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Management of Rigid Flat Foot in Children and Adolescents

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Abstract

Flatfoot (pes planus) is common in infants and children and often resolves by adolescence. Thus, flatfoot is described as physiologic because it is usually flexible, painless, and of no functional consequence. In some instances, flatfoot can become painful or rigid, which may be a sign of underlying foot pathology.

Article focus: In this review will focus in details on different common types of rigid flat foot in Children and Adolescents which are Congenital vertical talus, Congenital tarsal coalition, Accessory navicular bone, Peroneal spastic flat foot without coalitions, Iatrogenic and post-traumatic flat foot.

Key messages: This review accurately assesses the rigid flat foot in children and adolescence to select those who will need early surgical procedures and describe the approach to the surgical management. Important considerations will be taken of preoperative planning and best surgical techniques.

Keywords: Rigid; Flat foot; Foot pain; Children; Adolescents

Introduction

Rigid flatfoot is often a complex disorder, with diverse symptoms and varying degrees of deformity and disability. There are several types of flatfoot, all of them have one characteristic in common when is partial or total collapse (loss) of the arch [1]. The distinction between flexible and rigid flatfoot is important for diagnosis and treatment. The painful, rigid flatfoot requires further investigation. The rigid flatfoot is distinguished from the flexible variety by physical examination. Subtalar motion is restricted, and attempted motion may be painful. Peroneal spasm or contracture may be evident with attempted passive inversion. The toe-rise test is performed with difficulty and the longitudinal arch does not reform [2].

Although the exact incidence of flatfoot in children is unknown, it is quite common and is in fact, one of the most common conditions seen in pediatric orthopedic practice. All children are born with flat feet and more than 30% of neonates have a calcaneovalgus deformity of both feet. The focus of this article is to know the causes of rigid flat foot; and describe the variety of methods used to surgically manage [1].

Congenital vertical talus

Congenital vertical talus or congenital convex pes valgus is a condition characterized by multiple soft-tissue, joint and osseous abnormalities which result in a severe rigid Flatfoot called rocker bottom deformity of the foot. The term vertical talus should be reserved for feet with fixed equinus of the calcaneus and Dislocated talonavicular joint, with the navicular bone lying dorsally on the neck of the talus.

The incidence of congenital convex pes planus is <1% of all live births. It is more common in males than in females and frequently seen bilaterally [3].

Etiologies: Central nervous system/spinal cord: Myelomeningocele.

Spinal muscular atrophy Sacral agenesis.

Muscular problems: Arthrogryposis multiplex congenita.

Chromosomal abnormality: Trisomy 18, Trisomy 15, Trisomy 13.

Genetic syndromes: Neurofibromatosis.

Split hand and split foot.

Single gene defects: HOXD10 [4].

Tarsal coalition

Tarsal coalition is an abnormal fibrous (syndesmosis), cartilaginous (synchondrosis), or osseous (synostosis) fusion of one or more of the tarsal ossification centers of the hindfoot and midfoot that may produce pain and limitation of motion of the foot [5-6].

The incidence of tarsal coalition is about 1% of population, it is more common in male than female (2:1) and tarsal coalitions are bilateral in 50-60% of cases. The commonest (90%) are talocalcaneal and calcaneonavicular coaliation. Talonavicular, calcaneocuboid and naviculocuneiform coalition are uncommon (Figure1) [7-8].

Etiology: The etiology of tarsal coalition is unknown, the most likely cause is failure of segmentation of the fetal tarsal bone. There are several reported cases of familial occurrence of coalition as autosomal dominant. When the rotatory subtalar motion becomes restricted, the compensatory internal rotation of the subtalar joint is lost, resulting in loss of the longitudinal arch [8].

Accessory navicular bone

Accessory navicular is a term applied to a plantar medial enlargement of the tarsal navicular beyond its normal size [9]. It is frequently bilateral and occurs more commonly in women [10].

Etiology: An accessory navicular is normal anatomic variant that may become symptomatic for a variety of reasons. several reports describe autosomal dominant inheritance [6].

Pathogenesis: Three types have been described.

Type I is a small ossicle within the substance of the tibialis tendon, also called os tibiale externum.

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Figure 1: Types of tarsal coalition.

Type II is an 8-12mm ossicle that is connected to navicular bone by a cartilaginous bridge. 70% of the cases are in this type.

Type III is a cornuate navicular remaining after fusion of the accessory navicular with the primary navicular bone [6].

Tibialis posterior tendinopathy: The presence of either an accessory navicular type 2 or type 3 (cornuate navicular) is a risk factor for tibialis psterior tendinopathy, since the accessory navicular acts as it were a native navicular with the bulk of the posterior tibialis tendon inserting onto the accessory navicular. This leads to a more proximal insertion of the tibialis posterior tendon. Hereby, the leverage of the malleolus on the tibialis posterior tendon is reduced and therefore the stress on the tendon increases [11].

Peroneal spastic flatfoot without coalition

Peroneal spastic flatfoot is a name given to flatfoot deformity with increased tone in the peroneal muscles. These muscles evert the foot and disrupt the balance of muscular pull around the ankle, causing the deformity [12].

Etiology: Juvenile chronic arthritis, osteochondral fractures in the rearfoot, osteoid osteoma, neoplasms, dysplasia epiphysealis hemimelica (Trevor disease) and problems more proximal in the limb (slipped capital femoral epiphysis). When no cause can be found, the condition has been called as idiopathic peroneal spastic flatfoot [1,12].

Iatrogenic and post-traumatic flatfoot

Iatrogenic and posttraumatic flatfoot are uncommon and encompass a broad spectrum of foot disorders. Management can be challenging and complex, necessitating case-by-case consideration. In many cases, a perfect outcome is not possible. Often, the result is a rigid plantigrade foot.

Etiology: Overcorrected clubfoot.

Under corrected vertical talus.

Failed flatfoot surgery.

End-stage trauma.

Manipulation or casting of the pliable easily damaged infant foot [12].

How to Confirm Your Diagnosis

Laboratory investigation

Because a rigid flatfoot deformity can result from infection or other inflammatory disease as well as bone lesions, a laboratory work up including complete blood picture, ESR, C reactive protein, ANA, and rheumatoid factor may be warranted [13].

Imaging Investigation

Congenital vertical talus: Clinical appearance (Figure 2A and 2B).

Investigations: Plain x ray is most often diagnostic

At birth, only rounded ossific nuclei of some bones of the foot are visible radiographically (Figure 3).

Radiographic projections for vertical talus are captured while weight bearing and include an AP, lateral, and maximally plantar flexed and dorsiflexed views.

MRI, CT, and ultrasound: MRI, CT, and ultrasound investigations may be useful in imaging the deformity for diagnosis for surgical planning [14].

Tarsal coalition: Clinical appearance

The patient usually seen in 2nd decade of life with the complaint of m pain in the subtalar joint and limitation of motion of the foot. This may occur after prolonged use such as standing, walking over rough ground, or hiking, or when an abnormal Stress is imposed on the foot such as while jumping or participating in athletics [15,16].

Investigations: Plain X-rays 100% sensitivity and 88% specificity in the diagnosis of tarsal coalition (Figure 4) [17].

CT scan: CT scan are useful. CT to check for multiple coalitions and bone scan if radiological pattern or pain are atypical. CT of the ankle and hindfoot should be performed (Figure 5) [17].

Rozansky et al have recently proposed a CT-based classification in 3-D which allows better preoperative planning. This classification groups TCCs into five types:

Figure 2: A. Bilateral congenital vertical talus deformities in a 6-week-old baby demonstrating the convex plantar surface of the feet. B. Deep creases are present on the dorsolateral aspect of the foot in an 8-week-old baby with bilateral congenital vertical talus.

Figure 3: Congenital vertical talus.

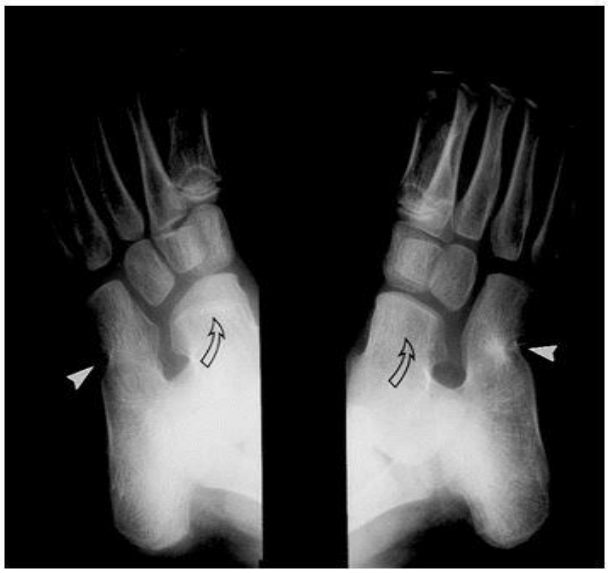

Figure 4: Talonavicular and calcaneocuboid coalitions in a 7-year-old boy. Oblique radiographs of both feet demonstrate bilateral talonavicular (arrows) and calcaneocuboid (arrowheads) coalitions.

Type I (Linear) are the most common and simplest to resect.

Type II (Linear with posterior hook) are similar to Type I but have a hook on the posterior aspect of the sustentaculum tali, which should be resected to recover the subtalar mobility.

Type III (Shingled) have a hypoplastic sustentaculum tali. In this type is important to perform resection in a plane higher than usual (caudal to cephalic) inclination.

Type IV (bone) is the most controversial as to whether it should be resected or whether the foot should just be realigned.

Type V (Posterior) is usually small and located in the most rear of the subtalar joint in intimate relationship with the neurovascular bundle [18].

MRI: MR imaging of the ankle and hindfoot should be performed (Figure 6) [17].

Bone scans: Bone scans have been used to show increased stresses at articular surfaces. Bone scans are sensitive but nonspecific.

Accessory navicular bone: Clinical appearance

A visible bony prominence on the midfoot (the inner side of the foot, just above the arch), Redness and swelling of the bony prominence. Vague pain or throbbing in the midfoot and arch, and usually occurring during or after periods of activity [19].

Investigations: Plain x ray

Accessory navicular bone is best visualized on oblique x-ray; it may also be seen on antero-pestorior view Figure 7.

CT scan: CT better delineates the extent of true and accessory navicular bone.

MRI: MRI shows edema of the marrow in patient with focal pain Figure 8 [6].

Peroneal spastic flatfoot without coalition: Peroneal spastic flatfoot without coalition is a painful foot deformity made rigid by spasm of the extrinsic muscles. Clinical findings are not limited to the peroneal muscles alone. The extensors, tibialis anterior, and tibialis posterior are involved. Although tarsal coalition is the most common cause of peroneal spastic flatfoot, its presence cannot be confirmed in several cases [20].

Clinical appearance: Peroneal muscle spasm, restricted subtalar and ankle motion, valgus appearance of the foot, and constant or intermittent pain in response to activity are the hallmarks of the condition. Gait pattern is antalgic with external rotation of the foot to the line of progression.

Investigations: Diagnostic imaging that fails to show a tarsal coalition or typical secondary findings of a tarsal coalition may show other pathologies that might explain the condition such as osteochondral defect, pathologic fracture through a bone cyst, or osteomyelitis.

Bone scan may help localize the pathology. A total body bone scan is useful to rule out otherwise silent multiple anatomical sites in systemic disease.

Laboratory studies should include a complete blood cell count with differential and acute phase reactants (erythrocyte sedimentation rate and C-reactive protein). Elevated inflammatory markers suggest a rheumatologic cause and merit further investigation [13].

Iatrogenic and Posttraumatic flatfoot: Patients with iatrogenic or posttraumatic flatfoot present with variable degrees of pain, loss of function and progressive deformity. All feet in this category have a history of previous manipulation, surgery, or trauma. Onset of flatfoot deformity may be either immediate or delayed by months or years.

Clinical appearance: Examination may determine: Pain, stiffness, scarring, abnormal function and gait disturbances [1].

Investigations: Plain x ray may show post-surgical changes, retained implants and hardware, malalignment, and arthritis. CT, MRI, and bone scans may be useful in further defining the deformity and in evaluating residual pathology [1].

Recent Modalities of Treatment

Congenital vertical talus

Conservative method: Serial cast treatment has been recommended and attempted by many but is largely ineffective because of rigidity of the deformity Manipulation and casting may be effective in milder cases.

Figure 5: Calcaneonavicular coalition in an 11-year-old boy. Axial (A) and coronal (B) CT scans show apposition of the anterior dorsal calcaneus with the navicular in the left foot, with narrowing and reactive sclerosis (arrow).

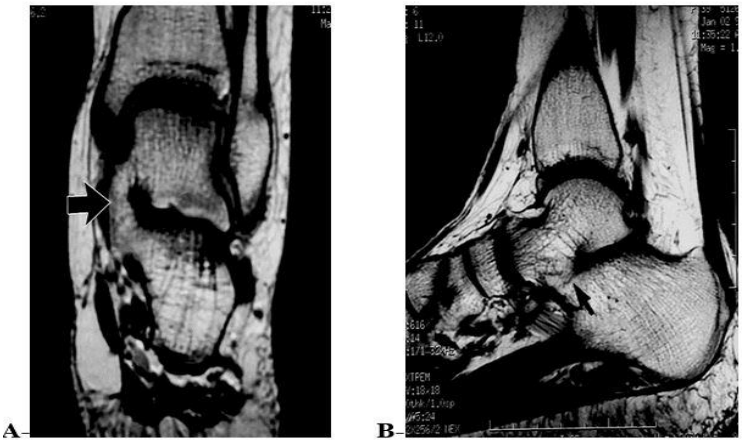

Figure 6 A: Osseous talocalcaneal coalition in coronal plane.**B:** Osseous talocalcaneal coalition in sagittal images show bone marrow contiguity across fused articulation (arrow).

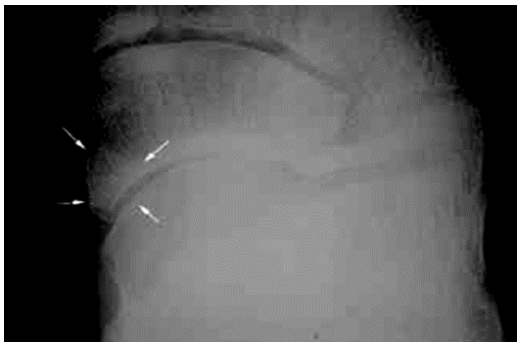

Figure 7: PTT tendinopathy associated with accessory navicular type 2. AP radiograph of the foot demonstrating a type 2 accessory navicular (small arrows).

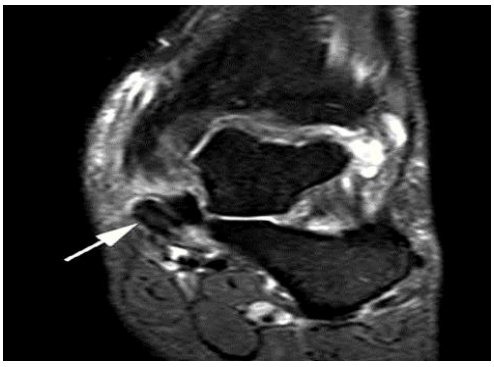

Figure 8: Weighted MR images reveal thickening of the PTT with a central area of high signal intensity consistent with tendinopathy (arrow).

The forefoot is first stretched into plantar flexion and inversion by applying distal traction to the metatarsals.

Upward push on the calcaneus and downward pull on the heel may stretch the equinus deformity.

The foot is casted in the most corrected position. (Reverse Ponseti technique) [21].

Surgical treatment: There are multiple surgeries described for the treatment of vertical talus. The type of procedure used for an individual patient is based on the age of the patient, severity of the deformity and the preference of the surgeon. Children up to the age of 3 years are usually offered an open reduction of the talonavicular joint, which can be performed through either a one-stage or two-stage operation,

Most surgeons now prefer a one-stage procedure because of fewer complications like avascular necrosis of the talus seen with the two-stage procedure [22].

A minimally invasive approach that consists of serial manipulation and casting followed by temporary stabilization of the talonavicular joint by Kirschner wire (K-wire) and an Achilles tenotomy has provided excellent short- and mid-term radiographic and clinical results for isolated and non-isolated congenital vertical talus. Thus, we recommend this method for management of all vertical tali regardless of the

patient's age at presentation or the presence of associated diagnoses. In patients with a severe rigid deformity (most often non isolated cases) in which complete correction is not achieved with casting, minor surgery is needed to complete the correction.

To successfully perform this minimally invasive procedure, the treating physician must have a thorough knowledge of the subtalar joint, experience treating clubfeet with manipulation and casting, and the ability to accurately localize the head of the talus on the plantar medial aspect of the midfoot. The head of the talus is the key landmark; it is the structure that the rest of the foot will be manipulated around during correction. All components of the vertical talus are corrected simultaneously, except for the hindfoot equinus, which is corrected last. Manipulations are gentle and consist of stretching the foot into plantar flexion and adduction with one hand while counterpressure is applied as the thumb of the opposite hand gently pushes the talus dorsally and laterally. It is essential not to touch the calcaneus during manipulations because this can prevent the calcaneus from correcting from a valgus to a varus position.

After 1 or 2 minutes of manipulation, a long leg plaster cast is applied to hold the foot in the position achieved with stretching. The cast is applied in two sections, with the short leg portion applied first to allow the treating physician to make the appropriate molds. Although the principles of manipulation and casting are not difficult, attention to detail is crucial. The foot should be held in the position achieved with stretching while an assistant rolls the plaster. Moving the foot into the corrected position after the cast is applied can result in a poorly molded cast, resulting in skin problems or cast slippage [23].

Discussion

Traditional management involves an extensive surgical release; however, extensive surgery is not necessary because excellent results have been achieved with a minimally invasive approach that emphasizes serial manipulation and casting. By avoiding more extensive surgery, it is likely that patients with vertical talus will maintain more flexibility, experience less pain, and have better function in the feet long-term, similar to the long-term results achieved with minimally invasive approaches for clubfoot.

Tarsal Coaliation

Conservative method: The initial treatment for any coalition should be nonsurgical. Patients with mild symptoms may respond well to footwear modifications, arch supports, or custom orthoses (Figure 9). The most common orthosis is the flattened on the bottom to reduce inversion and eversion stress on the foot. UCBL (University of California Biomechanical laboratory) orthosis.; The addition of high –top shoes may also be helpful.

Activity modifications, weight reduction, anti-inflammatory medication, and local anesthetic blocks may also be indicated. Cast immobilization for several weeks may be indicated for patients with more severe symptoms or with peroneal spasm [5].

Surgical treatment: Excision of calcaneonavicular bar

Surgical resection of calcaneonavicular coalition with fat interposition. Surgical technique for calcaneonavicular coalition excision: (a) Ollier's incision, (b) Mobilizing extensor digitorum brevis (EDB), (c) Then excision calcaneonavicular coalition, (d) fill defect with fat interposition graft, (e) repair of EDB origin.

It is our belief that fat interposition is the best, biologic method to fill the gap left after TCC resection, recently an arthroscopic approach has been described for surgical resection of CNC. Whilst good outcomes have been reported, the cases series is small with limited follow-up. In this approach no interposition material is used, thus raising concerns about the risk of coalition re-ossification. Limited space also makes access difficult and runs the risk of iatrogenic chondral or nerve injury. As such it remains the case, whether, an arthroscopic approach to CNC excision is superior to open with interposition graft [8].

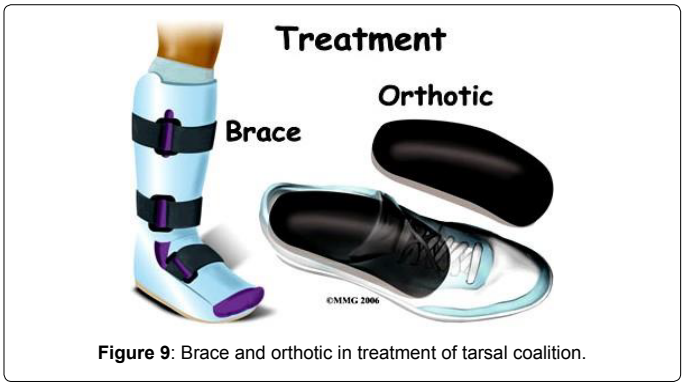

Figure 9: Brace and orthotic in treatment of tarsal coalition.

Talocalcaneal Coalition

There is a debate about how best to surgically manage TCC. Where possible it is felt that resection of the synostosis is appropriate management. However, poorer results have been observed in some series where the coalition forms greater than 50% of the posterior subtalar articulation and where there is significant rigid hindfoot valgus. This has been contested by other authors, who believe that resection of a symptomatic TCC is appropriate no matter how severe the deformity or extensive the coalition [24,25].

Some surgeons are also of the belief that resection of the coalition alone is appropriate management, but others would recommend resection combined with reconstruction of the foot. Our approach to the surgical management of TCC is summarized below and is akin to that published by Masquijo et al. categorizing TCCs into three common presentations [26].

Coalition consisting of <50% of the posterior subtalar facet, acceptable foot alignment (<16° hindfoot valgus), no degenerative signs in the subtalar joint (STJ)

In this presentation the pain is caused by the bar, so the prescribed treatment is resection. This would be achieved through a medial approach centered on the sustentaculum tali, as per resection of a calcaneonavicular bar, our interposition graft of choice is autogenous fat from the buttock.

Coalition <50% posterior facet, hindfoot valgus >16°, no STJ degenerative changes

In this scenario we would undertake combined resection of the coalition alongside foot realignment surgery. Reconstruction surgery in these cases is with the use of a lateral column lengthening (LCL) using an Evans/Mosca-type calcaneal osteotomy and a medial sliding calcaneal osteotomy. Most cases have severe deformities and require a combination of the procedures. After correction of the hindfoot if there is residual forefoot supination deformity the LCL would be combined with a medial cuneiform opening wedge plantarflexion osteotomy. Soft tissue surgery in the form of tendoachilles and/or peroneus brevis lengthening is undertaken if there is evidence of contracture.

Coalition >50% posterior facet, hindfoot valgus >16°, ± STJ degenerative signs

In this third scenario, we believe that the cause of pain is predominantly due to the marked deformity of the foot. The bar acts as an arthrodesis, holding the joint in a poor position. Some authors consider that this is a good indication for arthrodesis; however, the malalignment makes arthrodesis technically more demanding. For this reason, our preference is to realign the foot without attempting to respect the bar and reserve arthrodesis and salvage surgery for those cases that have previously failed resection/reconstruction. Arthrodesis are Subtalar arthrodesis and triple arthrodesis.

The future of surgical management of tarsal coalitions: In cases of TCC that the anatomy is complex, and two-dimensional fluoroscopy may not suffice in the intraoperative evaluation of whether adequate resection has occurred or not. With the technological advances in imaging hardware, CT scanners are increasingly available in the operating room to allow a formal 3-D assessment of the coalition at the time of surgery. It has been suggested that use of CT in this manner reduces surgical morbidity and optimizes the coalition resection whilst minimizing violation of the intact subtalar articulation. Three-dimensional printing is a transformative technology when applied to orthopaedics. Three-dimensional printing models can allow surgeons to evaluate the exact location of the coalition, the coexisting deformity, and plan for a more precise resection and deformity correction [27].

Tarsal coalitions are widespread and can be a source of significant pain and deformity .When surgically treating a child with a tarsal coalition it is important to remember that unlike in trauma, where one is restoring anatomy to a previous uninjured state, here one is dealing with articulations which have never been entirely normal. the success of, the surgical rationale to, where possible, provide a well-aligned, mobile, pain-free foot and ankle is sound and logical. To ensure that this surgical objective is achieved it is incumbent on the surgeon to have a comprehensive understanding of the anatomy of the coalition, any concomitant deformity, and degenerative changes. To attain this understanding, advanced imaging methods, commonly CT, are useful in the preoperative phase, and intraoperatively may further facilitate surgical intervention.

Whilst there are some common themes in the surgical approach to tarsal coalitions there is still significant variability in treatment methods. The variation in practice highlights the uncertainty that remains in the orthopedic community about the best methods to treat this common condition. Debate continues about the role and timing of foot reconstructive surgery, the best interposition graft material, the place of novel technologies, and minimally invasive techniques.

Accessory navicular bone: Conservative method

The treatment of the accessory navicular depends on the length of time that the symptoms have been present and the severity of the pain. Thus, pain that has been present for several weeks and is severe may not respond to non-operative care which includes:

Rest (decrease or stop activity).

Temporary immobilization in a boot or a brace.

Foot orthotic to control foot function and support the arch. The orthotic support will help control (but not cure) the flat foot and will.

often decrease the inflammation on the navicular Once the navicular inflammation has lessened it is not necessary to perform surgery unless the foot becomes progressively flatter or continues to be painful [5].

Surgical treatment: For these children there are three criteria for excision of the accessory navicular and restoring the continuity of TPT.

Localized tenderness with upward and medial pressure beneath the prominence.

Failure of at least 6 month of conservative treatment including shoe modification and anti-inflammatory medication.

Difficulty in performing a single heel- rise test [28].

Surgery can completely correct the problem by removing the accessory navicular bone and tightening up the posterior tibial tendon that attaches to the navicular bone.

Kidner procedure: The Kidner procedure consists of excising the accessory navicular and rerouting the tibialis posterior tendon into medial cuneiform [29].

Modified kinder procedure: It is excising accessory navicular and side to side repair rather than advancement of tibialis posterior tendon [29].

Percutaneous drilling: Nakayama et al. introduced a new technique in treatment of type 2 accessory navicular bone by percutaneous drilling. Drilling can induce union of the accessory navicular bone with relief of symptoms. Union was achieved in 58% within 12 months. Even those in whom union did not occur, the symptoms have been decreased significantly [30].

Two recent studies found no significant difference in outcome or complication after simple excision with or without advancement of tibialis posterior tendon.

Peroneal spastic flatfoot without coalition

Conservative method: Activity modifications can be supplemented with non-steroidal anti-inflammatory medications. Footwear modifications, arch supports, and orthosis may also be beneficial.

In more difficult cases, immobilization in a walking boot may prove helpful. However, patient compliance is often a problem. This can be solved with a non-weight bearing below-knee cast and crutches for 4-6 weeks. In extreme cases, an above knee cast can be considered. Common peroneal nerve blocks an injection of steroid and anesthetic into the sinus tarsi can be both therapeutic and diagnostic [31]. If symptoms do not resolve with nonsurgical treatment, surgical options can be considered.

Calcaneal osteotomy for treatment of peroneal spastic flatfoot

Cain and Hyman credited Dwyer with the suggestion that pain in the peroneal spastic flatfoot results from "oblique strain of ligaments" caused by activities that demand greater range of motion .According to Dwyer the valgus posture of the hindfoot produces the symptoms and he therefore suggested an opening wedge calcaneal osteotomy with bone graft [29].

The absence of coalition may present a diagnostic challenge and make appropriate treatment difficult. Past and present etiologic theories, diagnostic modalities, and treatments are outlined in this article. The common peroneal nerve block is of great value in the diagnosis and treatment of peroneal spastic flatfoot with or without coalition. With adjunctive treatments, increased motion and decreased symptomatology are often obtained.

Iatrogenic and posttraumatic flatfoot

Shoe modifications and bracing may be indicated in the initial management of these deformities. Activity modifications, weight re-

duction, physical therapy, and non-steroidal anti-inflammatory medication may be helpful. If the clinical response is satisfactory, continued non-surgical management and observation are in order.

If there is no response to nonsurgical treatment, surgical intervention may be necessary to achieve the goal of a stable pain-free plantigrade foot. The specific procedures are directed to the deformity, the condition of the soft tissues, the joints and osseous structures. Patient and parental education should be provided to encourage realistic expectations. Soft tissue release, osteotomy, and arthrodesis are the procedures most frequently used. In certain cases, severe deformities may be realigned with distraction osteogenesis (Ilizarov). Patients should be followed up for observation. Recurrence is possible and necessitates reevaluation [31].

Conclusions

Proper assessment of rigid flat foot in children and adolescence is particularly important to select those who will need early surgical procedures.

It is apparent that there are many causes of rigid flat foot; therefore, it is understandable why there is an abundance of surgical options. Rigid flat foot frequently causes enough symptoms to justify an operation. Surgical options may be soft tissue reconstruction, bone osteotomy or combined surgery.

Congenital vertical talus

Surgical treatment is often required, however casting before surgery may stretch the soft tissues and make skin closure easier. Some authors have recommended a two-stage procedure, but a single stage procedure is the most utilized method.

A minimally invasive approach that consists of serial manipulation and casting followed by temporary stabilization of the talonavicular joint by Kirschner wire (K-wire) and an Achilles tenotomy. Thus, we recommend this method for management of all vertical tali regardless of the patient's age at presentation or the presence of associated diagnoses. excellent results have been achieved with a minimally invasive approach

Tarsal coalition

Conservative treatment in the form of heel cups medial longitudinal arch support and short leg cast for brief periods should be tried. If these measures are not effective. Surgical resection of calcaneonavicular coalition with fat interposition and surgical management of TCC is akin to that published by Masquijo et al categorizing TCCs into three common presentations include, resection of the coalition ,graft interposition, lengthening, osteotomy and reserve arthrodesis and salvage surgery for those cases that have previously failed resection/reconstruction.

Accessory navicular bone

Symptomatic treatment by altering activities or modifying the shoes may be successful. In resistant cases simple excision can be carried out. Rerouting of the tibialis posterior tendon may be done with simple excision or not. Two recent studies found no significant difference in outcome or complication after simple excision with or without advancement of tibialis posterior tendon

Peroneal spastic flatfoot without coalition

Initial symptomatic relief in a young patient with mild symptoms includes non-steroidal anti- inflammatory drugs, paraffin baths, heat, warm soaks, and whirlpool. When a patient has moderate to severe pain on ambulation, using a below knee cast is recommended for four to six weeks. This can be combined with a common peroneal nerve block and an injection of steroid and anesthetic into the sinus tarsi, which are effective in both relieving pain and muscle spasm. If symptoms do not resolve with nonsurgical treatment, surgical options can be considered.

Surgical procedures include arthrodesis and realignment osteotomy. Observation and supportive orthoses should follow surgery.

Iatrogenic and posttraumatic flatfoot

Shoe modifications and bracing may be indicated in the initial management of these deformities. If there is no response to nonsurgical treatment, surgical intervention may be necessary to achieve the goal of a stable pain-free plantigrade foot. Soft tissue release, osteotomy, and arthrodesis are the procedures most frequently used. Severe deformities may be realigned with distraction osteogenesis (Ilizarov).

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