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Foot Falls – Managing Flatfeet in Children and Adolescents

Ranjit Deshmukh[1]

Abstract

Flat feet are rarely symptomatic in children. The reason for consultation is usually parental anxiety and peer pressure. Majority of the patients and their parents needs to be treated with assurance. The clinical assessment of the foot must however be performed systematically in order to detect signs of symptomatic flat feet that are detected early and treated within time.

Asymptomatic flexible flat feet constitute the majority of these feet and need to be assessed for a tight tendo achilles. Feet with a tight tendo achilles are most likely to become symptomatic and may need some form of treatment. The treatment is primarily conservative however in exceptional circumstances joint sparing osteo tomies of the feet are recommended Evaluation of the foot should detect any signs of a rigid flat foot. The cause of rigidity if established early can be addressed to prevent long term morbidity.

Keywords: Flexible Flatfoot. Rigid Flatfoot. Achilles tendon contracture. Foot Osteotomies.

Introduction

The flatfoot has been described as a condition with a low or absent medial longitudinal arch of the foot associated with hindfoot valgus [1]. The exact definition of the condition though seems to elude us. The literature as well does not seem to have a definite consensus regarding the treatment of the condition. The reason being that in spite of the condition being so common, the research on the subject has a lack of controlled studies and poor methodology. Harris and Beath conducted a survey of 3600 Canadian Army recruits in 1947 [2]. The data collected by them seems to provide guidelines for the prevalence and evaluation of the condition even today due to the lack of well conducted studies on the condition. The authors reported that 23% of the recruits had flatfeet of which 64% were flexible flatfeet and asymptomatic. Flatfeet associated with a short Tendo Achilles or a rigid flatfoot would be more likely to develop symptoms and hence may need some form of treatment.

The incidence of the condition is difficult to determine since most of the patients are asymptomatic; However, as seen in the previous paper, 20% of adults have flatfeet [2]. The prevalence of the condition is known to be affected by a number of parameters. The arch develops in children by the middle of childhood and older children have a lesser incidence after 5 years of age [3]. Obese children with ligament laxity have a higher prevalence of flatfeet [4]. Boys are twice as likely as girls to have the condition [5]. Ethnicity is also seen to play a part, with a higher prevalence in blacks as compared to Caucasian whites. Some races who do not shod their feet at a young age are also known to have a lesser incidence of flatfeet in their children [6, 7].

Two theories are prevalent in the literature regarding the cause of flatfeet. One proposes muscle weakness while the other suggests the inability of the bony ligamentous complex to maintain the arch [8,9].

Evaluation

History taking is an essential part of the evaluation of flatfeet. It would be useful at the outset to determine why the patient has come for the consultation. Since majority of the feet are asymptomatic it usually a parental concern which is the reason for the visit. The parent usually is concerned regarding the cosmetic deformity or the common perceptions in society regarding flatfeet. Usually, the question asked is if the deformity is likely to cause later disability.

If the child presents with symptoms then the history must evaluate the birth history and family history as well as a history of the symptoms. If there is pain, then the site of the pain needs to be determined. What triggers the pain or relieves it. The duration of pain and its pattern is essential to evaluate, because

[1]Consultant Orthopaedic Surgeon, Blooming Buds Paediatric Orthopaedics Department, Deenanath Mangeshkar Hospital, Pune, Maharashtra, India.

Address of Correspondence
Dr. Ranjit Deshmukh,
Consultant Orthopedic Surgeon, Blooming Buds Paediatric Orthopaedics Department, Deenanath Mangeshkar Hospital, Pune, Maharashtra, India.
E-mail: drranjitdeshmukh@gmail.com

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Figure 1: The arch forms when the child is non-weight bearing. If the child is made to stand on their toes the hindfoot abduction corrects with formation of the arch.

Figure 2: In the above picture the heel valgus in the left foot is corrected when the child stands on their toes. This correction is a feature of the flexible flat foot

prolonged intractable pain is usually the indication for surgery [10].

Assessment of causes of rigid flatfeet needs to be done by eliciting relevant history. Neuromuscular causes such as cerebral palsy and meningomyelocele can be asked for [10]. Family history of ligamentous laxity or talocalcaneal bars may be useful [1]. Location of the pain may be useful in determining the cause of the flatfoot. Flexible flatfeet usually have pain on the plantar medial aspect of the foot and the sinus tarsi. The rigid flatfoot is associated with multiple site pain. However, both are not associated with night pain or pain at rest or with swelling warmth or redness. This should alert one to the possibility of other causes for pain in the foot.

Clinical Examination

Physical examination of the lower extremity should be performed in detail. Assessment should be done for torsional and angular deformities in the lower limb. General examination for medical conditions should be done. Ligament laxity is associated with Marfan's and Down's syndrome.

Assessment of the Foot

- Shape
- Low or absent medial longitudinal arch
- Hindfoot valgus
- Mild abduction at forefoot.

The arch forms when the child is non-weight bearing. If the child is made to stand on their toes the hindfoot abduction corrects with formation of the arch. (Fig. 1).

In the above picture, the heel valgus in the left foot is corrected when the child stands on their toes. (Fig. 2).

This Correction is a Feature of the Flexible Flatfoot

The jack test

Formation of the arch on extension of the great toe occurs in a flexible flatfoot. The rigid flatfoot shows no formation of the arch. (Fig. 3).

Heel cord contracture needs to be assessed. Flexible flatfeet with tight Tendo Achilles are more likely to become symptomatic. Heel cord contracture can be assessed by the Silfverskiold test.

Silfverskiold test

The position of the hindfoot is important. The subtalar joint is inverted and locked in neutral position. This helps to assess movements at the talus with the ankle joint.

Measurement of the Angle of Dorsiflexion (Fig. 4 & 5).

The angle is measured between the plantar lateral border of the foot and the superior surface of the tibia. If the angle

Figure 3: Formation of the arch on extension of the great toe occurs in a flexible flat foot. The rigid flat foot shows no formation of the arch.

Figure 4: Measurement of the angle of dorsiflexion.

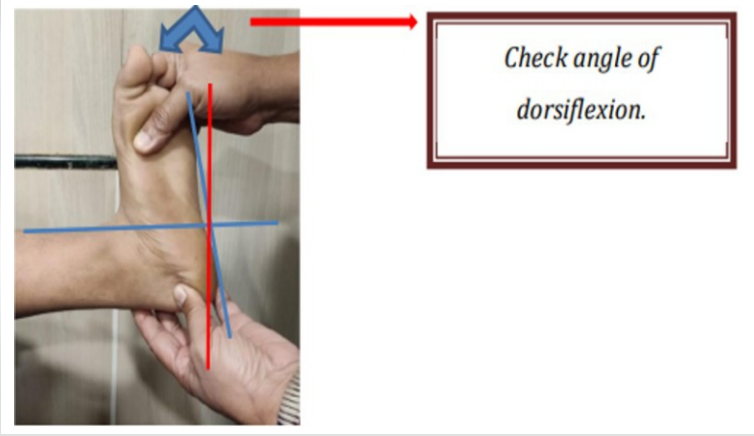

Figure 5: Technique of measurement of angles.

Figure 6: Davids et al have shown that the Talus 1st metatarsal angle varies by 10degrees in AP and 13 degrees in Lateral X-rays. The calcaneal pitch is an average of 17 degrees and Talonavicular coverage is 20 degrees.(8).

of dorsiflexion of the ankle is <10° with the knee flexed, the soleus is contracted. If the angle of dorsiflexion is more than 10° on knee flexion and becomes <10° on extension of the knee, a gastrocnemius contracture is to blame [11].

Examination of footwear is also helpful to give an idea of the flatfoot status. Flatfeet is usually associated with medial wear of the heel and midfoot. (Fig. 5).

X-rays

X-rays are required to assess symptomatic flatfeet. Standing AP and lateral views of the foot and AP view of the ankle are done. If a talocalcaneal bar is suspected, an oblique view with Harris axial view of the hindfoot can be ordered. A computed tomography (CT) scan is however a better investigation to evaluate for a coalition bar and the status of the remaining joints. Parameters to be assessed on X-rays are usually Check angle of dorsiflexion.

1. Calcaneal pitch (CP)
2. Talus 1st metatarsal angle (T1Mt)
3. Talonavicular coverage [12].

Davids et al., have shown that the T1Mt varies by 10° in AP and 13° in Lateral X-rays. The CP is an average of 17° and talonavicular coverage is 20° [13]. (Fig. 6).

Management

Non-surgical

Asymptomatic flatfeet usually do not require any management. There is no conclusive evidence that usage of inserts or orthoses leads to restoration of an arch [14]. The strengthening of intrinsic foot musculature as advocated by some is also not known to restore the arch [15]. In case of symptomatic feet pain relief may occur with usage of an orthoses [16]. These feet have to supple or flexible flat feet. In feet associated with a contracted Tendo Achilles or a rigid flatfoot, the pain may get aggravated. The insert attempts to evert the rigidly inverted foot or dorsiflex the rigidly plantar flexed ankle. This attempt to correct a rigid foot increases pressure at midfoot, causing an aggravation of pain [1, 17].

Stretching of a tight Tendo Achilles will help in flexible flatfeet associated with this contracture. Stretching can be taught to the parents. It is essential that they invert the hindfoot and supinate the forefoot. This fixes the subtalar joint in a neutral position so that movements occur only at the ankle joint. This prevents injury to the midfoot [10].

Surgical Indications

1. Failure of non-surgical treatment
2. Intractable pain in the midfoot and sinus tarsi region
3. Tendo Achilles contracture [4, 10]

Figure 7: X-ray and clinical appearance of Congenital vertical talus.

4. Surgery should rarely be performed in early childhood [3].

Osteotomies to realign the foot are the mainstay of treatment. The osteotomy should maintain movements in the subtalar joints as well as prevent arthritis.

1. Calcaneal lengthening osteotomy (CLO) [10]
2. Calcaneal cuboid cuneiform osteotomy (Triple C) [18]

Although these two osteotomies have become popular other osteotomies have been described for the condition such as Dwyer's lateral opening wedge as well as combined calcaneal lengthening with posterior medial calcaneal slide osteotomy.

Arthroeresis has also been advocated as a procedure to relieve symptoms of flexible flatfeet. This procedure involves the insertion of a synthetic or metal implant at the subtalar joint. This prevents further subtalar eversion at the joint and thus is supposed to relieve symptoms. At present, the evidence to support its use is insufficient [1,4].

The flexible flatfoot needs to be differentiated from the rigid flatfoot. The rigid flatfoot needs some form of treatment and is usually symptomatic. The flexible flatfoot as discussed above is usually asymptomatic and requires some treatment in exceptional circumstances. The main causes of rigid flatfoot are briefly discussed in the following description.

Congenital Vertical Talus

Pathology

Congenital condition involving the dorsal subluxation of the navicular, along with the forefoot on the talus and calcaneus. This form of rigid flatfoot is usually associated with myelomeningocele and arthrogryposis.

Evaluation

This leads to a talus which is plantar flexed in lateral X-rays in alignment with the axis of the tibia. The forefoot and midfoot remains dorsiflexed in lateral X-rays of the foot, taken in plantar flexion. (Fig. 7).

Management

The previous surgical management of the condition is now shifting to a more conservative cast manipulation followed by minimally invasive surgeries [19]. In those situations where the correction fails to occur a dorsal approach for an open release is now the present state of management [20]. Calcaneovalgus deformity of the foot needs a special mention at this point. It is encountered in 30% of neonates and is associated with increased intrauterine pressure. It is a positional deformity which usually resolves with time and is not associated with any long-term morbidity or flatfeet in children at a later age.

It is seen clinically as a hyper dorsiflexion deformity of the ankle with mild valgus at the hindfoot and subtalar joints. The longitudinal arch is present with a normal talonavicular joint. This helps it to be differentiated from a congenital vertical talus which requires some form of treatment.

Tarsal Coalition

Tarsal coalition is the abnormal fusion of two or more bones of the midfoot or hindfoot. The prevalence has been reported to vary from 2% to 13% [21].

Pathology

Fusion usually involves the talocalcaneal and calcaneonavicular joints. The coalition may either be of the fibrous or cartilaginous type. Usually, fibrous coalition is asymptomatic and may mature to a cartilage or ossify as the age of the child progresses. Usually, this age of maturation is around 8 years when the condition starts becoming symptomatic. Pain associated with the condition is either at the site of the coalition or it may occur in the surrounding joints. Pain is also present therefore at the midfoot.

Evaluation

A suspicion of coalition can be evaluated with the help of X-rays and a CT scan. Fibrous coalition may need an magnetic resonance imaging for evaluation. The CT scan is the mainstay of the investigation to take decisions regarding the management of the coalition [22].

Management

The coalition is usually asymptomatic and may not require any treatment. If the foot is to become symptomatic the treatment initiated is conservative. If the conservative treatment was to fail or not give any relief from the symptoms then surgical treatment of the condition may be considered. Surgical treatment is excision of the bar followed by interposition with fat, tendon, muscle, or bone wax. Calcaneonavicular excision has been reported to have good outcomes, in both short and long-term follow-ups [23].

Talocalcaneal bar excision has not been associated with good results on follow-up. The outcomes seem to correlate with the size of the coalition, the health of the posterior facet of the subtalar joint and the degree of hindfoot deformity [24].

Triple arthrodesis has been reported in talocalcaneal bars when the coalition is more than 50%, in the presence of degenerative changes in adjacent joints, inadequate pain relief, significant hindfoot valgus, or the recurrence of a bar after excision [25].

Based on a thorough evaluation of the bar, foot deformity, and presence of symptoms an approach has been put forward by Mosca and Bevan. Their approach offers not only resection with interpositional fat graft but also just osteotomy with deformity correction or both combined. The treatment is thus tailored to each foot based on the size of the bar, the status of the posterior facet and the hindfoot deformity [21].

Skew Foot

Pathology

The deformity in a skew foot involves

significant hindfoot valgus, along with metatarsus adductus. Exact cause of the condition is unknown. It may be present since birth or develop secondary to a surgical intervention as an iatrogenic cause. Evaluation X-ray of the foot in AP demonstrates translation of the parallel axes of the talus and the first metatarsus.

Management

Patients present in childhood with calluses and difficulty in shoe wear. Conservative treatment is the first line of management. This may involve modification in footwear and activities. If the pain is intractable then surgery may be resorted to. Surgery generally may involve CLO Calcaneal Lengthening Osteotomy with medial cuneiform opening wedge osteotomy. Tendo Achilles lengthening is invariably requires as heel tightness is a constant feature of the symptomatic foot [10].

Conclusion

The flexible flatfoot in children very rarely requires any form of treatment. Usually, the child is brought for consultation due to parental anxiety and perceptions of the flatfoot held by them. However, they need to be evaluated to rule out a rigid flatfoot which may need some form of intervention. Flexible flatfeet are rarely symptomatic and the mainstay of management is conservative. Usually, the symptomatic flatfeet are associated with a tight Achilles tendon. If the conservative treatment fails to give results, and the symptoms are persistent, surgical interventions may be required in selected cases. The osteotomies advocated are joint sparing and case selection should be carefully done. If the flatfoot is a rigid type, then usually symptoms are encountered. The management is then tailored according to the type of rigid flatfoot. A high index of suspicion is required to diagnose the type early and intervene at the appropriate stage to prevent long-term disability.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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