

Management of the Complex Clubfoot

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Abstract: Along with syndromic or neuromuscular clubfoot, complex (“atypical”) clubfoot represents a category of clubfoot that is difficult to treat using the Ponseti method. It is important to identify this type of foot early because the treatment and prognosis are different from that of idiopathic clubfoot. Some cases can be suspected at birth and prior to treatment while other cases are iatrogenically caused; but in both instances the anatomic features and treatment are the same. Consideration of complex idiopathic clubfeet should be given with the anatomic presence of a deep plantar crease and hyperextended first toe. In iatrogenic cases, the provider may be alerted by extreme irritation, redness, swelling and warmth with a history of cast failure and slippage. Parents should be made aware of the increased difficulty in treating complex clubfoot, and be prepared for additional cast time, early or repeat Achilles tenotomy, or difficulty with brace wear.

Key Points:

- Complex idiopathic clubfoot is a non-neurologic, non-syndromic category that occurs in 9%-17% of cases.
- Some may be detected at birth, while most are detected later during treatment and may be iatrogenic, but both have the same features and treatment.
- The three main anatomic features are rigid equinus, a deep plantar crease, and hyperextended first toe.
- Excellent results can be obtained using a modified Ponseti technique, but recurrence rates may be higher.

Introduction

With the adoption of less invasive techniques for clubfoot treatment, such as the Ponseti method, the rate of surgical releases in the United States decreased from 70% in 1996 to just over 10% in 2006.¹⁻³ However, the relapse rate after successful Ponseti treatment is relatively high, brace compliance notwithstanding, and is reported to be about 30% with 4-year follow-up.^{4,5} In studies with longer term follow-up, the relapse rate increased as the duration of follow-up increased. A systematic review showed rates of relapse from 3.7% to 67.3% of cases, occurring as late as 10 years of age.⁶

The first person to recognize the concerning issue of relapse after use of the Ponseti method, was Dr. Ponseti himself.⁷ In his initial technique, he recommended using bracing for 2-years post correction and then noted through his own experience that some children recurred even years after that time.^{8,9} Towards his later years, he recommended longer use of the brace to prevent recurrence. Additionally, he began to identify a group of idiopathic cases that were extremely challenging to correct and had specific physical characteristics. He cited Turco’s observation that a subset of clubfeet “respond altogether differently to both operative and nonoperative treatment” and warned particularly against



Figure 1. Illustration of these physical characteristics in a newborn infant. This type of clubfoot presents early, without the iatrogenic swelling, warmth and erythema in cases that have had failed casting.

surgery.¹⁰ Unlike usual idiopathic cases, these feet were refractory to normal manipulations and likely retained some residual deformity—the persistent, rather than recurrent foot, or an under-corrected clubfoot at the time of bracing. These feet were termed “complex idiopathic clubfeet” but have also been called “atypical clubfeet.”

Etiology and Epidemiology

Dr. Ponseti identified 50 out of 762 (7%) consecutive patients with complex clubfoot pattern, and this remains the largest detailed series to date.⁷ Other papers have reported an incidence of 9%-17%.¹¹ The percentage of affected boys is much larger than that of girls.^{7,12-14} Nineteen of Dr. Ponseti's patients (38%) presented at his institution with complex clubfeet prior to treatment, while 31 (62%) had been treated in casts prior to their visit. Thus, the etiology was considered iatrogenic with warmth, swelling and erythema consistent with cast irritation. Regardless of when the diagnosis was made,

the physical appearance was similar and treatment was the same.

A recent paper questioned whether complex clubfoot patterns could be detected in idiopathic clubfoot and that these patients were really all iatrogenic cases.¹⁵ The authors analyzed 38 patients with feet which had documented pre-treatment photographs confirming lack of complex features, who then presented to the treating institution with complex clubfeet. In many cases, the authors observed that rigid, poorly molded, plaster of Paris casts on short, stubby feet had resulted in the feet slipping

backward into a forced, plantar-flexed position. There were fewer presenting patients who had soft casts, leading the authors to speculate that the nonconformability of the plaster material leads to the secondary deformities as well as the accompanying erythema and swelling. Radiographs of the feet inside the cast confirmed marked equinus of the hindfoot, plantarflexion of the metatarsals at the Lisfranc joint, and severe cavus.

Not all short, stubby feet became complex in spite of casts slipping. The authors concluded that there may be intrinsic factors such as fibrotic muscles or a short gastrocnemius muscle which predisposed certain feet to develop the complex deformity after ill-fitting cast



Figure 2. This is a 2-month-old infant with bilateral clubfoot, who may have an iatrogenic etiology as the child has failed initial casts.

placement. Ponseti also described severe fibrosis in the quadratus plantae, gastrosoleus, and ligaments.⁷

Clinical Presentation

Complex idiopathic clubfoot has been described as having the following key features:

1. Rigid equinus
2. Forefoot adduction and supination
3. Severe plantar flexion of all metatarsals
4. A deep transverse crease in the sole of the foot
5. A deep crease above the heel
6. Short and hyperextended first toe

It is critical to identify the iatrogenic complex type of foot early, as modifications to the casting technique can achieve success or at the very least, not worsen the existing deformity. Consideration to making this diagnosis should be given as soon as there are early failures of casting. It may be helpful to have initial photographs taken, so that a retrospective look can be made after cast failure.

In clinical practice, it is not necessary to have all of the features present to identify a foot as complex clubfoot pattern. The most common components are a short stubby foot with rigid equinus, a severe plantar crease in the sole of the foot, as well as a short and hyperextended first toe.

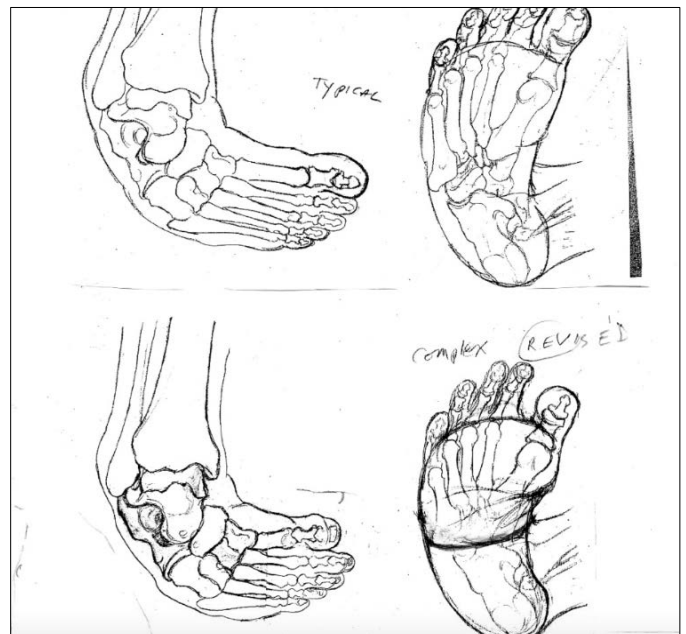


Figure 3 This drawing depicts features of typical vs. complex foot. The complex foot is shorter with severe cavus. (Artwork by Hugh Nechamie.)

All other features of the child should point to an idiopathic cause for clubfoot—the physical examination should rule out arthrogryposis, myelomeningocele, and severe peroneal nerve palsy resulting in a drop foot or drop-toe sign.¹⁶

Although most patients do not obtain radiographs, the findings would be severe plantar flexion of the calcaneus and talus, medial cuboid displacement, and severe

plantarflexion of the metatarsals.⁷ Because there is often an iatrogenic etiology, there may also be hyperabduction of the forefoot through the tarso-metatarsal joints. This results from the practitioner who fails to recognize the development of the complex pattern and who continues to persist with the classic forefoot abduction method that Ponseti taught us in more routine clubfeet

Treatment

Once the complex clubfoot has been identified, the standard Ponseti method (forefoot abduction against pressure on the talar head) should be abandoned and the method modified in order for correction to occur.

Supination Maneuver

The importance of this is somewhat controversial. Although Dr. Ponseti discussed this maneuver, it is probably of secondary importance compared to the next described step. Complex clubfeet are generally short and stubby, making it difficult to recognize anatomic landmarks. Special care should be taken to identify the subtalar joint, in particular, the lateral head of the talus. Ponseti described putting the index finger on the lateral malleolus while the thumb of the same hand-applied pressure over the lateral head of the talus immediately anteriorly, taking care not to confuse the talus for the prominent anterior calcaneal tuberosity.⁷ Adduction of the forefoot should correct fairly easily as supination is applied to the forefoot with a correct counterpoint on the lateral head of the talus. In fact, the foot should not be abducted past 40° degrees, and one should be cognizant of formation of a lateral skin crease indicating possible midfoot break.

Midfoot Dorsiflexion, or “Four finger” Technique

Sometimes called the “four finger” technique, it is essentially to stabilize the hindfoot/ankle firmly and correcting the cavus while pushing up on the metatarsals with the thumbs.¹¹ Once maximal dorsiflexion is achieved and a short leg cast is applied, a dorsal splint

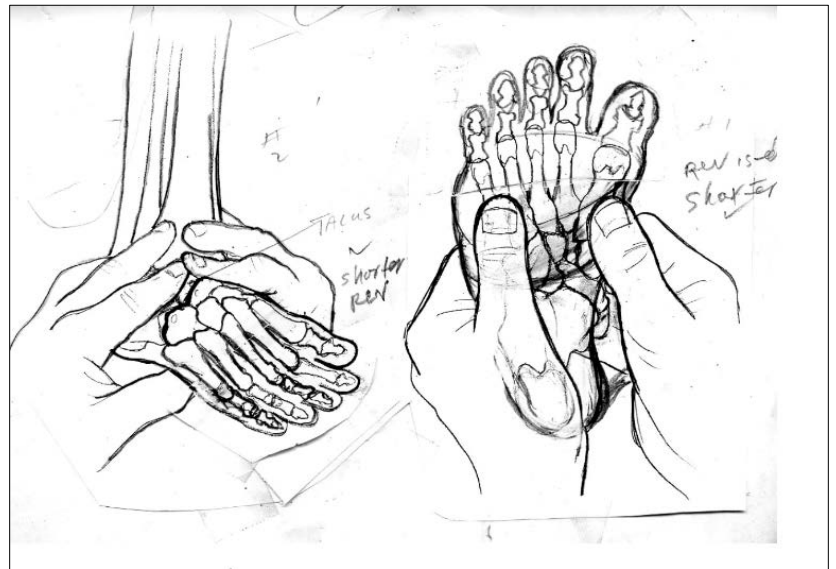


Figure 4. Here we demonstrate the 4-finger maneuver, which is critical to address the severe metatarsal plantarflexion, as well as to accommodate for the hindfoot equinus. (Artwork by Hugh Nechamie.)

can be applied above the knee and held in position with a light circumferential plaster wrap. In order to prevent slippage, this long leg component of the cast can be placed in 100-110 deg of flexion using an anterior splint which is then wrapped again with a light layer of plaster.⁷ Because of the hyperflexion, care should be taken to ensure distal vascularity is not compromised by compression in the popliteal fossa.

Achilles Release

As in idiopathic cases, Achilles tenotomy is almost always performed prior to placement of the last cast. In complex clubfoot, the Achilles tendon has been described as being exceptionally taut and fibrotic up to the middle of the calf.¹² Ideally, the midfoot crease has been corrected in prior casts and the tenotomy can be reserved to address the hindfoot portion of the equinus deformity. However, in cases where the cast continues to slip, an early tenotomy may be helpful to keep the casts on during the midfoot correction. A lateral view of the corrected vs. uncorrected foot should show both midfoot and hindfoot resolution of equinus.

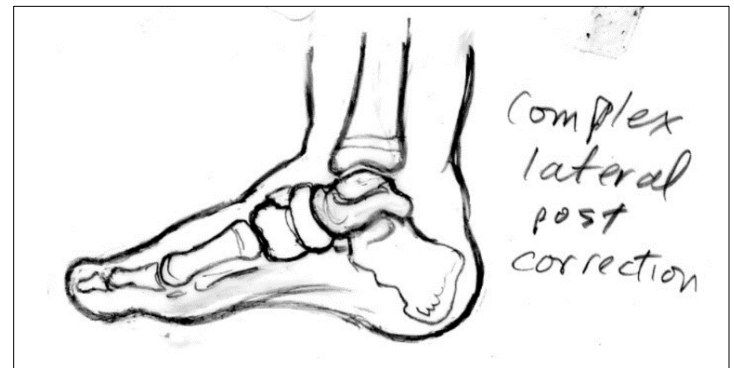
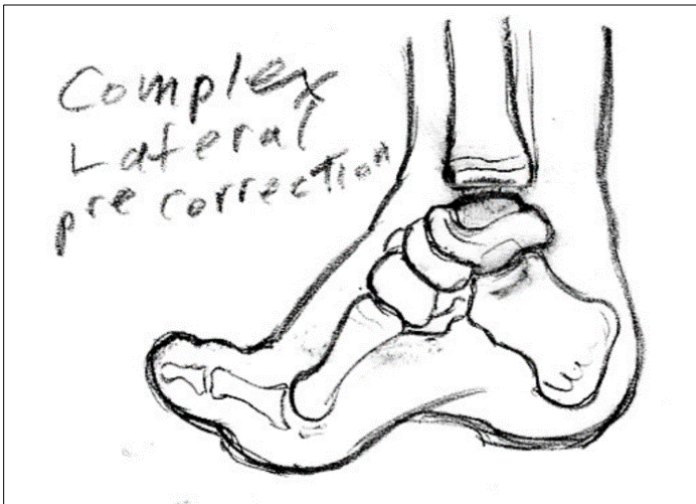


Figure 5. This figure demonstrates an uncorrected lateral foot, compared to a corrected lateral foot. (Artwork by Hugh Nechamie)

Bracing

The foot abduction orthosis is applied at in lesser degrees of external rotation (40°) with the usual recommended dosage of full, 23-hour wear for the first 12 weeks. This is followed by 12-14 hour wear for a minimum of 3 years.¹²

Alternate Diagnoses

Recurrence after the Ponseti method can occur early or later in the process of treatment. Chu and Lehman described persistent clubfoot as occurring soon after brace placement due to under correction of the clubfoot.¹⁷ True recurrence tended to occur in a foot that was corrected but had a natural tendency to recur due to an underlying, undiagnosed syndrome such as neurologic causes, arthrogyriposis, or peroneal nerve palsy.¹⁸ A complex idiopathic clubfoot that has not been initially identified would likely fall into the category of early failure. Once identified, whether in a newborn or in an older child who has had sub-par results from the traditional Ponseti method; we would recommend careful evaluation and pursuit of whichever treatment component will address the residual deformity.^{17,19-21} In the majority of cases, there will be midfoot plantarflexion, and casting using the “four finger technique”, when applied correctly, will be beneficial.

Outcomes

Using the modified technique, Ponseti had excellent results at 23 months, with all feet well corrected and minimal ankle dorsiflexion of 15° .⁷ He reported 14% of patients with one relapse, and 4% with a second relapse, all of which were identified by parents who had difficulty with brace wear. Three patients required a second tenotomy, but there were no other surgeries needed.

Mandlecha et al. had 16 patients with a follow-up of 14.8 months.¹² Unlike Ponseti, this series required more casts (7.44 vs. 5). An excellent result was also achieved, but the relapse rate was 11.1%, treated by repeat manipulation and tenotomy.

Goksan et al. reported on “complex” deformities prior to Dr. Ponseti’s definition of complex clubfoot.¹³ He noted that the experience of the practitioner played a role in the success of the Ponseti method, and a group of patients with iatrogenic failure by poorly placed casts relapsed at a rate of 66% (6 out of 9 feet). However, with a follow up of 46 months, only 1 of those feet required joint release surgery.

Finally, Matar et al. looked at 11 children with 17 complex feet, treated with the modified Ponseti technique at an average follow up of 7 years.¹⁴ These

findings encapsulate and confirm what has been reported by other authors: more casting required (average of 7), 100% rate of Achilles lengthening, and a relapse rate of 53%.²² Half of the relapses were managed by repeat casting and/or repeat tenotomy, but 4 feet required extensive surgical releases.

Conclusion

Complex clubfeet occur in 9%-17% of cases and may be recognized by certain anatomic features: stiff equinus, plantarflexion crease, and hyperextended first toe. If not noted at birth, complex clubfeet can be detected during treatment with the standard Ponseti sequence and thus iatrogenic causes are suspected as a foot slips repeatedly out of casts or fails early on after brace initiation. The Ponseti technique should be modified for treatment through avoidance of hyperabduction, working on careful dorsiflexion of the midfoot, and consideration for early tenotomy in cases recalcitrant to casting. When performed correctly, the modified Ponseti technique is successful in the majority of cases. If recurrence occurs, it can be treated again via casting, repeat tenotomy, or rarely, surgical release.

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