

Pediatric foot and ankle disorders: clubfoot

Kelly D. Carmichael, MD

Numerous articles are written each year about pediatric foot conditions. This article summarizes papers from October 1998 to December 1999. Clubfoot articles can be divided into three main types. Basic science articles describe anatomy, radiography, and pathophysiology. Surgical techniques and the evaluation of complications resulting from clubfoot surgery are also discussed. Nonoperative management of metatarsus adductus and the operative treatment of vertical talus are included. Adolescent bunion care continues to evoke controversy. Flatfeet and tarsal coalitions are common problems in pediatric orthopedics. There are many causes of heel pain in children with descriptive articles on diagnosis and treatment. Short sections on ingrown toenails, trauma, pediatric foot pressures, cleft foot, anesthesia, and syndromes involving the foot are the last topics discussed. The reference section includes annotations on articles of particular interest. The reader is referred to this section if a more detailed description is required. *Curr Opin Orthop* 2000, 11:113-116 © 2000

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University of Texas Medical Branch at Galveston, Galveston, Texas, USA

Correspondence to Kelly D. Carmichael, MD, University of Texas Medical Branch at Galveston, 301 University Boulevard, Galveston, TX 77555-0353, USA; e-mail: kdcarmic@utmb.edu

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Abbreviations

CC calcaneocuboid
TC talocalcaneal

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Numerous articles are written each year concerning clubfoot deformity. There are descriptive articles on the anatomy and pathophysiology. Cahuzac *et al.* [1•] described the anatomy of the clubfoot using three-dimensional magnetic resonance imaging. They present findings of volume reduction of 24% for the talus and 21% for the calcaneus as well as the angular and rotational deformation of the talus, calcaneus, and bimalleolar axis deviations. They looked at cartilage anlage axis and the axis of the ossific nuclei. Wang *et al.* [2] used multiplanar magnetic resonance imaging to describe talocalcaneal (TC) angles in clubfeet with three normal comparisons. The talar body-to-neck angle averaged 30 deg. The TC angle on anteroposterior averaged 16.7 deg, whereas the lateral was 16.2 deg. Talonavicular dislocations were noted in 9 of 11 feet. A study of the ankle capsule obtained from clubfoot surgery was performed by Vander Sluijs and Pruys [3] and showed no histologic abnormalities and no differences among various types of clubfeet. Loren *et al.* [4•] showed that biopsy results of the peroneus brevis could show which feet are at particularly high risk of recurrence. Abnormal fiber size or fiber types, especially in bilateral males, had higher recurrence rates, so they recommended postoperative ankle foot orthosis in this group. Katz *et al.* [5] used prenatal ultrasonography to diagnose clubfeet and found many associated anomalies. Treadwell *et al.* [6•] showed high false-positive rates in prenatal ultrasonography for clubfeet, so its use for the orthopedists for parental counseling is limited.

There are many articles describing surgical technique. Letts and Davidson [7] had 70% satisfactory results in using bilateral talectomy to treat rigid neuromuscular clubfeet and recommended that the technique be done before 5 years of age. El-Tayeby [8•] described a procedure for neglected clubfeet consisting of complete posteromedial release, trapezoidal closing wedge osteotomy of cuboid, and tibialis anterior tendon transfer to the cuboid. Best results were seen in supple feet with resilient ligaments with close to 90% satisfactory results in this group. A comparison of posteromedial release and complete circumferential subtalar release was performed by Manzone [9•]. There were more soft tissue problems with complete circumferential subtalar release, but overall results were similar with close to 25% failure rates in the long term with both techniques. Macnicol *et al.* [10••] used calcaneocuboid (CC) alignment on anteroposterior radiographs to help predict the need for revision surgery. Feet with TC alignment had good results,

even if CC alignment was not good. TC malalignment usually corrected spontaneously if CC alignment was good. Feet with poor TC and CC alignment usually needed revision surgery, so CC alignment was helpful in this group. CC alignment is especially useful in young patients before navicular ossification in terms of predicting which patients would benefit from revision surgery.

Several articles described the sequelae and complications of clubfoot surgery. Kuo and Jansen [11] described the dorsal subluxation of the navicular as a complication of clubfoot surgery. They suggest this subluxation be reclassified as a rotary deformity in which the medial border of the navicular rotates superiorly. Stevens and Otis [12••] showed the recurrent deformity of treated clubfeet was often (67%) ankle valgus and that the hindfoot varus could negate or mask this on clinical examination. Standing anteroposterior radiographs of ankle/tibia should be used. The treatment of ankle valgus is medial malleolar epiphysiodesis or supramalleolar osteotomy, not a hindfoot procedure. Lehman *et al.* [13•] described a CC fusion combined with complete soft tissue release as treatment for recurrent clubfoot deformity. When used in the 4- to 8-year-old range, they had 26 of 27 feet with good long-term results. A case report by Hootnick *et al.* [14] showed hypoplastic anterior and posterior tibial arteries in a patient who had partial foot loss after clubfoot surgery. Gain and Turner [15•] showed experimentally that significant (30% total body blood volume) blood loss must occur to soak through a plaster cast, especially if three rolls of plaster are used. They recommend release of tourniquet before closure and a close postoperative check 2 to 3 hours after surgery, when most of the blood loss will occur.

Metatarsus adductus

Katz *et al.* [16] showed that a below-knee cast can be just as effective as an above-knee cast for treatment of metatarsus adductus. They reported that all moderate deformities were corrected and 37 of 48 severe deformities were corrected. Of the eight remaining severe deformities, seven changed to moderate and one remained severe.

Vertical talus

Duncan and Fixsen [17•] described the use of three incisions (posterior, medial, and lateral) to treat congenital vertical talus. They performed tendon-Achilles lengthening with release and transfer of the tibialis anterior tendon to the neck of the talus. All but one of seven patients were satisfied. Kodros and Dias [18] described a single-stage correction via Cincinnati incision. They used K wires to joystick the talar head into an anatomically reduced position with the navicular, and then held reduction by transfixing to the navicular. Another K wire was used to hold the calcaneus and talus in an anatomically reduced position.

Hallux valgus

There are numerous surgical techniques for adolescent bunions. Grace *et al.* [19] had 90% good results using a modified Lapidus procedure. They did not include first to second ray arthrodesis and fixed the first ray in plantar transposition with screws or pins as their modification to the Lapidus procedure. In patients with cerebral palsy, most bunion procedures had good results. Jenter *et al.* [20] showed first metatarsal phalangeal arthrodesis gave the best results. Schwitalle *et al.* [21] compared the McBride procedure to that of the Mitchell procedure. They concluded McBride is best used in less-severe deformities (< 15-deg intermetatarsal angle). The Mitchell procedure shortens the first ray but gives good results for more severe deformities. They used their own set of subjective and objective criteria to measure good, satisfied, and dissatisfied outcomes.

Flatfoot

Sullivan [22••] described numerous conditions associated with flatfoot as well as idiopathic flexible flatfoot. He described presentation, diagnosis, and treatment of each condition. Most flexible flatfeet do not require treatment. Calcaneovalgus foot will usually resolve spontaneously. Vertical talus is treated early with surgical reduction and late with subtalar fusion. Accessory navicular is usually treated conservatively with pads. The accessory ossicle can be excised if it continues to be symptomatic. Tarsal coalitions are treated with calcaneonavicular excision and extensor digitorum brevis interposition; the TC coalitions have less-predictable results. Skewfoot is treated with early serial casting and late hindfoot stabilization procedures. Staheli [23] also described a benign course for flexible flatfeet. Sanchez *et al.* [24•] showed unpredictable results with subtalar staple arthroereisis in neuromuscular planovalgus feet and now recommend osteotomies instead. Bhan and Malhotra [25] showed good results with subtalar fusion using fibular dowel graft and screw in postpolio and cerebral palsy feet. The dowel is placed from the talar neck into the calcaneus, and fixation is augmented by a single talus to calcaneus screw.

Tarsal coalitions

Doyle and Kumar [26] described symptomatic talonavicular coalitions. Clinically, the foot is in planovalgus deformity with the great toe shorter than the second toe. Associations include symphalangism, clinodactyly, and ball-and-socket ankle. Inheritance is usually autosomal dominant but some are autosomal recessive. All TN coalitions were treated with casts or insoles, and no surgeries were required. Vincent [27••] described associated conditions, inheritance, prognosis, diagnosis, and treatment of tarsal coalitions. Calcaneonavicular symptoms appear at ages 9 through 13 years and TC later. Most coalitions were treated conservatively, but Vincent's surgical option for calcaneonavicular coalitions was a takedown of the coalition with extensor digitorum brevis interposi-

tion. Less-predictable TC surgeries were also discussed. Raikin *et al.* [28•] used split flexor hallucis longus tendon interposition to treat TC coalitions that failed conservative management and had good results. Thirteen of 14 patients had pain relief and increased subtalar motion. Arthritis of the middle facet is a contraindication to this procedure. Turhan *et al.* [29] wrote of a case report with accessory ossification center in the calcaneus with talonavicular and second metatarsal cuneiform coalition.

Heel pain/infections

Articles about heel pain were descriptive articles of causes and their treatments. Kosinski and Lilja [30] described various infectious etiologies, including osteomyelitis from neonatal needle sticks. Kim *et al.* [31] describe various etiologies and treatment plans for heel pain in children, including Severs disease, overuse syndromes, enthesopathy, juvenile rheumatoid arthritis, seronegative arthropathies, fractures, tumors, osteomyelitis, and tarsal coalitions. Martin *et al.* [32•] also described three cases of osteomyelitis after neonate heel sticks. The patients went on to develop asymptomatic flatfeet and premature apophysis closure.

Ingrown toenails/dermatosis

Nonorthopedic journals provide two less-invasive techniques for ingrown toenails. Schulte *et al.* [33] used a plastic tube as a splint to allow the nail to grow out. Lazar *et al.* [34] used a Steri-strip (3M, St. Paul, MN) and patient education. Guenst [35] described pediatric foot dermatoses, their presentation, and treatment.

Trauma

Anterior process fractures of the calcaneus can be distinguished from calcaneus secundarius. Hodge [36] described radiographic and clinical distinguishing features. Haasbeek [37] wrote of foot and leg compartment syndrome in an infant whose foot was trapped in a toddler's bed. The foot was trapped for an unknown period of time and required compartmental releases.

Gait/foot pressures

Dynamic foot pressures in children differ from those in adults. Bowen *et al.* [38•] established normal reference from 108 feet (54 children) for heel, lateral and medial midfoot, and lateral and medial forefoot. Pediatric pathologic feet and gait can now be referenced to these measurements.

Cleft foot

This is an uncommon foot deformity with a spectrum of clinical severity. Abraham *et al.* [39•] classified this into three types. Type I is a central ray deficiency and is treated with syndactylism and hallux correction if needed. Type II is a deeper cleft with splaying of the forefoot and is treated with syndactylism and first ray osteotomy before age 5 years and first ray amputation after 5 years of age. Type III is absence of rays 1 through 4, and no forefoot surgery is recommended.

Anesthesia

Eberson *et al.* [40•] showed that ketorolac can significantly decrease narcotic use, gastrointestinal side effects, and hospital stay in pediatric patients undergoing foot reconstructions and long bone osteotomies.

Syndromes with foot involvement

Many syndromes involve the feet. The following listed articles describe syndromes and the foot pathology. The reader is referred to the articles for a more complete description of these syndromes. Christianson *et al.* [41] described oligohydramnios and clubfeet. Rumball *et al.* [42] write about Antley-Bixler syndrome and tarsal coalitions/clubfeet. Gunal *et al.* [43] described the types of congenital absence of the fibula and their treatment. Pollard *et al.* [44] discussed velocardiofacial syndrome and orthopedic manifestations including clubfeet. Finally, Carranza-Bencano and Gonzales-Rodriguez [45] gave surgical technique for correcting type II tibial hemimelia foot and leg deformities.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- Of special interest
- Of outstanding interest

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