Managing Pediatric Metatarsus Adductus: Should You Treat It?

April 03, 2008
Volume 21 - Issue 4 - April 2008
Pages:
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Yes, this author advocates early treatment for moderate to severe metatarsus adductus, and semi-rigid or rigid deformity. He cites problematic compensatory effects from residual deformities and a documented association between metatarsus adductus and hallux abducto valgus deformity.

Metatarsus adductus is a transverse plane congenital deformity with adduction of the forefoot at the tarsometatarsal joint. It has a reported incidence of one per 1,000 live births. However, it has been acknowledged that this may reflect only the severe cases and the true incidence may be higher.

Researchers have also reported that the incidence increases to 5 percent when one sibling has the deformity.1 In another study, which followed 484 premature children and 114 healthy-term children for five years after birth, the study authors found metatarsus adductus to be more frequent in twins (41 percent) than in single infants (16 percent). They reported similar frequency in single pre-term and term infants (16 percent versus 12 percent).2

There are several clinical factors to consider with metatarsus adductus and one must weigh these factors in determining if treatment should begin. These factors include:

• the natural history of the deformity including the likelihood of it persisting without treatment;
• potential compensations for the adducted forefoot when the condition persists;
• significance of residual deformity as the child becomes an adult; and
• the reported increased incidence of hallux abducto valgus deformity in the presence of underlying metatarsus adductus.

In advocating for treatment of this condition in select cases, we must consider the reported outcomes for conservative correction of this deformity in infants.

What about congenital foot deformities that you have deemed likely to persist and thereby contribute to compensatory or associated deformities with or without symptomatology? You should ideally correct these deformities in infancy prior to weightbearing. In doing so, podiatrists can "optimize" the foot before the effects of ground reaction force, the superstructure above and shoe gear are introduced. These post-weightbearing factors can contribute to the development of secondary problems over time.

What Does The Literature Reveal About Proper Patient Selection?

There is wide agreement in the literature that neonates and infants with moderate to severe metatarsus adductus, and those with partially flexible (semi-rigid) or rigid deformity will not be able to achieve spontaneous correction with normal development. Therefore, one should consider these patients as candidates for early treatment.

The percentage of patients that falls into this group varies according to several reported studies. Farseti, Weinstein and Ponseti followed 31 patients (45 feet) over 32 years and six months.3 They considered 16 feet as passively correctible and that only mild to moderate or no treatment was required. They noted that all of these patients had good results. The study authors identified the remaining 29 feet as having moderate to severe and partially flexible or rigid deformities. They subsequently provided serial plaster cast treatment and noted 26 "good" and three "fair" results.

In a 10-year follow-up study, Ponseti and Becker evaluated 379 patients and 44 (12 percent) patients (80 feet) underwent cast treatment, yielding 57 good, 19 acceptable and four poor results.4 The remaining patients in this study (88 percent) had mild to moderate deformities that were passively correctible. The study authors reported that most of these patients had spontaneous improvement or correction.4

In a classic study, Rushforth followed 83 children, over the course of seven years, who had 130 feet affected by metatarsus adductus and received no treatment.5 At the conclusion of the study, only 14 percent of

the children still had moderate (10 percent) or severe (4 percent) deformities.

In his analysis of these conclusions, Bleck reported that we must be mindful that these children are now too old to benefit from conservative treatment.6 He goes on to say that the difficulty in putting into practice Rushforth's natural history of spontaneous correction to normal or "mildly" deformed feet in 86 percent of cases is that we have "no objective methods to determine which feet should be treated and, if treated, at what age."

For the majority of physicians in practice, Bleck says there are "obvious practical, ethical and legal problems" with not treating an infant who presents at a follow-up (visit) two to seven years later with moderate or severe deformity. At this stage, "only a surgical procedure will correct the deformity," maintains Bleck in his study.6

Interestingly, Rushforth states that 13 feet (10 percent) in his population exhibited asymptomatic residual deformity at the follow-up visit. In their analysis of this data, Farseti, Weinstein and Ponseti state that this 10 percent residual deformity is consistent with the percentage of feet they believe should be treated. They add that physicians may have prevented this residual deformity by treating those patients in this population who had partially flexible or rigid deformities.3

What You Should Know About Compensatory Effects From Residual Deformities

Metatarsus adductus feet often develop abnormal pronatory changes within the rearfoot and midfoot complex. These changes may be due to improper treatment or shoe gear, the compensatory effect caused by ambulation, or weak ligaments or muscle imbalance as in connective tissue syndromes.

This abnormal pronation of the midtarsal joint leads to the development of a skewfoot (or a Z or serpentine foot). Some believe the compensatory changes at the midtarsal joint, with or without underlying connective tissue disorders, may be a consequence of reminding children to walk straight. This actually increases firing of the peroneals, particularly the peroneus brevis, which is a strong pronator of the midtarsal joint.

In addition, the effect of the last shape of the shoe in a child with

metatarsus adductus is to create a midtarsal torque as a result of the laterally directed force on the medial first metatarsal head and the stabilizing force on the lateral side of the heel. The forefoot joint furthest from the force origination at the metatarsal head is the midtarsal joint. The long lever arm of this force on that joint will result in compensation at this site. Researchers have associated this compensation over time with plantar fasciitis, bunion deformities, hammertoes, neuromas, tendonitis, sinus tarsi syndrome and osteoarthritis.7

How Is Metatarsus Adductus Linked With Hallux Abducto Valgus?
Numerous reports in the literature have documented a link between residual metatarsus adductus and an increased incidence of hallux abducto valgus. In one study of 63 cases of adolescent HAV in 54 patients, researchers noted a high metatarsus adductus angle in 75 percent of the cases.8 In an 11-year retrospective study of 45 patients (60 feet), Coughlin found moderate to severe metatarsus adductus in 22 percent of the cases, "a rate much higher than that in the normal population."9 In looking at 40 patients (72 feet) under 21 years of age who underwent surgery for symptomatic HAV, Banks, et al., found a "statistically significant correlation between an increasing metatarsus adductus angle and an increasing hallux abductus angle."10 Finally, Ferrari and Malone-Lee evaluated the relationship between metatarsus adductus and hallux valgus on 100 dorsoplantar radiographs.11 They reported the prevalence of metatarsus adductus as 55 percent in patients with hallux valgus and 19 percent in patients without hallux valgus. A Chi test showed this to be a significant difference in the distribution of the data.2 What The Studies Say About Treatment Outcomes In the aforementioned study by Farseti, Weinstein and Ponseti, researchers reported 26 good results and three fair results after using an above-knee cast in 29 feet with partially flexible or rigid, moderate to severe deformities.3 They conclude that their data is consistent with previous reports that serial manipulation and casting is sufficient to correct deformity and prevent recurrence.12 Ponseti and Becker reported 57 good, 19 acceptable and four poor results from the use of above knee serial casting in 80 feet receiving treatment (12 percent) in their study of 379 patients.4
In a more recent study, Katz, et al., validate the effect of below-knee serial

casting for the correction of infant metatarsus adductus.13 In 65 infants with 37 feet graded as moderate and 48 feet graded as severe, inflexible metatarsus adductus correction occurred in six to eight weeks in all cases. At two- to six-year follow-up with a mean of four years, researchers reported a maintained correction for all children who had a moderate deformity. Out of the 44 feet with severe deformity that were available for reevaluation, six had a moderate deformity and one had a severe deformity. These results are similar to those reported for above-knee casting and the authors conclude that a "below-knee plaster cast is effective in the treatment of metatarsus adductus."
In a prospective study of 160 children (265 feet) with 147 patients treated with casts and subsequent splints, Bleck reports that the only significant predictor of a good outcome was the age of the patient. There was a statistically significant better outcome if the treatment started between one day and eight months of age.6

In Conclusion

Given these results, Bleck notes that it seems "wiser to treat in infancy those feet with metatarsus adductus graded moderate or severe. If not, extensive surgery will be necessary to correct a severe deformity."6 He also states that "if left untreated, children's feet with metatarsus adductus often develop compensatory changes within the midtarsal joint and subsequent symptoms later in life. … It is possible that some spontaneous corrections of moderate and severe metatarsus adductus occur by this mechanism and perpetuate an illusion of successful observational management."6
Bleck concludes "that metatarsus adductus is an objectionable foot deformity" and cites "numerous" reports of surgical management for persistent deformity that is severe in children over the age of 2.6

These conclusions, in addition to the documented relationship between metatarsus adductus and hallux abducto valgus deformity, argue strongly for the early treatment of partially flexible or rigid metatarsus adductus that is moderate to severe in infants. In regard to flexible, reducible and mild deformities, observation for spontaneous correction is acceptable. The well documented positive outcomes of conservative cast treatment in

infants further validates this approach to management of the infant with metatarsus adductus as the correct one.

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No, this author says the deformity does not necessarily require treatment. He emphasizes key criteria in the clinical exam as well as other diagnostic findings for determining the appropriate course of treatment or non-treatment.

Should a physician choose not to treat a deformity? Should a physician not provide medical care or attention to a patient in an attempt to heal or cure?

A clear-cut response is hard to delineate. Let us examine some of the evidence about metatarsus adductus that will help to establish the fact that an aggressive or radical treatment, although available, is not necessarily indicated.

Metatarsus adductus is a congenital transverse plane deformity that occurs at the Lisfranc tarsometatarsal articulation. Clinically, the forepart of the foot is adducted. The incidence is 3/1,000. Adduction of the foot can be associated with internal tibial torsion and one may also see this as a residual deformity of clubfoot.

The etiology of metatarsus adductus is not fully understood at this point but there are a few theories. It is possibly due to excessive pressure characteristically present in the uterus with the firstborn or the uterus could just be generally constrictive regardless of the number of children. It is also possible that malpositioning of the fetus and a lack of ontogeny

has a deforming effect on the metatarsals.
Whether it is because of the malposition of the fetus or the number of fetuses present within the uterus, it is still a matter of a fight for space. The fetus is packed into the tight compressive uterus. With the internal torque and flexion of the leg segment, the feet wrap around the inferior buttocks. The fetus's increases in size, along with the strong uterine musculature, prevent the foot and leg from going through the external abductory torque that should normally occur.
With malpositioning, specific muscles gain a mechanical advantage. For example, the abductor hallucis may become overactive, causing the hallux and the first ray to adduct, thus creating a metatarsus adductus (metadductus) deformity. The abductor hallucis muscle lies on the medial side of the foot. It arises from the medial aspect on the calcaneal tuberosity, centrally from the flexor retinaculum and distally on the aponeurosis. The muscle travels along the medial border of the plantar aspect of the foot, and the tendon eventually inserts into the base of the proximal phalanx along with the medial head of the flexor hallucis brevis. The abductor hallucis tendon abducts the great toe on the metatarsophalangeal joint (MPJ) in addition to flexing the joint. With a malpositioning of the metatarsal that is adducted, the muscle tendon apparatus of the abductor will lie even more medially, creating an increase of abduction of the great toe. It is this shortened position that causes the muscle tendon apparatus to become overactive. This is not necessarily a neuromuscular dysfunction. If the peroneal muscles are weak, the tibialis anterior and tibialis posterior muscles gain a mechanical advantage that will cause the forefoot to supinate and adduct.

A Pertinent Overview Of Clinical Signs

The diagnosis of metadductus is predominantly clinical. One can observe the following five clinically diagnostic criteria in the weightbearing or non-weightbearing positions.

• The foot maintains an inward position when one strokes the lateral border. It may twist outward for a moment but it then returns to the original adducted position.

• The foot develops a medial concave border and a lateral convex border with a prominent base of the fifth metatarsal. The prominence of the fifth

metatarsal base becomes more evident after the child loses some fat and the fifth metatarsal base becomes ossified. One may observe a C-shaped foot from the plantar aspect.

• The metadductus foot may appear to exhibit a high arch. In the infant, the foot seems to be in a cavus position.

• One can observe a marked separation of the great toe from the lesser toes. The great toe can remain in this adducted position, yielding a hallux varus and a high first metatarsal adductus angle. In the presence of a tight tendo-Achilles, the foot pronates. Eventually the adducted hallux will drift laterally as the first ray and metatarsophalangeal joint compensate by dorsiflexing. The first MPJ loses its stability and a hallux valgus deformity develops.

• View the metatarsus adductus foot plantarly in a non-weightbearing attitude and construct two imaginary lines. One line should bisect the heel longitudinally and the other line should bisect the forefoot area longitudinally. In a metadductus foot, these two lines intersect and create an angle greater than 25 degrees.

Understanding The Role Of Radiographs In Evaluating The Deformity

Physicians should not make the decision to perform surgery on the metadductus foot on a cosmetic basis. In order to consider surgical options, the child should present with difficulty in finding comfortable shoe gear, have experience tripping or be experiencing pain on the various pressure points of the foot (e.g. first metatarsal head, fifth metatarsal base).

When determining the appropriate surgical procedure, one should examine the metatarsal bases for the progression of development. During the developmental years, the bases appear rounded at the cartilaginous junction.

While metatarsus adductus is largely a clinical diagnosis, podiatric physicians may obtain weightbearing angle and base of gait films, including dorsoplantar and lateral views of the foot, and anterior/posterior views of the ankles. The radiograph is not a necessary diagnostic tool unless it is a means of monitoring the progression of the deformity or if one is using radiographs as a template for surgical

intervention.
The dorsoplantar radiographic view allows one to measure the adductus deformity via the metadductus angle and localization of the deformity at either the tarsometatarsal joint, midtarsal joint or both. Therefore, radiographs are an aid to help establish a value system for the deformity. One can assess the severity of the deformity and determine an appropriate surgical or non-surgical approach. Radiographs can also be beneficial with postoperative or post-casting monitoring.
The metatarsus adductus angle is the angular relationship between the line representing the bisection of the second metatarsal and a line representing the lesser tarsus abductus angle. A normal metatarsus adductus angle is approximately 22 degrees. A significant metatarsus adductus angle would be greater than 25 to 30 degrees with a normal midtarsal joint position.
Since the foot of the infant is not osseously mature, one cannot accurately identify the lesser tarsus. The space between the points of identification are too wide at the articular margins of the medial aspect of the first metatarsal and cuneiform, the navicular and talus, the lateral aspect of the calcaneus and cuboid, and the fifth metatarsal and cuboid.

How The Position Of The Navicular On The Talar Head Comes Into Play

One should take the position of the navicular on the talar head into consideration when determining whether to employ surgical treatment or a conservative non-treatment approach. A laterally positioned navicular demonstrates subtalar pronation while a medially positioned navicular on the talar head is present with talipes equinovarus and cavus foot deformities. The physician has to address this type of supinated position separately and it is usually present with a forefoot adductus deformity.
Podiatrists can use the radiograph to assess the navicular position on the talar head. When reducing the metatarsus adductus angle with transverse plane abduction, one should be aware that an abductory force may exert at the Chopart's articulation.
If a lateral deviation of the navicular occurs during cast reduction, one should cease cast therapy. With continued transverse force and midtarsal

joint abduction, the result will be a rectus foot at the expense of a pronated flatfoot.

Understanding The Importance Of The Calcaneal Cuboid Relationship
Study the calcaneal cuboid relationship to determine the presence or absence of forefoot adductus. Forefoot adductus is a soft tissue deformity produced by midtarsal joint supination around the oblique axis. This results in plantarflexion, adduction and inversion of the forefoot. Forefoot adductus is evident with an adducted position of the cuboid on the calcaneus. On the radiograph of an adducted forefoot, a line from the calcaneus through the lateral surface of the cuboid deviates in the direction of adduction. Normally, these two lines do not converge.
An adducting forefoot demonstrates oblique axis supination. If the line is abducting, midtarsal joint oblique axis pronation is present. In the presence of abduction of the cuboid (midtarsal joint pronation), one will need to address a metatarsus adductus deformity more radically and aggressively.

What One Study Shows About The Treatment Of Metatarsus Adductus
Metatarsus adductus is frequently present in children and it is important to determine if it will correct spontaneously or whether early treatment is necessary.
A study examined 84 patients with metatarsus adductus. There were 50 boys and 34 girls, ranging in age from 5 1/2 months to 2 1/2 years. There were 124 feet with metadductus deformities. Researchers took weightbearing AP and lateral radiographs. They found that greater than 43 percent of the children with a simple metatarsus adductus required no treatment. Their midfoot and hindfoot were in normal alignment. Of the children with a metatarsus adductus whose midfoot was laterally translated, 14 percent required no treatment.
The remaining children with a severe complex rearfoot deformity and an adducted deformity of the forefoot required cast treatment twice as long as the 57 percent with simple metatarsus adductus. When there is a severe breakdown at the midtarsal or subtalar regions, the foot requires more aggressive therapy. In these patients, one needs to consider prolonged cast therapy along with the possibility of surgical intervention and rearfoot stabilization, with or without tendo-Achilles lengthening.

In Conclusion

Metatarsus adductus is a deformity that does not necessarily have to be treated. Sadly and incorrectly, surgeons often feel that if a deformity is present, then they should perform surgery.

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