 18 months with average (12) months.

Evaluation included preoperative history taking, clinical & radiographic examination. Number of casts was calculated for each patient. Postoperatively, outcome was measured according to the clinical & radiographic improvements and the recurrence.

Our study population included all patients presented below the age of 4 years with idiopathic congenital vertical talus excluding patients with syndromic vertical talus and non-idiopathic vertical talus.

All our patients undergone deformity correction with serial manipulation & casting using reversed ponseti technique followed by minimally invasive open talonavicular reduction.

*Casting technique:* Manipulation begins with palpation of the head of the talus which is located at medio-plantar aspect of the sole of the foot. The thumb press against the head of the talus during manipulation with the other hand is used to manipulate the forefoot.

The calcaneus is not touched in order to allow the calcaneus to slide from valgus to varus position under the talus. The direction of manipulation is in equinus and inversion. All components are corrected simultaneously except for the equinus. Gentle manipulation is repeated for 10 to 15 minutes in order to stretch all the ligaments and joint capsules of the foot to allow reduction.

This is followed by casting in the reduced position of equinus and inversion. The cast is extended above the knee joint to avoid slippage and maintain position in a 90° knee of flexion. Only a thin layer of cotton is applied so that the osseous landmarks of the foot can be easily palpated, which allow careful molding of the plaster cast. Four to six plaster casts, changed weekly following manipulations, are necessary to loosen the dorsal & lateral ligamentous structures of the foot.

The cast is removed just three hours before the following cast using warm water. The time of operation is scheduled according to obtaining a full reduction of the talocalcaneal joint which is confirmed by an X-ray of the ankle joint in the last cast. On the last cast, a lateral X-ray of the ankle is taken and the talofirst-metatarsal angle of less than 15 degrees is an indicator of full talar reduction and now the patient become ready for surgery. The operation is then scheduled one week later.

*Operative technique:*

The patient is placed in a supine position. General anesthesia is used. Above knee tourniquet is inflated. After draping, a small skin incision of about 2cm is made over the talonavicular joint. The talonavicular joint capsule is exposed and opened. The head of the talus and the navicular bone is exposed.

The talonavicular joint capsule is incised to facilitate talonavicular reduction. Reduction is obtained under vision with inverting the foot in equinus. The reduction is then maintained using a 1.5mm k-wire which is introduced antegrade from the first metatarsal across the talonavicular joint aiming at the posterior cortex of the talar body. Intraoperative fluoroscopy is used to ensure a talonavicular axis angle of <20° after Kirschner wire fixation. The joint capsule is sutured again with tightening of the attenuated spring ligament and the capsule.

Following reduction and fixation of the talonavicular joint, the Achilles tendon become tight. A percutaneous tenotomy of the Achilles is carried out using no. 11 scalpel to correct the equinus deformity. The foot held in dorsiflexion with the knee in extension. The scalpel is introduced just one and half cm above the insertion of the Achilles tendon with the blade pointing proximally. We prefer to do the cut from medial to lateral to avoid the neurovascular bundle.

A pop is heard indicating full Tenotomy of the Achilles tendon and the foot can be dorsiflexed to at least 20 degrees. If plantar flexion is limited to <25°, fractional lengthening of the extensor digitorum communis and tibialis anterior tendons is done at the level of the musculotendinous Junction through a small incision proximal to the ankle Joint.

If passive forefoot adduction is <10°, fractional lengthening or z-plasty of the peroneal brevis tendon is performed at the musculotendinous junction.

After reduction, k-wire fixation and Achilles lengthening, an above knee cast in neutral position is applied. A long leg cast is then applied with the foot in a neutral position and the ankle in 5° of dorsiflexion for 6 weeks.

The k-wire is removed after six weeks and a Dennis brown splint is used. The Dennis brown splint is formed of two medical shoes with inner arch support connected at 90 degrees to a straight metal bar equal the length of the distance between the child’s shoulders.
Fig. (1): Position of the thumb [13].

Fig. (2): Direction of manipulation [13].

Fig. (3): Cast with the foot in equinus, hindfoot varus, and forefoot adduction.

Fig. (4): Talonavicular reduction under vision and fixation with a K-wire.

Fig. (5): The foot before and after Achilles tenotomy.

Fig. (6): Site of the incision for dorsiflexors and peroneal tendon lengthening.
The shoes are placed on the bar pointed straight ahead rather than externally rotated. The shoes are is made in 15° of plantar flexion and 15° of adduction at the midtarsal joint to help to maintain reduction.

The splint is worn for three months continuously with only one hour free per day. Following that, the splint is worn at bed time for 8 hours at night and 4 to 6 hours during day time till the age of three and half years.

In case of recurrence the deformity, the patient treatment method with manipulation and serial casting is repeated followed by open reduction and k wire fixation. Through the same incision, the tibialis anterior tendon is elevated from its insertion and re-attached to the neck of the talus acting as a sling to hold the talus in the reduced position.

Results

Patients were evaluated at fixed time intervals, during the first year; they were evaluated every three months then every six months.

Duration of follow-up was four years with a minimum of two years.

Thirty patients (46 feet) with CVT were included in our study. The average age of the patients was 12 months (range 4-18 months), 22 patients were male, and 8 patients were female.

Sixteen patients had bilateral while 14 had unilateral vertical talus.

All the patients were treated first by manipulation and casting. The average number of casts needed to manipulate the foot into inversion and equinus in order to stretch the soft tissue was 6 casts (range 5-8 casts).

All the patients needed Achilles tenotomy and k-wire fixation. This decrease the incidence of postoperative subluxation. Four patients (6 feet) show recurrence and were treated by peroneal tendon lengthening and lengthening of the extensor digitorum tendons.

Of these 6 feet, the talonavicular reduction was unstable in 2 feet and needed tibialis anterior transfer around the neck of the talus.

At 4 year follow-up, 42 (91%) feet out of 46 feet show excellent results with correction of the rocker bottom deformity and complete reduction of the talonavicular joint, correction of the hindfoot valgus and the forefoot abduction. The valgus deformity of the heel is reduced below than 7 degrees valgus in 42 (91%) patients.

Graph (1): Different surgical procedures in the CVT group.

Graph (2): Valgus foot assessment.

Graph (3): Rocker bottom deformity assessment.
In all feet, restoration of neutral forefoot abduction was achieved. Regarding the ankle range of motion, 38 out of 46 patients had more than 20 degree plantar flexion and dorsiflexion, with the rest of patients less than 10 degrees plantar flexion & dorsiflexion.

Complications:

The procedure of correcting the congenital vertical talus deformity with serial casting and manipulation is associated with minimal complications including pressure ulcers on the site of pressure over the head of the talus, recurrence, wound problems and pin tract infection. In our series, it was observed only in two cases had pressure ulcers during casting and were managed using local treatment. Recurrence was observed in 6 feet because of the tightness of the toes dorsiflexors and the peronei were managed by surgical lengthening of these tendons. Wound problems and pin tract infection were found in only three patients and were managed with change dressing and local antibiotics. No cases had avascular necrosis in our series.

Discussion

Congenital vertical talus is a rare deformity of the foot that causes a severe disability. If left untreated the condition will result in a very painful and deformed foot in adolescence. Most authors agree that the disorder should be recognized early and treated before the age of 2 [14].

Although many surgical procedures have been described for the correction of congenital vertical talus, the best operative technique to treat this condition hasn’t been established yet [14].

Serial casting and manipulation of the foot found to be beneficial for stretching the soft tissues and neurovascular structures of the foot but it was not seen as a way to achieve definitive correction of the deformity.

Of the different types of major reconstructive surgery, single-stage releases, two-stage releases, soft-tissue releases with navicular excision, Grice-Green subtalar fusion and triple arthrodesis.

All of these procedures were accompanied by major complications including avascular necrosis of the head of the talus, under correction, recurrence of the deformity and foot stiffness.

Reviewing the different techniques of only surgical reconstruction of the foot with congenital vertical talus we found that using extensive release with lengthening of tendons and fixation procedures (ETLF) on 78 patients, only 55 (70%) patient’s show good results and 30% show poor results. Using extensive release with tibialis anterior transfer (ETT) operated on 43 patients; only 32 (74%) patients show good results after the operation and 26% show poor results.

Treatment of patients with navicular excision on a small series of four patients, only 2 (50%) patients show good results and 2 poor results [14].

In comparison to our serious, we have 30 patients (46 feet) with 40 feet show excellent results (87%) with only 6 feet (13%) show recurrence and after revision they show very good outcome.

From these results our technique of treatment has a superior outcome with less surgical invasion and minimal complications.
Seimon reported success with a more limited surgical approach on 7 patients (10 feet) that involve release of the dorsal talonavicular joint capsule and lengthening of the peroneus tertius, extensor hallucis longus, and tibialis anterior tendons followed by Kirschner wire fixation of the talonavicular joint. All patients in his study had some restriction of inversion-eversion, which ranged between 25% and 75% of normal. In addition, one patient had a fixed equinus contracture.

This is compared to our series in which 44 feet (96%) show full range of motion with no restriction and only 2 feet (5%) had some restriction.

The introduction of Ponseti technique in treatment of clubfoot deformity opened the way for using serial casting and manipulation in treatment of congenital vertical talus. The overall goal of treatment of a congenital vertical talus is the restoration of a normal anatomic relationship among the talus, navicular, and calcaneus.

The technique was first described by Dobbs using serial casting and manipulation, the deformity could be reduced by stretching the tendons and ligaments of the foot facilitating minimal surgical intervention. The results were satisfactory and feet were corrected [13].

The principles of manipulation and treatment with plaster casts are similar to those used in the Ponseti method of clubfoot correction, but the forces are applied in an opposite direction. An average of five casts was required to reduce the forefoot onto the head of the talus in our study. By the time that the last cast is applied, the cast is applied so that the foot mimics the appearance of an untreated clubfoot, achieving maximum stretch of the soft tissues that are hindering correction.

Once the forefoot is seen radiographically to be reduced on the head of the talus, the reduction is best held with a Kirschner wire placed percutaneously across the talonavicular joint with the foot in maximum plantar flexion. Once the forefoot is held in the reduced position, the hind foot equines can be corrected with a percutaneous Achilles tendon lengthening without risking loss of forefoot reduction. A solid ankle-foot orthosis is recommended to be worn full time until the child reaches walking age and then for walking until the age of three years to keep the forefoot plantar flexed and to prevent recurrence of the deformity.

In our study, we conducted the procedure of serial manipulation and casting using reversed Ponseti technique over 46 feet with congenital vertical talus. All of them were below 4 year old. Forty two of them showed satisfactory results with no recurrence after the first procedure. Only six feet had recurrence of the deformity because of the contracted tendons and the stiffness of the foot. They all were corrected by lengthening the dorsiflexor and peroneal tendons and transfer of the tibialis anterior tendon around the neck of the talus. Minimum follow-up was 2 years with a maximum of 4 years follow-up. Our study show excellent results with full correction of the feet which is similar to the results published by Dobbs in 2006, 2007 which was conducted on 11 patients (19 feet) with congenital vertical talus. In both studies all the patients needed Achilles tendon tenotomy. In our study, 6 feet needed tendon lengthening, dorsiflexor lengthening (4 feet) and peroneal tendon (2 feet) lengthening in comparison to Dobbs who had 2 patients for tibialis anterior lengthening and one patient needed peroneus brevis lengthening and extensor tendon lengthening. In our study, the talonavicular joint of all the feet were fixed using a k-wire. This prevents later on talonavicular subluxation which was observed in three patients in Dobbs study who were not stabilized by K-wires [13].

Graph (5): Comparing our results to Dobbs results.

In both studies, no extensive surgical releases were used with no major complications. Both series show good results in most of the patients in comparison to other methods of treatment.

Conclusion:

Serial manipulation and cast immobilization followed by talonavicular pin fixation and percutaneous tenotomy of the Achilles tendon for treatment of congenital vertical talus provides excellent results, in terms of the clinical appearance of the foot, foot function, and deformity correction at a 4 years follow-up. Complications of this technique are minimal and at the same time give an excellent outcome.
References


