

CURRENT CONCEPTS IN THE MANAGEMENT OF CLUBFOOT DEFORMITY: The Ponseti Method

Anna Weber, DPM

Eric Jaakola, DPM

Todd Haddon, DPM

Clubfoot is among the most common and severe congenital deformities of the foot. The incidence is reported to be 1:1000 live births Caucasians.¹ Several etiologies have been proposed, and genetic involvement has been confirmed.^{2,3} On a pathologic level, clubfoot specimens reveal an excess of collagen synthesis and retracting fibrosis in the muscles, fasciae, ligaments and tendon sheaths of the posterior and medial aspects of the foot and leg.⁴ The structural deformity that results is a combination of equinus, cavus, adductus and varus.

For many centuries, the primary deforming forces as well as the appropriate conservative and surgical treatment of clubfoot have been debated. Manipulation and casting of clubfoot was discussed as early as 400 BC by Hippocrates.⁵ The first surgical treatment, consisting of subcutaneous tenotomies, was performed by Lorenz in 1782.⁵ Since that time, numerous treatment approaches have been described. Most authors presently agree that surgical intervention should follow, or be performed in conjunction with, a period of casting.

In 1930, Kite described a casting technique which utilizes gentle, progressive manipulation followed by a series of plaster casts. Kite described abduction of the foot at the midtarsal joint, with the thumb pressing in the area

of the calcaneocuboid joint. Kite's technique addresses the heel varus separately by everting the calcaneus over many months. Ponseti, in 1948, described an alternative method of plaster casting based on years of observation of both conservative and surgical clubfoot treatment. The new concept that Ponseti introduced, was that the heel varus can be corrected by abducting the calcaneus under the talus rather than by everting the calcaneus. In the Ponseti method of casting, the navicular, cuboid and calcaneus are gradually abducted, causing simultaneous reduction of the heel varus. Counter-pressure is applied at the head of the talus, which is palpated laterally.⁶

Of paramount concern, and perhaps discussed the least, is the long-term functional outcome of individuals with clubfoot deformities (Figures 1, 2). Regardless of what methods are employed, it seems clear that the long-term function can be seriously limited in individuals with clubfoot deformities. While successful casting is certainly desired, a final success is sometimes difficult to quantify. In situations where medical treatment is unavailable to infants born with clubfoot, such as in third world countries, undesirable results are frequently expected. However, in the United States it would seem reasonable to hope that the children treated with casting from birth, even when



Figure 1. 1-year-old following unsuccessful conservative treatment.

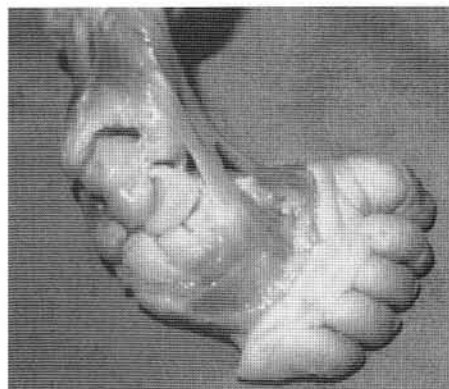


Figure 2. 3-day old infant specimen demonstrating clubfoot anatomy. (Image Courtesy of I. Ponseti)

requiring surgery should have acceptable functional outcomes in the form of a plantigrade foot that functions with minimal discomfort. With such significant debate existing regarding a standard treatment protocol, casting techniques and even the surgical reduction approaches, it should come as no surprise that not all surgeons approach a clubfoot in the same fashion.

The primary goal of all clubfoot surgery has centered on performing a successful posterior medial release. Exactly how this is performed can vary quite significantly between surgeons. Among the most popular surgical approaches, the Cincinnati and the Turco, allow for excellent exposure and release of necessary structures.^{7,8} (Figures 3-5) Structures to be evaluated and released may include the: Achilles tendon, posterior ankle, posterior and medial subtalar joint, flexor digitorum longus, flexor hallucis longus, tibialis posterior, calcaneofibular ligament, and peroneal

tendon sheaths while preserving the deep deltoid and interosseous talocalcaneal ligaments.

THE PONSETI METHOD

Although the Ponseti method of clubfoot casting relies on simultaneous reduction of all the components of the clubfoot deformity, the components will be addressed separately for ease of explanation. As in other methods of casting, gentle manipulation and serial cast applications should be started as early as possible even within the first few days of life. Casts are then applied at weekly intervals. Successful reduction of the deformity is usually achieved with as few as five to six casts.⁹ In 85% of cases, the equinus deformity is not manually reducible and a percutaneous Achilles tenotomy is required.¹⁰ This is performed in the clinic under local anesthesia and is

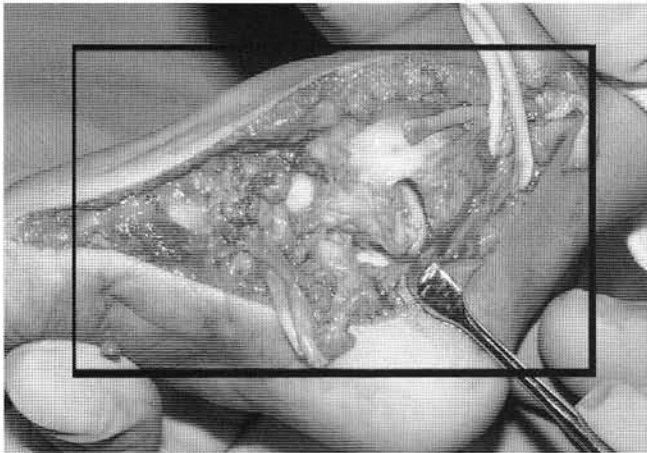


Figure 3. Typical medial appearance with the Turco approach.

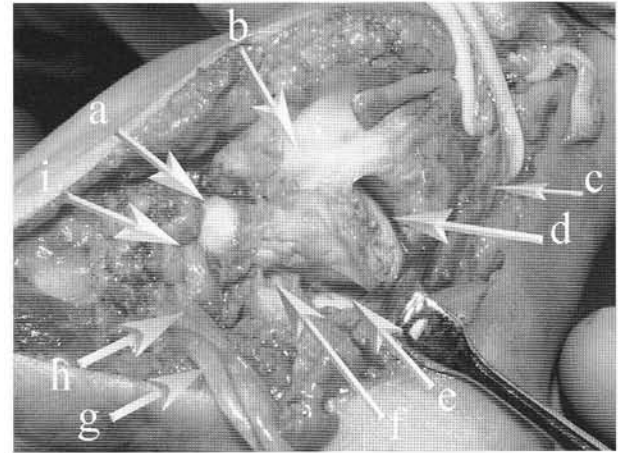


Figure 3A. Magnified region of image 2. a-Talar Head, b-Deltoid Ligament, c-Neurovascular Bundle, d-Ankle Joint, e-Subtalar Joint, f-Interosseous Ligament, g-Flexor Halucis Longus Tendon, h-Tibialis Posterior Tendon, i-Navicular.



Figure 4. Medial column fixation performed under direct visualization ensuring reduction of the talonavicular joint.



Figure 5. Final appearance of the corrected foot. Note position of K-wire following retrograde advancement and distal exit.

followed by a final cast which is left on for three weeks. Successful maintenance of correction relies on a foot abduction bar, which the baby must wear at all times for three months and thereafter at night for an additional two years.

CAVUS

Although the overall appearance of the clubfoot is that of a supinated deformity, the forefoot is actually pronated with respect to the rearfoot, causing a forefoot cavus. This is due to a severely plantarflexed position of the first metatarsal while the fifth metatarsal maintains a proper sagittal plane alignment with the cuboid and calcaneus. The cavus component is usually reduced with the first cast. The forefoot is supinated by applying pressure to the



Figure 6. Note forefoot supination in first cast. Deformity often appears more severe at this stage.

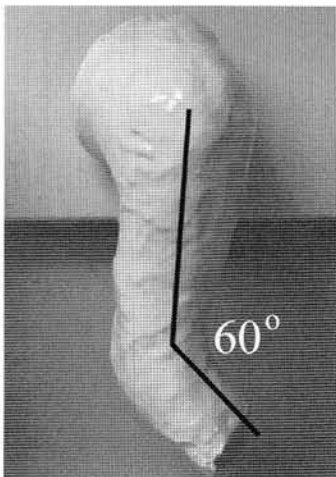


Figure 8. Last cast prior to correction of equines deformity. Note the abducted, overcorrected position of the forefoot.

plantar aspect of the first metatarsal. The forefoot is simultaneously abducted while counter-pressure is applied to the head of the talus, which can be palpated laterally (Figure 6.).

ADDUCTUS AND VARUS

In the clubfoot, the talus is in severe equinus, the body is misshapen and the neck of the talus is angulated medially. The anterior process of the calcaneus lies directly beneath the head of the talus, causing heel varus and equinus. Gradual abduction of the calcaneus, navicular and cuboid over a series of several casts eventually brings the calcaneus into a normal relationship with the talus. Reduction of the calcaneal varus occurs simultaneously without the use of additional eversion force (Figure 7). Manipulation and

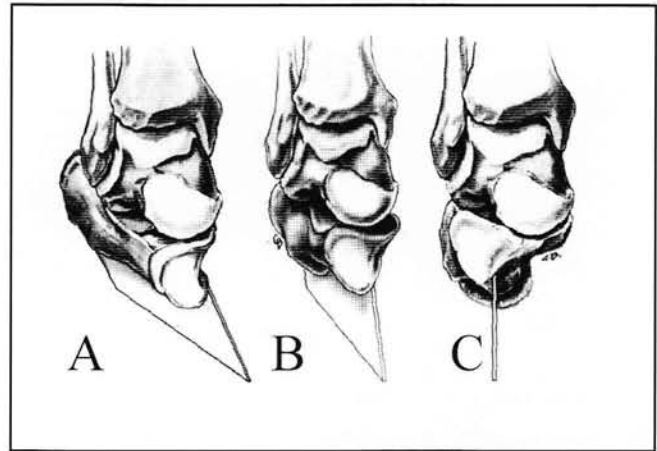


Figure 7A. Position of talocalcaneal relationship in unreduced deformity. Figure 7B. Incorrect reduction with forced eversion of calcaneus. Figure 7C. Heel varus reduced by gradual abduction of calcaneus, cuboid and navicular about the fixed talus. (Image Courtesy of I. Ponseti)



Figure 8. Last cast prior to correction of equines deformity. Note the abducted, overcorrected position of the forefoot.

casting involves further abduction of the forefoot against counter-pressure at the head of the talus. At the same time, the supination described above is gradually lessened but without pronating the forefoot. Weekly casts are continued until approximately 70 degrees of abduction is achieved.

EQUINUS

Once the foot has been casted in approximately 70 degrees of abduction, the equinus deformity is addressed (Figure 8). Over an additional one to two casts, the foot is dorsiflexed with one hand under the entire plantar aspect of the foot while the other hand gently grasps the heel and pulls downward. A rocker-bottom deformity can occur if the dorsiflexory pressure is exerted at the metatarsal heads rather than the entire plantar surface. It is reported that approximately 85% of feet require a percutaneous Achilles tenotomy (Figure 9) to achieve the desired 15 degrees of dorsiflexion.¹⁰ This can be performed in the office under local anesthesia using a small cataract blade. A light sterile dressing is applied, followed by the last cast which is left in place for three weeks.

FOOT ABDUCTION DEVICE

Following removal of the last cast, the baby is placed in a foot abduction device, such as the Denis-Browne splint (Figure 10). This is worn at all times for three months and then at night for an additional two to three years. The device is fitted to maintain the foot in 70 degrees of abduction and 15 degrees of dorsiflexion. Failure to wear the splint is the most common cause of recurrence following Ponseti casting technique. Therefore, the importance of brace compliance cannot be overemphasized with the patient's family.

RESULTS

Laaveg and Ponseti reported on 104 patients at a follow-up of ten to twenty-seven years. Of the 104 patients, 48 underwent a transfer of the tibialis anterior tendon to the third cuneiform to treat relapse or residual supination. Seventeen (16%) had various other procedures. Only four of the 104 patients in their series required posterior medial release.¹¹ Eighty-eight percent of patients were satisfied with the overall result of treatment. In 1997, Herzenberg et al abandoned their protocol of traditional casting followed by posterior medial release and began using the Ponseti method of casting. They found that only one of thirty-four Ponseti-treated feet required PMR, compared to 32 of 34 patients treated with their previous protocol.¹²



Figure 10. Denis-Browne splint maintaining the abducted forefoot position.

DISCUSSION

The Ponseti method of clubfoot casting is a useful technique for managing clubfoot with early non-surgical intervention. Follow-up studies of Ponseti-treated clubfeet are favorable and offer some of the longest-term results in the literature. This does not suggest that surgical intervention can be completely avoided, but reserved for more resistant cases. Even in the most skilled hands, the posterior medial release may leave a patient with residual pain, scarring and deformity. Therefore, it is prudent to have made every effort to avoid surgery until the most effective conservative measures have been attempted.

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