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Step by Step®
Management of Clubfoot by Ponseti Technique

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2nd Edition

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CHAPTER 13

Atypical Clubfoot

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INTRODUCTION: ATYPICAL CLUBFOOT

Congenital idiopathic clubfoot is a deformity typically occurring in an otherwise healthy child. The most recent reports using the Ponseti method showed excellent corrections in the majority of patients. Most clubfeet correct with four to six manipulations followed by plaster cast applications by skillful orthopaedists. However, a small percentage of clubfeet are very severe and difficult to treat. They have been called very severe, stiff, and teratogenic. Numerous surgeons have performed complete, plantar, lateral, medial, and posterior releases with poor results. Relapses have been frequent.

There are a small number of clubfeet refractory to the usual corrective manipulation and casting as Turco observed. He said they "respond altogether differently to both operative and nonoperative treatment and that early surgery results in a grotesquely deformed foot." He called these feet atypical and warned against surgery.

AETIOLOGY

- Exact cause of this variant is still in debate.

- Peroneal nerve dysfunction is considered as one of the factors responsible for this variant. (This should not be confused with that of peroneal nerve palsy due to prolonged immobilisation by plaster cast in typical clubfoot, because of compression around fibular neck. In the earliest cases, the results were not fruitful whereas one can expect good results in prolonged plaster cast cases.)
- *Iatrogenic:* Slipping of typical idiopathic clubfoot in a plaster cast is an iatrogenic cause of atypical clubfoot. This slipping of cast leads to forced forefoot plantar flexion relative to the midfoot, resulting in severe midfoot cavus. It also compresses posterior calf muscles and in same process it may compress the peroneal nerve producing neurological dysfunction.

PATHOANATOMY

There may be severe involvement of gastrosoleus muscle in calf and intrinsic muscles and ligaments of sole when compared to typical clubfoot.

Calf muscles are short and Tendo-Achilles is long, wide, and very tight, pulling the calcaneus upwards leading to severe equinus and causing a deep crease above the heel. The forefoot is in adduction and all the metatarsals are in plantar flexion, causing a severe cavus and a deep crease across the sole of the foot. Although the forefoot adduction can be corrected easily with one or two plaster casts, the metatarsals remain in severe plantar flexion. Additional attempts to correct the hindfoot varus by abducting the foot deformity pushes the metatarsals and toes into additional flexion and abduction resulting in a grotesque deformity.

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We suspect the abnormalities affecting the calf muscles and the posterior ligaments of the ankle extend to the deep intrinsic plantar muscles and ligaments of the foot. If the deformity is recognised as such it can be corrected with modified Ponseti technique.

CLINICAL FEATURES OF ATYPICAL CLUBFOOT

- Rigid equinus (tight Tendo-Achilles and fibrotic up to middle of the calf) **(Fig. 13.1)**
- Deep posterior crease above the heel **(Fig. 13.2)**
- Short and stubby fat feet **(Fig. 13.3)**
- Deep transverse crease present over the sole of foot **(Fig. 13.4)**
- Forefoot in adduction **(Fig. 13.5)**
- Severe supination **(Fig. 13.6)**



FIG. 13.1: Rigid equinus



FIG. 13.2: Deep postcrease over the heel

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FIG. 13.3: Short and stubby foot



FIG. 13.4: Deep transverse crease in midfoot



FIG. 13.5: Foot in adduction



FIG. 13.6: Foot in supination

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- All metatarsals were in plantar flexion, making the foot look short and arched downwards **(Fig. 13.7)**.
- Short and hyperextended first toe **(Fig. 13.8)**
- Bowing of tibia **(Fig. 13.9)**
- Lateral malleolus is always prominent.
- The calcaneus is in 50–70° of plantar flexion.
- The anterior tuberosity of the calcaneus is prominent dorsally and in contact with a small, barely identifiable head of the talus.
- The navicular is in contact with the medial malleolus.
- There is minimal motion in the severely supinated tarsal joints.
- The gastrosoleus is small and bunched up in the upper third of the leg.
- The tendo-Achillis is long and wide, inserting into the severely plantar flexed calcaneus.

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FIG. 13.7: Flexed metatarsals



FIG. 13.8: Short and hyperextended big toe



FIG. 13.9: Bowing of tibia

RADIOGRAPHIC EVALUATION (FIGS. 13.10A TO D)

- The talocalcaneal angle is generally parallel on both the anteroposterior (AP) and lateral views.
- The cuboid is displaced medially.
- There is severe plantarflexion of the talus, calcaneus, and all metatarsals, especially the first metatarsal.
- In patients who have developed abduction of the forefoot after attempted casting, the metatarsals may be hyperabducted at the tarsometatarsal joints with up to 90° of plantar flexion.

Treatment

- With regular Ponseti technique it leads to unpleasant deformity because of short and tight structures on medial and posterior aspect.
- Therefore, Ponseti proposed a modified manipulation technique and treatment protocol for this deformity.

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FIG. 13.10A: Atypical clubfoot 0° talocalcaneal angle



FIG. 13.10B: Normal foot 27°



FIG. 13.10C: Atypical clubfoot 0° talocalcaneal angle in lateral view, metatarsals in plantar flexion



FIG. 13.10D: Normal foot 45° talocalcaneal angle in lateral view

Radiographs showing parallel talocalcaneal angle and plantar flexion of metatarsals ***(Figs. 13.10C* and *D)***.

What details are needed before treatment?

- Age of the patient at the first visit
- Previous treatment and type of treatment before referral
- Number of plaster casts
- Previous tendo-Achilles tenotomy or lengthening procedure.
- Correction of the deformity components
- Degree of ankle dorsiflexion after tenotomy
- Need for a second percutaneous tendo-Achilles tenotomy.
- Complications with casting
- Compliance with the foot abduction brace (assessed based on parent's reports)

Modified Ponseti Technique

- Identification of subtalar joint is required prior to the correction of the deformity. The forefoot has to be grasped with one hand while feeling the malleoli from front with the thumb and index finger of the other hand. The thumb and index finger then were moved forward to clasp the head of the talus and feel the navicular on one side and the anterior tuberosity of the calcaneus on the other side. Motion at the subtalar joint could be felt when the foot was slowly abducted and anterior tuberosity of the calcaneum moved laterally under the head of the talus. In these complex atypical clubfeet, movement at subtalar joint was minimal at first but could be felt after completion of second or third plaster cast.
- Correction also requires clear identification of talus head, which is difficult to locate because it is less prominent than anterior tuberosity of calcaneum.

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To make certain of the position of the talar head during stretching and while applying the cotton and plaster cast bandage over the foot, the index finger should rest over the posterior aspect of the lateral malleolus while the thumb of the same hand applies counterpressure over the lateral aspect of the head of the talus, not on the very prominent tuberosity of the calcaneum.

- Standard abduction of 70° should not be done in atypical clubfoot. Up to 20–40° of the abduction should be done. Abduction beyond 40° leads to abduction at tarsometatarsal joints and thus disruption of this joint.
- While abduction is being done, the foot usually comes into alignment with the long axis of the leg. This usually leads to slippage of cast which may cause foot edema and skin excoriation. To prevent this the cast has to be applied with knee flexion up to 110°.
- Proper moulding of the cast was also performed. To prevent bunching of excessive cast behind the knee, we applied slab of cast anteriorly on the knee to strengthen the cast. A similar slab was applied behind ankle.
- When desired abduction was obtained, the metatarsals were still severely plantar flexed. Here another modification was performed. Thumbs of both hands were placed under the heads of 1st and 5th metatarsals. Index fingers of both hands were placed dorsally over the talar head and dorsiflexion of metatarsals and ankle was performed **(Figs. 13.11A and B)**.
- Tenotomy should be performed in all cases at 1.5 cm above the posterior deep crease. Post-tenotomy dorsiflexion of 5–10° was usually obtained. Post-tenotomy cast was applied for 3 weeks. If ankle dorsiflexion of <5° was obtained post-tenotomy then plaster cast was applied for 1 week only and a new cast was applied

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FIGS. 13.11A AND B: Pictures showing how to manipulate plantar flexion of forefoot

weekly with increasing dorsiflexion till 5–10° of dorsiflexion.

- Following cast removal, well-moulded shoes attached in 40° outer rotation to a foot abduction bar are indispensable to prevent relapses in short and stubby complex clubfeet. Brace is applied for 23 hours for first 3 months.
- During the hour when the brace was removed, two exercises were performed. One, the child was made to squat for 10 minutes. Second, the parent passively dorsiflexes the affected foot for 10 minutes.
- Following initial 3 months in brace, weaning from brace was done with 2 hours of bracing time reduced every month until night-time bracing (12 hours) was started and is advised to be kept for 3–4 years.

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CASE STUDIES

Case 1

A boy aged 17 weeks was having a typical clubfoot. There was rigid equinus, severe planter flexion of all metatarsal, short hyperextended first toe, deep crease above the heel, and transverse crease in the sole of the foot. As a result, the foot is very short and stubby **(Figs. 13.12A to E)**.

Six plaster casts were applied by modified Ponseti technique. 40° abduction was achieved. Percutaneous Achillis tenotomy was performed. All the deformities were corrected. Ponseti abduction shoes were given **(Figs. 13.12F to K)**.



FIGS. 13.12A TO E: *Continued*

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Continued



FIGS. 13.12A TO E: Case 1—pre-correction clinical pictures

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Step by Step® Management of Clubfoot by Ponseti Technique

The book is providing a simplified method to correct the deformities in the clubfoot with other information, so that it can be easily mastered and implemented. Special focus is given to atypical clubfoot and secondary clubfoot.



RA Agrawal was born in Uttar Pradesh, India, in 1948. He graduated from GSVM Medical College, Kanpur, Uttar Pradesh, in 1973 and completed his Master of Surgery in Orthopaedics in 1977. He joined government service in 1977 and was posted at Nainital and then transferred to District Hospital, Gorakhpur, Uttar Pradesh, as an orthopaedic surgeon. He established a 60-bedded orthopaedic and trauma hospital in Gorakhpur. He worked in City Hospital, Karlsruhe, in Germany for 2 months in 1988. He got special training for Ilizarov Technique from Altai Regional Orthopaedic Center, Burnaul, Russia, in June 1994. He received National Award from the Government of India in public recognition for his outstanding performance in the field of "People with Disabilities" in December 2000. He received AO International Fellowship in May 2001 and worked in City Hospital, Feldairch, Austria. He worked as co-supervisor in the Department of Science and Technology, Government of India, and worked in one project for carbon composite ring at the National Physical Laboratory, New Delhi. He received Gold Medal from the Indian Orthopaedic Association for best poster. He was invited as a faculty member at 13th Limb Deformity Course at Baltimore, USA. He was awarded President's Gold Medal for best paper in UPCON 2007. His previous book "Step by Step Management of Equinus Foot by Ilizarov Technique" is already a success, having sold more than 2,000 copies. He was the Editor of Journal of Foot and Ankle Surgery (India), Past President of ASAMI India, and Past President of UP Orthopaedic Association. His paper "Post-traumatic cubitus varus: Long-term follow-up of corrective osteotomy using the Ilizarov method of compression distraction osteogenesis" has been published in Journal of Pediatric Orthopaedics in 2020. He has been presenting national and international scientific papers from time to time. He has been organising conferences and camps for the handicapped for many years. He has recently received the "Outstanding Achievement Award" in the 6th World Congress of the ASAMI-BR & ILLRS Societies.



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