Neuromuscular Foot

Spastic Cerebral Palsy

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KEYWORDS

• Cerebral palsy • Pes planovalgus • Equinovarus foot • Subtalar fusion
• Calcaneal lengthening

KEY POINTS

- Fixed equinus contracture owing to equal gastrocnemius and soleus contracture can be treated with open tendoachilles lengthening.
- Ankle valgus is a secondary deformity, but can be treated with medial epiphysiodesis if there is more than 10° of valgus and the child has sufficient growth remaining.
- Pes planovalgus is the most common foot deformity in diplegics and quadriplegics; surgical treatment includes lateral calcaneal lengthening and subtalar fusion in severe cases.
- Most equinovarus deformities improve with age, but can be treated with tendon transfers in older children if the foot passively corrects without residual fixed heel varus.
- Preoperative gait analysis can help to define the need for adjunctive tendon transfers or additional procedures proximal to the ankle.

Foot and ankle deformities are common in patients with cerebral palsy. Deformity can vary with degree of spasticity and anatomic classification (ie, diplegic vs quadriplegic). Ambulatory children will have problems that inhibit gait efficiency. Nonambulatory children typically have foot and ankle problems that can prevent comfortable shoe and orthotic wear.[1] Although hemiplegia more often leads to an equinovarus deformity, equinovalgus deformity is seen more commonly in children with spastic diplegia and quadriplegia.[2]

Equinus contracture occurs in children with spasticity owing to overpull of the dorsiflexors relative to ankle plantarflexors.[3] Articulating ankle–foot orthoses can be used in children with mild, flexible ankle equinus. In children where the equinus becomes fixed, botulinum toxin injections can be used to prevent or delay surgery. Children with fixed contracture who cannot dorsiflex to neutral despite bracing and botulinum toxin injections are considered candidates for operative intervention.

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Ankle valgus is typically a secondary deformity. The amount of ankle valgus is determined by measuring the tibiotalar angle on a weight-bearing anteroposterior view of the ankle. Radiographic features identified with ankle valgus include narrow distal fibular physis and a shortened fibula. Ankle valgus is effectively treated with epiphysiodesis of the medial malleolus. Guided growth is an effective option when the physis are open and the child has more than 2 years of growth remaining.

In planovalgus deformity, the hindfoot is in valgus with midfoot pronation and forefoot eversion. This segmental malalignment can decrease substantially the lever arm for the third rocker[4] and allows for less push-off power. Fusion procedures should be avoided if possible in children who are functional ambulators. Lateral column lengthening, either via lengthening at the calcaneal neck or performing an opening wedge osteotomy through the calcaneocuboid joint, should be used to correct the deformity. In children who have lesser functional demands with severe deformity, subtalar fusion can be added to lateral column lengthening with good results.[5] Intraoperative examination after subtalar fusion and calcaneal lengthening is critical to ensure that the normal balance of the foot is restored.

Spastic equinovarus deformity is caused by spasticity of the gastrocsoleus, posterior tibialis, and/or anterior tibialis. Nonoperative treatment is preferred in young children because mild varus can often progress to planovalgus as children grow into middle childhood and adolescence.[6] Varus deformity is more likely to progress in hemiplegics. Both the anterior tibialis and the posterior tibialis can drive the deformity. Before surgical intervention is undertaken, gait analysis with electromyographic (EMG) monitoring and pedobarographs can be helpful to determine which tendon is most overactive and out of phase. The treatment of a severely fixed varus deformity is triple arthrodesis.

OPERATIVE TECHNIQUES

Open Tendoachilles Lengthening

Several techniques exist to treat equinus contracture. Open tendoachilles lengthening should be performed in children with fixed equinus contracture in whom the gastrocnemius and soleus are equally contracted.

Preoperative planning

Preoperative physical examination determines extent of contracture in each muscle. Children with large differences in contracture between the gastrocnemius and the soleus are better treated with fractional gastrocnemius lengthening. Radiographs aid in confirming that there is no midfoot or forefoot involvement.

Patient positioning

Patients should be positioned supine with a tourniquet placed on the upper thigh. The tourniquet can be placed sterilely during the procedure if more proximal procedures are also planned.

Surgical approach and procedure

1. An incision is made along the medial aspect of the Achilles tendon. Straight posterior incisions should be avoided to prevent shoe and brace wear discomfort.
2. The fascia of the Achilles tendon is incised, and a retractor is placed around the tendon. The tendon is freed up from other soft tissue attachments.
3. The Achilles tendon is incised through its center (**Fig. 1**A). Care should be taken to ensure sufficient overlap after lengthening and allow for appropriate tension of the tendon (usually 3–4 cm central limb is needed).