Treating Pediatric Foot and Leg Deformities

Children often present a challenge for podiatrists.

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We are often faced with the challenges of treating the pediatric patient in our offices. When we enter the treatment room for the first time, we see the worry on the parents' faces, and the child is initially either shy or scared. As we examine the child and listen to the parents concerns, we often think about what we would do as parents if this were my child. We all want to provide the best possible care, but we need to understand the risks and benefits of all treatment techniques and the potential long-term outcomes.

Unfortunately, many foot and ankle specialists treat children based on lectures they have heard or papers they have read, but sometimes these sources are not very reliable. There are currently very few credible peer-reviewed articles on the use of braces, custom orthotics, or long-term surgical outcomes with respect to pediatric foot and leg deformities. Many lectures are given by speakers who are affiliated with the company that makes a surgical device and do not always share their true experiences with us.

The purpose of this article is to share our experiences with conservative and surgical management of the pediatric patient and to discuss common pathologies and treatment plans. It is our goal that this will help to stimulate new clinical and surgical research to help us all improve our long term outcomes in this patient population.

Psychological Factors

When a child is seen as a patient for the first time, it is vital to make the experience fun for them. After listening to the parents' concerns, it is helpful to watch the child walk and run in the hall, if possible, and to examine the lower extremities afterwards. This helps to break the ice and the child is a little more relaxed after this. When taking a history about the child, do not forget to ask about the history of the parents. Did anyone else in the family have a similar problem? Did anyone else have treatment for this problem? This may include braces, orthotics or surgery.

It is important to remember when treating these patients that the parents are very worried. Address their concerns from the beginning. Explain to them the genetic component of the problem, and advise them that the child is still developing and much is unknown at this point. If the foot and leg are not skeletally mature, then there are several things that can be done which may alleviate pain and improve the development of the feet. Assure the parents that you will continue to monitor the child on a 6-12 month basis in order to assess the

effectiveness of the treatment plan. If you have children of your own, let them know this so they feel comfortable that you understand their concerns.

Discussing the child's treatment plan is a critical process, creating confidence, hope, and anxiety all at once. Be mindful of the age of the child. Explain most treatment options in front of both the child and the parents, but if it is a serious condition, you should discuss surgical options and potential risks with the parents separately. Emphasize to them that you will try all simple methods first, but sometimes this is not enough to alleviate the symptoms and sometimes more complicated treatment methods are necessary. It is important to be very brief if you need to discuss surgical options on the initial visit. The less anxiety the parents and child have, the more responsive they will be to your treatment plan. Explain to them the potential benefits of braces or custom orthotics.

Role of Braces

If a child is diagnosed early and the parents seek treatment before the child is walking, then braces can be very helpful. Braces have proven to be very helpful for metatarsus adductus and internal tibial torsion, but their effectiveness in children with abnormal femoral torsion is questionable. This is due to the inability of the brace to apply appropriate pressure proximal enough to bring about any measurable osseous change at the level of the hip(1) In contrast, internal tibial torsion is affected more directly with the brace by applying constant traction on the distal tibial epiphysis and therefore will increase the amount of external tibial torsion.(1,2) The Denis Browne splint and the counter rotation splint are the most effective devices for abnormal tibial torsion in an infant, and are usually set at 20-45 degrees externally.

It is ideal to use the device for 2-6 months if tolerated. We typically evaluate the child every month and expect to see 5-10 degrees of improvement at each visit. The counter rotation splint is well tolerated at all times versus the Denis Browne splint which may be more effective but is usually used only at night due to comfort.

The Bebax Shoe

When treating metatarsus adductus or calcaneovalgus in a young child, the splint/shoe that we like to use is the Bebax shoe (made by Inter Axial France, Sallanches, France). This is a great alternative to serial casting. If you prefer casting your patients, then consider using the Bebax shoe after casting for 1-3 more months as necessary. It is by far the best tolerated device and can be used from ages 6 months to 4 years of age. The shoe itself should be snug on the foot and is worn over a sock. Various sizes are available.(3)

The Bebax shoe can be adjusted to correct in multiple planes and does not have the presence of a bar between the feet. It is ideal for the flexible met adductus foot type and you will often see a significant difference within a 2-4 month period. It is used only in the house as the bottom of the shoe is not meant for walking. In the non-ambulatory child can wear it all day.

The ambulatory child we ask the parents to have them wear it at night, nap time and if watching TV. When not wearing the device, we place the child in a straight last shoe with a custom orthotic as described later in this article. We typically adjust the settings every 1-2 weeks in a child less than 1 year of age and every 3 weeks if the child is older. We usually prefer to use the device for a 6-month period, followed by a custom orthotic.

Role of Pre-fabricated Orthotics

Most children do not typically walk in a normal heel-to-toe manner until they are 4 years old. Therefore, it is important to keep in mind that a custom orthotic with all its "bells and whistles" will not be as effective until the child walks with a more normal gait. It is our preference to prescribe pre-fab's for most patients under the age of 4 and to consider custom devices after 4 years of age if the symptoms or deformity persist. If a child has a severe deformity such as calcaneal eversion greater than 4 degrees in resting calcaneal stance or severe in-toeing (causing daily tripping), then we may prescribe a custom orthotic or flexible hinged orthosis at 2-3 years of age.)

Pre-fabricated devices play an integral role in conservative therapy for all children. Most orthotic labs have a pediatric pre-fab device available for shipping within 2-3 days of placing an order. This allows for a quick and simple temporary therapy until the custom made orthotics are fabricated. An appropriate pre-fab orthotic allows the patient and parent to monitor a small yet significant improvement in the child's gait and pain cycle. An effective pre-fab device allows for an adjustment period for the patient to get used to a device in the shoe prior to dispensation of a custom made functional foot orthoses. Pediatric pre-fab orthotics give the practitioner a treatment option for the milder foot deformity and often serve as an introductory step in the management of the pathology.

Role of Custom Functional Orthotics

This is the most vital and amazingly most under-utilized method of conservative management. It is common that we will see a child with a foot deformity who was recommended to have surgery by another doctor or who has previously been given poorly prescribed orthotics. The use of custom orthotics has advanced tremendously in the past few years. We are now able to prevent the need for unnecessary surgery at a much higher percentage than in years past. This is due to the creation of improvements in the precision of orthotic fabrication, and the invention of new modifications such as the inverted technique, medial skive technique, and the fixed hinge or flexible hinged custom orthosis.

Negative Challenging

The most challenging aspect of orthotic therapy for the pediatric patient is negative casting. It is often recommended to cast the pediatric patient in the prone position. This position will allow the practitioner an ease of capturing the flexible hypermobile foot in the neutral subtalar joint position along with locking the midtarsal joint. The prone position also allows gravity to help with the negative suspension casting technique, and discourages the child from firing the anterior tibial tendon.

One can never over-emphasize the importance of the correct prescription for the individual pediatric deformity. Due to the increase in ligamentous laxity, the pediatric patient tolerates a minimal plaster cast arch fill for maximum subtalar and midtarsal joint correction and control. It is important to thoroughly investigate a lab's biomechanical knowledge prior to submitting a pediatric negative cast. The knowledge of proper negative cast correction with respect to cast arch-fill, medial skive technique, as well as inversion of the positive cast, is an integral part of finding a quality orthotic lab.

Some labs profess knowledge of the medial skive technique, yet indicate degrees in their prescription forms when in reality the medial heel skive is measured in millimeters. Some orthotic labs advertise expertise in negative cast correction, but are unable to

reproduce a positive cast with the appropriate medial and lateral heel expansion and cast arch-fill.

Not all orthotic labs are familiar with these techniques and in this patient population it is essential to have these tools when you need them. Some labs manufacture their devices much differently than others. There are many labs who pour plaster into your negative cast to create the positive cast and then add modifications by hand. This is the traditional method and it has produced good devices for years. But new technological advances have developed.

Some labs scan the negative cast digitally with a laser and use a computer assisted design to help mill or machine the device. The technician can view the positive cast image prior to fabricating the device and this helps in adding modifications or correcting casting mistakes more precisely. The traditional plaster positive cast method does not allow for this. The technician has to rely on the memory of the negative cast when making modifications.

Concerns of Parents

Parents are often concerned about the use of the orthotics for their child. We like to emphasize to the parents that just as eyeglasses do not permanently correct a person's vision, but help prevent further eye problems, a pair of custom orthotics will help prevent further damage to the foot and ankle and slow down the progression of the deformity. We explain that the child may always have an abnormal foot, but by wearing the prescription orthotics, we can correct for the deformity and allow the child to exercise or participate in sporting activities comfortably with less risk of secondary injuries. Once the child is skeletally mature, it is possible that he/she may not need the devices anymore, but we always re-evaluate the patient every 6-12 months during adolescence to help determine this.

The younger the age of starting use of an orthotic, the better chance there is of influencing the shape of the arch and the development of the foot.

It is always a challenge when a child does not want to wear orthotics. This usually happens because the child or parents are forgetful or the child doesn't think they are cool. Most children like the way they feel immediately and rarely is there a problem with fit or hardness. If the orthotic feels too hard, consider adding a Nylene or a soft EVA topcover. The most common problem with kids is the shoes they wear. If the orthotic is moving around in the shoes due to width, or the child not tightening the laces, then the orthotic is not as effective. New Balance, Brooks, Skechers, Stride Rite, Nike, Asics and Adidas all make shoes with removable insoles that fit well with orthotics.

Explain to the child that many professional athletes wear othotics to help them run faster and keep their feet comfortable. If the child is younger tell them that the orthotics are like magic and they will help them be fast like Superman or quick like Michael Jordan. Anything you can do to help them laugh and get excited about wearing them will improve compliance and outcomes.

Other Factors in the Management of Pediatric Deformities:

Torsional Abnormalities

We often see many children during the year who have persistent in-toeing observed by the parents and pediatrician. Although some studies have revealed that more than 80% of children with in-toeing resolve spontaneously (4,5), many patients have persistent symptoms

affecting gait. In-toeing is most commonly caused by abnormal femoral torsion, abnormal tibial torsion, or metatarsus adductus.

Femoral Torsion

Femoral torsion can be measured in a variety of ways. We prefer to measure this with the child supine. One advantage of this method is that it can be performed on the parent's lap if the child is anxious. In the supine method, the leg is grasped above the knee to isolate the hip segment. Internal and external rotations of the hip are performed. If the knee can be turned inward to face the opposing leg more than 90 degrees of internal rotation is present. Normal internal rotation/femoral anteversion in an infant is approximately 30 degrees. The angle should decrease steadily 1 to 2 degrees until age 10, and when an adult the average should be approximately 12 degrees. (6)

Tibial Torsion

Tibial torsion is assessed by comparison of the transmalleolar axis to the frontal plane of the knee. This is best seen with the child in a supine or sitting position. Tibial torsion at birth is usually 0 degrees, but at 1 year of age it should increase to 12 degrees externally. By 5 years of age, it should increase to approximately 20 degrees external and by adulthood, 25-30 degrees (7).

Once it has been determined that a soft tissue imbalance at the knee is producing the internally rotated position in gait, the knee should be evaluated with the hip both extended and flexed. If the internal tibial position is present with the hip flexed but not with the hip extended, tightness of the medial hamstrings should be suspected. If there is no change in the internal tibial position with the hip flexed and extended, local musculature and ligaments about the knee are the most likely causes(8).

Based on these findings, one may recommend a physical therapy stretching program for hamstring tightness, whereas if the problem is originating from musculature at the knee, a custom orthotic or flexible-hinge custom orthosis may be very helpful.

Closed Kinetic Chain Internal Rotation

It is also important to consider closed kinetic chain internal rotation of the leg. This causes pronation of the rearfoot and midfoot, which produces abduction or external rotation of the foot on the leg.(8) In an ambulatory child greater than 4 years of age, the flexible hinge custom orthosis helps to control closed kinetic chain internal rotation of the leg more effectively than other forms of braces or orthotics.

Limb-Length Discrepancy

Many children have one leg shorter than the other which will often contribute to all of the pediatric deformities discussed in this paper. The rule of thumb for treating pediatric patients with limb-length discrepancy (LLD) is to think very conservatively. The LLD is often categorized as a structural or functional LLD. A structural LLD is defined as an osseous abnormality in the lower extremity. For example, the LLD could be caused by a curvature in the spine as well as due to a unilateral pelvic torque. A functional LLD is defined as a muscular abnormality in the lower extremity. Orthotic therapy can be helpful in the treatment of a limb length deformity. It should be communicated to the parent that the

orthotic device will correct for about 25-50% of the LLD, however a heel lift is not recommended because of the growth potential.

Ankle Equinus

The role of ankle equinus can never be underestimated in the pediatric patient. It may aggravate and/or partially cause painful pes planus, juvenile bunions, calcaneal apophysitis, and met adductus. Calf stretching exercises on a daily basis and physical therapy can be helpful for this deformity, but may not be long lasting. Custom orthotics can sometimes accelerate the progression of equines, particularly if one uses a rearfoot post or inverts the device.

In asymptomatic patients, gastrocnemius equinus and gastrocnemius soleus equinus are common in 33% and 17% of patients respectively.(9) In a child with a symptomatic foot deformity it is often an integral part of the pathology. The minimum amount of ankle range of motion necessary for normal gait is 10 degrees of dorsiflexion and 20 degrees of plantarflexion. In a child less than 12 years of age, ankle dorsiflexion should be even greater.(10)

If the equinus is symptomatic with daily pain or cramping, then surgical repair may be indicated. It is the author's preference to perform an open gastrocnemius recession if the ankle joint dorsiflexion is 10 degrees or greater with the knee flexed but less than 5 degrees with the knee extended. Some foot and ankle surgeons recently have been advocating a minimal incision technique for this procedure. (11) In a study on 18 patients, the mean dorsiflexion after 12 months was less than 5 degrees with the knee extended. In our opinion, it is very difficult to get a complete release of the aponeurosis to the gastrocnemius muscle with this technique. The open technique popularized by McGlamry and Fulp (12) is simple, allows for immediate weight-bearing in a cast, and has a fast recovery time, with very few potential risks and complications. One should achieve 5-10 degrees of dorsiflexion post-operatively every time if the procedure is performed in a patient with a true gastrocnemius equinus.

Prescription Writing

Custom functional foot orthotics have been used for pediatric foot deformities for many years. There has been very little scientific literature proving the effectiveness of these devices in treating foot and ankle deformities. This is primarily due to a lack of effort on the part of the educational institutions in our profession. In our experience, orthotics are not only a very effective and integral part of the treatment plan, but should be an essential part of the podiatric surgeon's effort to help prevent the need for surgical intervention. Orthotics will not help all of your pediatric patients, but if it were your child, we am sure you would try the best possible orthotic to help alleviate the pain and symptoms.

There have been several advances in orthotic techniques over the past 10 years. More labs across the country are beginning to offer these techniques to their clients, but the majority of the labs do not understand these concepts. In 1986, Blake first described his inverted technique (13).The benefits of this modification are that it controls the velocity of pronation and the talo-navicular joint more effectively than a traditional root device. The traditional Blake inverted technique recommended that a 5 degree positive cast correction could achieve a 1 degree heel position change. In our experience it is excessive to prescribe a 15-25 degree inverted orthosis for a child who has 3-5 degrees of eversion in resting calcaneal stance. We usually prescribe 1 degree of inversion for every 2 degrees of calcaneal eversion in

stance in combination with a 4 mm. medial heel skive technique. (Fig. 1) The medial skive technique was described by Kirby (14). It helps to control the subtalar joint by redistributing ground reactive forces more medially across the subtalar joint axis.

Pediatric Orthotic Prescription Writing Recommendations

Juvenile Bunions

In a child who is not skeletally mature, we prefer to prescribe an orthotic with maximal correction to help support the foot in a neutral position during development. Our preference is to use a polypropylene shell (usually 5/32nd of an inch) unless the child weighs more than 125 lbs.; then we would use a thicker shell. The rest of the prescription would include a normal heel cup (14mm), minimal cast/arch fill, and a 4/4 degree rearfoot post.

The child who is is skeletally mature may not tolerate a minimal arch fill, type of orthotic. Therefore, we recommend a standard arch fill for these patients.

Calcaneal Apophysitis

This pediatric injury usually results from repetitive trauma from jumping activities, and sometimes the abnormal pull of a tight Achilles tendon. Abnormal pronation often plays a role in the etiology of this pathology as well. Initial treatment usually includes a 1/4-1/2 inch heel lift and anti-inflammatory medication. When symptoms persist, a custom orthotic is often very helpful. We prefer a polypropylene shell with a deep heel cup (18 mm.) and 4/4 degree rearfoot post. The deep heel cup helps to push the plantar fat pad under the calcaneus. (Fig. 1) In addition, a soft topcover such as Nylene or Poron with a leather topcover is essential. If symptoms persist, a below-knee cast or CAM walker immobilization for 2-4 weeks may be necessary prior to using an orthotic.

Pes Planus

In a child with a flexible flatfoot deformity, the subtalar joint axis is often abnormally displaced medially, resulting in severe pronatory forces across the rearfoot. The midtarsal joints are often hypermobile and are unable to stabilize the foot during the midstance or propulsive phases of gait. If the child is not treated aggressively with a well-prescribed orthotic, degenerative changes of the subatlar or midtarsal joints may develop with time.

The orthotic prescription should be determined by the severity of calcaneal eversion or the resting calcaneal stance position. This should be compared to the neutral calcaneal stance position. In the authors' experience, the device should be inverted 2 degrees for every degree of calcaneal eversion and if the subtalar joint axis is abnormal, the positive cast should have 4 mm. of medial skive. When using a medial skive technique, it is important to also ask the lab for a deep heel cup (18 mm.).

We typically prefer a polypropylene shell with a 4/4 degree rearfoot post. Some authors prefer a UCBL-type device for severe flatfoot, but most kids will have difficulty fitting this into their shoes, and often find this type of device uncomfortable due to the higher flange on the medial side.

Metatarsus Adductus

If the deformity is flexible and reducible manually, then an orthotic with a high and long medial flange may be helpful. A 4 mm. medial skive with 2-6 degrees of inversion can

also be very helpful in controlling the abnormal forces across the midfoot and forefoot. It is vital in these patients to cast out the forefoot supinatus when taking the negative cast impression. In addition, these patients should have a minimum arch fill, and polypropylene shell with a deep heel cup. This foot type typically has abnormal lateral column loading and therefore the rearfoot post should not be beveled.

When the child is skeletally mature, the orthotic device needs to be wide to help prevent pronation of the device. In addition, one should prescribe a standard arch fill to prevent medial arch irritation. It is common that the rigid met adductus foot type will often have a prominent 5th metatarsal base and therefore requesting the lab to add a release or aperture with a Poron filler at this site might be very helpful to improve comfort.

Surgical Repair

It is always difficult to explain to parents that their child needs foot or ankle surgery. This needs to be discussed if the child continues to have pain or is limited in daily and recreational activities due to the feet or ankles. Other clinical abnormalities may include walking with a limp, night cramps, and a desire for only sedentary hobby activities.

Juvenile Bunions

When parents see a bunion deformity in their child, they are very worried because they know that it is only going to get worse each year. Often the parents or grandparents have had severe bunions and they know what will happen with time.

We always advise the parents that it is not necessary to have surgery if the bunion does not hurt, but once the bunion affects childhood activities, develops increased pain or begins to cause deformities in the neighboring toes from pressure, then surgery needs to be considered. It is ideal if the foot is skeletally mature when it is operated on, but it is not necessary to wait until the child is 13-14 if there is daily pain.

Choosing the Best Procedure

Choosing the best procedure for the child depends on the size of the deformity. The biggest concern in operating on a child who is not skeletally mature yet is the chance of recurrence. In order to minimize recurrence, we believe that the surgeon should consider the effect of the metatarsus adductus angle and particularly the total adductus angle (1st intermetarsal angle plus the met adductus angle). If the total adductus angle is 28 degrees or greater, then we prefer to perform a proximal procedure such as a Juvara-type closing base wedge osteotomy or a Lapidus arthrodesis. One critical factor that must be considered is the degree of shortening of the procedure and the long-term effects of a shortened 1st metatarsal in a child.

If a Lapidus is performed, then curettage of the cartiledge should be performed rather than using a saggital saw since the cartilage is usually nice and soft compared to that of an adult. In addition, if the growth plate is still open at the base of the 1st metatarsal, then a Lapidus is not an option and the base wedge procedure needs to be performed more distal in the proximal half of the bone. We have tried epiphyseal stapling, but it is not our favorite procedure because it is common that a second procedure will be needed in the future.

1st metatarsal head osteotomies are a good option if the total adductus angle is less than 28 degrees. Regardless of the procedure, the proximal articular set angle needs to be

evaluated intra-operatively. If this is significantly abnormal, then a Reverdin-Green type osteotomy at the head of the bone needs to be performed as well. In this situation, the use of custom orthotics is essential in long term prevention of recurrence post-operatively.

Pes Planus

The symptomatic flatfoot has been a challenge for foot surgeons for years. The flexible flatfoot will primarily be discussed in this paper as it often responds better to conservative modalities. Hopefully, the parents of the child will seek treatment earlier in life when a flexible deformity is more responsive to orthotic management or more simple surgical procedures. In contrast, the rigid flatfoot is usually a surgical problem whether it is caused by a tarsal coalition or a congenital vertical talus. It is often associated with degenerative joint changes and limited motion.

Smith (15) and Maxwell (16) have both increased the popularity of subtalar implants. In recent years, these authors and other experts have been teaching others that the Sta-Peg and MBA implant should be utilized for frontal plane deformities (calcaneal eversion) in pediatric flatfoot patients. The problem is that this is very rare. Most patients with symptomatic flatfeet have a transverse plane deformity with the forefoot abducted on the rearfoot or a combination of a frontal plane and transverse plane deformity).

If a subtalar implant is utilized with a transverse plane deformity, then additional procedures such as a calcaneal lengthening procedure (Evans or callus distraction) or medial column plantarflexory procedure are usually necessary which may make the subtalar device unnecessary. Proponents of the arthoeresis argue that it is a minimally invasive technique that does not distort the normal anatomy of a child's foot (17). In our opinion, placing a permanent foreign implant in a mobile segment of a developing foot has a significant risk of creating cartilage damage to the subtalar articular facets over time. This is particularly true of an implant that is not cemented, or one that could easily move if a person develops an ankle sprain or other trauma to the foot later in life. It is common that we need to remove the implant several years later.

According to Smith (18), the STA-Peg is indicated in children 3 to 8 years of age if the resting calcaneal stance position is greater than 5 degrees of eversion. In children ages 8 to 11, additional procedures are recommended. This is the age group that we feel needs to be looked at more closely. Why should one perform multiple procedures in a 10 year old child, when a single procedure such as an Evans calcaneal osteotomy with a good custom orthotic, may be all that is necessary to alleviate pain. Do all patients with a navicular-cuneiform fault or talo-navicular fault need an arthrodesis in conjunction with a subtalar implant? Several studies have shown poor results with medial column fusions in the pediatric flatfoot (19, 20).

Medial column arthrodesing procedures often result in a significant loss of inversion and eversion of the midtarsal joints. Some surgeons have suggested correcting the medial column supinatus in these patients with an adjunctive Young tenosuspension procedure (21). In our experience this procedure works well for a short period of time but seems to lose its effectiveness after 1-2 years as the medial column begins to sag again.

The large majority of pediatric patients with symptomatic flatfoot have some degree of transverse plane deformity. We have found the most success with the Evans calcaneal osteotomy whether we use a bone graft or an external fixator for lengthening the lateral column. The Evans procedure helps to correct forefoot abduction, heel valgus, and helps to stabilize the medial column.(21,22) Although the Evans procedure has reported good long-

term results in some studies (23), it has been our experience that this procedure does not work as well in the skeletally mature foot. It is our preference to perform a calcaneal block fusion in a skeletally mature child as the Evans sometimes leads to calcaneo-cuboid arthritis later in life.

We believe that medial column supinatus is often a contributing factor to flexible pediatric flatfoot symptoms, but it usually does not demonstrate degenerative joint changes in a skeletally immature child. If there is residual supinatus after performing an arthroerisis or an Evans procedure, we need to consider the benefits of using an inverted custom orthotic versus the risks of performing a medial column arthodesis or Young procedure. One should be able to control medial column flexibility and faulting with an orthotic unless degenerative changes are present.

Met Adductus

The decision to perform surgery on a child with metatarsus adductus should be based on persistent symptoms after utilizing custom orthotics, and a Bebax shoe. These symptoms include pain over pressure points at the 1st and 5th metatarsal, frequent tripping or pain in closed shoes. It is very rare that the flexible met adductus foot requires surgery as symptoms can usually be improved when treating a child younger than 6 years of age with conservative methods. If symptoms persist in a child under 6 years of age, a Heymen-Herndon-Strong (3)procedure followed by several months of a Bebax shoe may correct the deformity. This soft tissue release is performed at the Lisfranc articulation and usually pinned or stabilized with K-wires for 6-8 weeks. This procedure is not always effective and one study on 37 children revealed a 41% failure rate (Stark 1987). In addition, if there is any damage to the articular surfaces during dissection, degenerative changes may result and fusion is likely to develop.

If symptoms persist, it is ideal to wait until the child is skeletally mature or at least 8 years of age prior to performing surgery. In this age group, the met adductus usually is semi-rigid or rigid and has an osseous component. The Lepird procedure (Jay, 1999) of performing closing-base wedge ostetomies is a good procedure but technically very difficult. It is difficult to make all 5 osteotomies in the exact same plane. If the procedure is to be successful, the osteotomies of metatarsals 2,3, and 4 must be parallel to the supporting surface. This error often results in more of a frontal plane rather than a transverse plane correction.

We have had better success with a closing base wedge osteotomy of metatarsals 1 and 5 only and a crescentic osteotomy of metatarsal bases 2,3,4. It is easier to get better transverse plane correction and results in less shortening of the central metatarsals.

Conclusion

The pediatric patient is a unique population of our practices. It is important to keep in mind the psychological effects of your conversations with the child and to treat children with the same sensitivity that you would treat your own child. There are several new advances in orthotic management for these patients. Pediatric deformities require orthotics with more precise prescription writing, and manufacturing to help alleviate the symptoms. If surgical repair is necessary, it is important to weigh the risks and benefits of the procedures being considered.

It is possible that a custom orthotic in combination with a more conservative surgical procedure may achieve the same or a better long-term result than trying to correct the

deformity with surgery alone. As new devices and new procedures are developed for the pediatric patient, we need to strive as a profession to look at these procedures unbiased and create good long-term research studies to help determine their true efficacy. In addition, we need to create better research for orthotic and brace management for pediatric patients. It is our hope that with better understanding of the treatment options and new technologies, we will all improve our outcomes in treating children.

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