The early recognition and treatment of congenital talipes equinovarus, or clubfoot deformity, is acknowledged as being necessary to obtain the best functioning foot possible. The initial treatment for this condition usually involves either serial immobilization casting, surgery, or both. All too often, though, after the initial dramatic correction is obtained, the follow-up care is not carried for a long enough period of time and much of the deformity recurs. This is usually due to a combination of the patient’s parents becoming lax on returning for the extended period of post correction visits after the

Continued on page 126

By Mark A. Caselli, DPM

The Role of Shoe Therapy in the Management of Pediatric Congenital Clubfoot

Proper footgear helps maintain the correction achieved by surgery or serial casting.

Goals and Objectives

After reading this article the podiatric physician should be able to:

1) Recognize a talipes equinovarus (clubfoot) deformity in an infant
2) Understand the methods of treatment used in the initial correction of a clubfoot deformity
3) Prescribe maintenance shoe therapy for an infant with a recently corrected clubfoot
4) Address the complications associated with post correction clubfoot shoe therapy
5) Utilize shoegear in a treatment plan for the post correction residual foot and gait problems found in clubfoot

Welcome to Podiatry Management’s CME Instructional program. Our journal has been approved as a sponsor of Continuing Medical Education by the Council on Podiatric Medical Education.

You may enroll: 1) on a per issue basis (at $17.50 per topic) or 2) per year, for the special introductory rate of $109 (you save $66). You may submit the answer sheet, along with the other information requested, via mail, fax, or phone. In the near future, you may be able to submit via the Internet.

If you correctly answer seventy (70%) of the questions correctly, you will receive a certificate attesting to your earned credits. You will also receive a record of any incorrectly answered questions. If you score less than 70%, you can retake the test at no additional cost. A list of states currently honoring CPME approved credits is listed on pg. 132. Other than those entities currently accepting CPME-approved credit, Podiatry Management cannot guarantee that these CME credits will be acceptable by any state licensing agency, hospital, managed care organization or other entity. PM will, however, use its best efforts to ensure the widest acceptance of this program possible.

This instructional CME program is designed to supplement, NOT replace, existing CME seminars. The goal of this program is to advance the knowledge of practicing podiatrists. We will endeavor to publish high quality manuscripts by noted authors and researchers. If you have any questions or comments about this program, you can write or call us at: Podiatry Management, P.O. Box 490, East Islip, NY 11730, (631) 563-1604 or e-mail us at bblock@podiatrym.com.

Following this article, an answer sheet and full set of instructions are provided (p. 132).—Editor
Clubfoot...

...foot looks “good” and the doctor’s reluctance to strongly encourage these visits. It is well-recognized that rigorous post-operative physical therapy is of equal importance to good surgical technique in the outcome of joint reconstruction procedures. This analogy can be used in the correction of talipes equinovarus; that is, rigorous shoe follow-up therapy is often of equal importance to the initial correction for long-lasting results.

Talipes Equinovarus

Talipes equinovarus, or clubfoot, is one of the most common congenital deformities of the foot. First described by Hippocrates, it has been known since ancient times. The incidence of talipes equinovarus varies with race and sex. In whites, the birth frequency is 1.2 per 1000, with a male-to-female ratio of 2:1. The incidence in Asians has been reported as low as 0.57 per 1000, whereas in full-blooded Hawaiians, it is 6.81 per 1000. Involvement is bilateral in about 50% of the cases. In unilateral cases, the right side is affected slightly more frequently than the left.

The deformity resembles the embryonic foot position at the 7th—9th weeks of development. The clinical picture of talipes equinovarus is characteristic. The foot points plantarward with the small heel drawn up and rolled in under the talus in an inverted position (fig.1). There are deep creases at the posterior aspect of the ankle joint. The midfoot and forefoot are adducted, inverted, and have an equinus pitch (fig. 2). Internal tibial torsion is a common associated finding.

The etiology of talipes equinovarus remains controversial with the potential causes including 1) Abnormalities of development and insertion of muscles, tendons, and ligaments; 2) Bony abnormalities; 3) Neurogenic problems; 4) Intrinsic talar deformity with head and neck medially deviated; 5) Degeneration of muscle and nerve tissue; 6) Arrested embryonic development;
Clubfoot...

and 7) Abnormal uterine pressure [B]. Congenital talipes equinovarus may be categorized into idiopathic clubfoot, which is an isolated deformity, and extrinsic teratogenic clubfoot, which usually occurs as a result of outside influences such as myelomeningocele, intraspinal tumors, diastematomyelia, poliomyelitis, distal type progressive muscular dystrophy, cerebral palsy, and Guillain-Barre syndrome.5

Radiographs provide a useful baseline not only for assessment of the deformity in clubfoot but also for monitoring progress of treatment and for determining recurrence following treatment. In the AP view, the intersection of the long axes of the talus and calcaneus forms the talocalcaneal angle (normal range 20-40 degrees), which will be less than 20 degrees in clubfoot (fig. 3). Similar lines drawn through the long axes of the talus and calcaneus on the lateral view form the lateral talocalcaneal angle (normal range 35-50 degrees). The equinus deformity of the clubfoot reduces this angle to -10 to 35 degrees (fig. 4). On both the AP and lateral views, the lines bisecting the talus and calcaneus become more parallel with the increasing severity of the deformity.

If talipes equinovarus remains untreated, the deformity will progressively increase and the contractures will become more rigid. The child will bear weight on the lateral border of the foot and on the fibular malleolus. Ambulation will become difficult and the gait will be awkward. Painful callusities and bursae often develop over the lateral side of the foot.

One of the outstanding clinical signs to be found on examination of a corrected clubfoot is the creasing that is left, just plantar and medial to the talonavicular area and lateral to the external malleolus (fig. 5). In cases in which a clinician is called upon to examine a foot that may have been a clubfoot at birth, this constant clinical sign invariably reinforces the opinion that the child once did have a true clubfoot. It is also useful in differentiating a corrected clubfoot from a residual metatarsus adductus or rigid pes cavus.

Initial Treatment

Treatment for talipes equinovarus should begin as soon after birth as possible. Manipulation—attempting to remold the foot into a more normal shape—should be attempted early and be combined with other treatments. One should put traction on the forefoot when remolding position in order to bring the displaced navicular around the talar head, thereby preventing an impingement of the navicular on the talus. Plaster of Paris above knee casts should be applied from toes to groin. These casts are changed from twice weekly in the newborn to semiweekly in older infants.

Throughout treatment, the practitioner should be wary of creating a rocker-bottom foot which can result from forced dorsiflexion of the forefoot against a plantarflexed hindfoot. To avoid this complication, the deformity should be corrected from distal to proximal, the correcting sequence being a) the adducted forefoot; b) the inverted rearfoot; and finally c) the equinus. Correction should be confirmed by x-ray. The x-ray should demonstrate that the long axis of the talus is in line with the first metatarsal. Surgical treatment is necessary when conservative measures are inadequate and after a proper trial period of 3-6 months of conservative serial casting.

Shoe Therapy

Once full correction of the foot has been accomplished, the next step in the logical sequence of management is the maintenance of the correction achieved. If no method of

Continued on page 128
Browne splint (Fig. 6). Maintenance of correction is accomplished by two mechanical factors: one is the external rotation of the shoes on the bar (usually 30-45 degrees external), and the other is the force placed on the foot by the shoes. The two commonly used shoes are the open toe straight last shoe (Fig. 7) and the open toe abducted last shoe such as the Markel Tarso-Pronator (Fig. 8).

The straight last shoe is divided equally between right and left halves, with the functional axis down the center. This high shoe is open at its distal end with a large tongue that is attached to one side so that the upper part of the shoe can be opened to the side and the foot easily placed into the shoe. The shoe is also laced from the most proximal to distal end of the upper to allow for a snug fit. The open toe abducted last shoe has a C-shaped last abducted both in the forefoot and the rearfoot. The rest of the shoe is constructed in a similar manner as the open toe straight last shoe.

The function of these shoes can further be enhanced with the addition of felt padding placed in the shoes. Padding can be done with layers of 1/8-inch adhesive felt. The shoe is padded from the distal end of the shoe along the first ray, ending at the first metatarsal base, at the cuboid area of the foot to act as counter pressure, and when used in the treatment of metatarsus adductus, a varus heel pad can be added to maintain neutral heel position (fig. 9). Padding is also added as necessary to increase corrective pressure. Spot padding is added at any point where prominences must have increased padding. This is particularly true of the first metatarsophalangeal joint. This method of treatment gives the clinician immediate visible control over the correction as it proceeds.

The parent is advised to maintain the shoe-splint in place 21-22 hours a day, permitting the child 2-3 hours daily of freedom from this apparatus as well as relieving areas that might be subjected to excessive pressure, thus reducing the incidence of pressure sores on the foot. This discipline should be continued until the child is ready for walking, at which stage the splint is worn only at night and an out-flare forefoot last shoe is worn during the day. This is a high shoe with a closed toe-box; only the front of the shoe is abducted. The rear part of the shoe enclosing the rearfoot and midtarsal area remains in a functionally neutral attitude (fig 10). This type of...
In some instances, the parent may call attention to the fact that the foot will not remain in the shoe or that a blister forms on the child’s heel from use of the shoe-splint combination. There are two main reasons for these occurrences. One is that the shoe is too small or too large. The other is that there remains an element of persistent fixed equinus position. The former is easily corrected by an accurate fitting of shoe size for the individual foot. The latter indicates that adequate correction of the equinus deformity has not been obtained and further treatment of this element of deformity must be undertaken before resorting to the use of the shoe-splint.

Fixed equinus deformity and the shoe-splint are incompatible. Unless the child’s heel engages the inside bottom part of the heel of the shoe, the child can thrust with his forefoot in flexion and work his foot out of the shoe. It is inappropriate to persist in forcing such a foot to remain in the shoe by a strap over the tarsus or tight lacing of the shoe. Success in keeping such a foot in a shoe will only result in producing a rocker bottom deformity of the foot. This is not only undesirable but also productive of an additional deformity which, in itself, will require special corrective measures to overcome.

If the failure of the foot to stay in the shoe is due to a fixed equinus position of the foot, the deformity should be corrected by further use of corrective casts or by surgical means and then progression to the shoe-splint maintenance of the correction. With the equinus position eliminated, there will be no difficulty in keeping the foot in the shoe provided the fit is proper.

The tendency for some children to remove the shoe from the bar can be overcome by setting the circular or wing nut with a wrench or pliers so that the child cannot unscrew it manually (Fig. 11). For those children who untie the shoe laces and remove the shoes, there are obtainable barrel-shaped containers which screw together in two halves over the bow knot so the child has no access to the knot.

In a primary well-corrected clubfoot, correction can be maintained in most instances by the wearing of the shoe-splint 21 to 22 hours a day until the child starts walking. Then the splint is applied at night and the out-flare forefoot last shoe is worn throughout the day. The child should be seen every one to two months until one year of age, then every two to three months thereafter until age five years. The night splint and tarso-pronator shoe combination should be worn as long as possible at night, though usually is discontinued by 18 to 24 months of age when the child rejects this form of treatment.

At this time, the corrective shoe can be used alone without the splint. This is usually well tolerated. When the child outgrows...
Clubfoot...

the largest size open toe shoe (usually by age three years), a closed toe out-flare forefoot last shoe, with the end of the toe box cut out for comfort, can be used for several years more during the night. This type of shoe is available in larger sizes. Corrective shoe therapy, both day and night, is recommended until the child is at least five years of age.

Discontinuance of maintenance of correction has consistently shown a recurrence of the deformity, especially the forefoot adductus component.2 (Fig 12). This is why a five-year period of treatment has been chosen to avoid recurrence and to assure maintenance of correction. It cannot be overemphasized that the chief cause of persistent or recurrent deformity in the clubfoot is failure to achieve an initial full correction as well as failure to maintain correction after the initial full correction has been procured by premature interruption or discontinuance of treatment in the child, two, three, or four years of age.

Even if the foot is completely corrected, and the correction appears well maintained, the child should be reexamined at least every six months until the foot has attained its full growth. Even in feet which have been corrected easily and rapidly, this deformity is notorious for its recurrence if maintenance treatment is discontinued too soon.

Other Shoegear Considerations

Even when an appropriate treatment regimen is followed for the correction of a talipes equinovarus foot deformity, there often remain a number of foot and gait problems that should be recognized and addressed with proper footwear prescriptions and/or modifications. These conditions include 1) limb-length; 2) foot-length; 3) limited ankle joint dorsiflexion; 4) reduced subtalar joint range of motion; 5) Forefoot adduction; and 6) in-toe gait.

Differences in the clubfoot side are consistently found. Both limb length and foot length are reduced in the unilateral clubfoot as compared with the normal side. Even when the clubfoot is bilateral, differences are found but are less pronounced. Studies have shown that the average limb length discrepancy in a unilateral clubfoot is 0.5 inch and 0.3 inch in a bilateral case. This difference should be addressed to prevent undesirable biomechanical compensations in other segments of the skeletal structure. An internal lift placed in the shoe can be used to equalize up to 1/4 to 3/8 inch difference depending on the available depth of the shoe.

Above this, the sole of the shoe can be split and the necessary lift added. The average foot length differed 1.6 inches in the unilateral clubfoot and 0.4 in bilateral situations.2 There are many ways of handling this problem, including prescribing mismatched sized shoes, using high top shoes/boots of the same size which prevent the short foot from sliding forward in the shoe, or using a foot orthosis to take up space within the shoe while holding the foot in proper alignment. If the difference is small, no accommodation might be needed and only periodic evaluation of foot size is indicated.

Ankle dorsiflexion is generally found to be reduced after clubfoot correction. This can be addressed by adding a heel lift in the shoe and/or using shoegear with a forefoot rocker sole configuration. There are many athletic shoes on the market that fill this need (Fig. 13). A supportive athletic shoe with a well-molded foot orthotic can be used in the management of a patient with reduced subtalar joint range of motion (Fig. 14).

Forefoot adduction is the most common residual problem in clubfoot correction.2 A patient with this condition usually presents with the complaint of pain, irritation, hyperkeratosis, and/or bursitis at the styloid process at the base of the fifth metatarsal. A leather foot orthosis with a deep heel cup and a padded lateral flange extending just proximal to the styloid process placed in a deep shoe can reduce many of these symptoms.

In-toe, attributed to internal tibial torsion, is a frequently seen condition associated with clubfoot.2 The most common presenting complaint is tripping and falling, espe-

References
1) The incidence of congenital talipes equinovarus is usually reported as 1 per 1000 live births, though the frequency varies dramatically with race. In which one of the following ethnic groups is there an exceptionally high incidence?
   A) Caucasians
   B) Hawaiians
   C) Asians
   D) Native Americans

2) Which of the following foot positions best describes that of an infant with a talipes equinovarus foot deformity?
   A) plantar flexion-abduction
   B) dorsiflexion-abduction
   C) plantar flexion-adduction
   D) dorsiflexion-adduction

3) Which one of the following is not considered a potential cause of a talipes equinovarus deformity at birth?
   A) Down syndrome
   B) Talar deformity
   C) Neurogenic problems
   D) Arrested embryonic development

4) A talocalcaneal angle on an AP radiograph consistent with talipes equinovarus would be:
   A) 15 degrees
   B) 30 degrees
   C) 45 degrees
   D) 60 degrees

5) The lines bisecting the talus and calcaneus become ______ with the increasing severity of the clubfoot deformity.
   A) more oblique
   B) more parallel
   C) longer
   D) shorter

6) The most common site for painful callosities in an untreated clubfoot is:
   A) medial ankle
   B) distal hallux
   C) posterior heel
   D) fifth metatarsal base

7) At what age is it best to begin treatment of a congenital clubfoot?
   A) Birth
   B) One month
   C) Six months
   D) One year

8) Plaster casts applied on a two week old infant for the correction of clubfoot are usually changed:
   A) every day
   B) once or twice a week
   C) every two to three weeks
   D) every four to six weeks

9) In order to prevent creating a rocker bottom foot when casting a clubfoot, the correcting sequence should be:
   A) equinus, inversion, adduction
   B) adduction, equinus, inversion
   C) adduction, inversion, equinus
   D) abduction, eversion, equinus

10) Surgical treatment is necessary when conservative measures are inadequate after a trial period of:
    A) 1-2 months
    B) 3-6 months
    C) 8-10 months
    D) 1-2 years

11) When a Denis Browne splint is used in the maintenance of clubfoot correction, it should be set at what angle?
    A) 10 degrees internal
    B) 30 degrees internal
    C) 10 degrees external
    D) 30 degrees external

12) Which one of the following shoes is not used in conjunction with a Denis Browne splint in the management of clubfoot?
    A) Open toe straight last
    B) Open toe abducted last
    C) Tarso-pronator
    D) Tarso-supinator

13) The function of an open toe abducted last shoe can be enhanced by:
    A) Adding felt padding
    B) Using a smaller shoe
    C) Reversing the shoes
    D) Stretching the shoe

14) To best maintain the initial correction obtained from clubfoot casting or surgery, the shoe-splint combination should be worn _____ hours daily.
    A) 24
    B) 21-22
    C) 18-20
    D) 12

15) The main causes for difficulty in maintaining the foot in the shoe-splint combination or the formation of blisters include all of the following except:
    A) shoe too small
    B) shoe too large
    C) fixed equinus deformity
    D) residual adductus deformity

Continued on page 132
16) The type of shoe commonly used to maintain forefoot adductus correction in the ambulating child is the:
   A) Out-flare forefoot last shoe
   B) Rocker-sole shoe
   C) Orthopedic oxford with outer wedge
   D) Adducted-last shoe

17) Residual forefoot adductus, commonly seen in the previously treated clubfoot, is commonly due to:
   A) The child walking too early
   B) The wrong type of corrective shoes used
   C) Improperly setting the Denis Brown splint
   D) Early discontinuance of maintenance of correction

18) Studies have shown that the average difference in foot length in a patient having a unilateral clubfoot is:
   A) 0.4 inch
   B) 1.1 inches
   C) 1.6 inches
   D) 2.6 inches

19) A shoe that appears to reduce the tripping and falling resulting from in-toe gait is the:
   A) Rigid oxford with inner sole wedge
   B) Flexible sneaker with outer sole wedge
   C) Rocker-sole shoe
   D) Padded abducted-last shoe

20) Which one of the following statements best describes the use of corrective shoegear in maintaining correction in clubfoot?
   A) Corrective shoes should be used to one year of age
   B) Corrective shoes should be used until total correction is obtained
   C) Corrective shoes are only necessary when inadequate surgery is performed
   D) Corrective shoes should be used in some form until at least five years of age

See answer sheet on page 133.
Note: If you are mailing your answer sheet, you must complete all info. on the front and back of this page and mail with your check to: Podiatry Management, P.O. Box 490, East Islip, NY 11730. Credit cards may be used only if you are faxing or phoning in your test answers.

TESTING, GRADING AND PAYMENT INSTRUCTIONS

(1) Each participant achieving a passing grade of 70% or higher on any examination will receive an official computer form stating the number of CE credits earned. This form should be safeguarded and may be used as documentation of credits earned.  
(2) Participants receiving a failing grade on any exam will be notified and permitted to take one re-examination at no extra cost.  
(3) All answers should be recorded on the answer form below. For each question, decide which choice is the best answer, and circle the letter representing your choice.  
(4) Complete all other information on the front and back of this page.  
(5) Choose one out of the 3 options for test grading: mail-in, fax, or phone. To select the type of service that best suits your needs, please read the following section, “Test Grading Options”.

TEST GRADING OPTIONS

Mail-In Grading

To receive your CME certificate, complete all information and mail with your check to:
Podiatry Management  
P.O. Box 490, East Islip, NY 11730

There is no charge for the mail-in service if you have already enrolled in the annual exam CPME program, and we receive this exam during your current enrollment period. If you are not enrolled, please send $17.50 per exam, or $109 to cover all 10 exams (thus saving $66 over the cost of 10 individual exam fees).

Facsimile Grading

To receive your CPME certificate, complete all information and fax 24 hours a day to 1-631-563-1907. Your CPME certificate will be dated and mailed within 48 hours. This service is available for $2.50 per exam if you are currently enrolled in the annual exam CPME program (and this exam falls within your enrollment period), and can be charged to your Visa, MasterCard, or American Express.

If you are not enrolled in the annual 10-exam CPME program, the fee is $20 per exam.

Phone-In Grading

You may also complete your exam by using the toll-free service. Call 1-800-232-4422 from 10 a.m. to 5 p.m. EST, Monday through Friday. Your CPME certificate will be dated the same day you call and mailed within 48 hours. There is a $2.50 charge for this service if you are currently enrolled in the annual 10-exam CPME program (and this exam falls within your enrollment period), and this fee can be charged to your Visa, Mastercard, American Express, or Discover. If you are not currently enrolled, the fee is $20 per exam. When you call, please have ready:
1. Program number (Month and Year)
2. The answers to the test
3. Your social security number
4. Credit card information

In the event you require additional CPME information, please contact PMS, Inc., at 1-631-563-1604.

Enrollment/Testing Information and Answer Sheet

Please print clearly...Certificate will be issued from information below.

Name _____________________________________________________________________________ Soc. Sec. #______________________________

Please Print: FIRST                                     MI                                     LAST

Address_____________________________________________________________________________________________________________  

City__________________________________________________State_______________________Zip________________________________

Charge to: _____Visa   _____ MasterCard   _____ American Express  

Card #________________________________________________Exp. Date____________________

Note: Credit card payment may be used for fax or phone-in grading only.

Signature__________________________________Soc. Sec.#______________________Daytime Phone_____________________________

State License(s)___________________________Is this a new address? Yes________ No________

Check one:  

I am currently enrolled. (If faxing or phoning in your answer form please note that $2.50 will be charged to your credit card.)

I am not enrolled. Enclosed is a $17.50 check payable to Podiatry Management Magazine for each exam submitted. (plus $2.50 for each exam if submitting by fax or phone).

I am not enrolled and I wish to enroll for 10 courses at $109.00 (thus saving me $66 over the cost of 10 individual exam fees). I understand there will be an additional fee of $2.50 for any exam I wish to submit via fax or phone.

Over, please
EXAM #9/04
Pediatric Congenital Clubfoot
(Caselli)

Circle:
1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D
16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D

LESSON EVALUATION

Please indicate the date you completed this exam

____________________________________

How much time did it take you to complete the lesson?
______ hours ______ minutes

How well did this lesson achieve its educational objectives?

_______ Very well _______ Well
_______ Somewhat _______ Not at all

What overall grade would you assign this lesson?
A   B   C   D

Degree____________________________

Additional comments and suggestions for future exams:
__________________________________________________
__________________________________________________
__________________________________________________
__________________________________________________
__________________________________________________
__________________________________________________

ENROLLMENT FORM & ANSWER SHEET (cont’d)