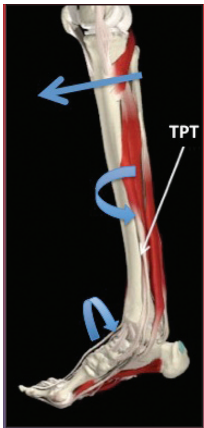

The Accessory Navicular

Identification, clinical significance, and management

BY JOSEPH C D'AMICO, DPM

Goals and Objectives

1) To present an overview of the incidence, identification, and clinical significance of the accessory navicular.

2) To discuss its attendant bio—and patho-mechanics.

3) To review its relationship to flatfoot deformity.

4) To establish a rationale for its conservative as well as surgical management.

5) To enable the astute practitioner to resolve discomfort, improve dysfunction, and restore quality of life for patients.

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The accessory navicular has been reported to occur in up to 21% of the non-patient adult population; however, its incidence in clinical practice is markedly higher. Some have erroneously considered this entity as an anatomic and roentgenographic variant; however, certain types are associated with pathologic conditions such as posterior tibial tendon dysfunction and tears, navicular enthesopathy, and painful navicular syndrome. Its identification, clinical significance, bio—and patho-mechanics, as well as conservative and surgical management, will herein be discussed and illustrated.

Incidence, Significance and Synonyms

The accessory navicular was first described by Bauhin in 1605.[1,2] It is an autosomal dominant congenital anomaly in which a tuberosity develops from a secondary center of ossification.[3,4] This frequently bilateral condition has been reported to occur in 4-21% of the population; however, its incidence in a patient population may be markedly and significantly higher.[5-8] A recent radiographic study of 100 consecutive adult patients revealed the presence of an accessory navicular in almost every instance.[9]

Synonyms for this condition include: os tibiale externum, os navicularis, os naviculare secundarium, hooked navicular, gorilloid navicular, cornuate navicular, prehallux, and bifurcate navicular. It is an atavistic

Continued on page 144

trait or reversion, rendering this hypermobile foot type better suited to prehensile tasks than to ambulation. Monahan considered the accessory navicular a dormant center of ossification left in all feet by atrophied fin rays.[10] The accessory navicular is an example of Hoeckle's law of recapitulation in which ontogeny recapitulates phylogeny.

Figure 1a: Ectomorphic body type in a 6 year old girl with painful navicular prominence and excessively pronated flexible flatfoot deformity. Note marked calcaneal eversion and "too many toes" sign.

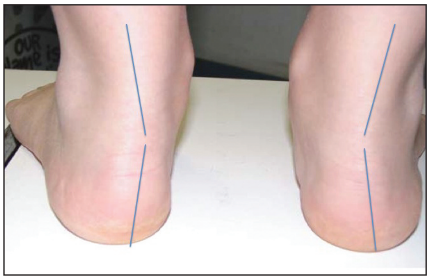

Figure 1b

The Ectomorph Connection

A recent study by Wong and Griffith examined 18 consecutive adolescents who presented with flatfoot and navicular tuberosity pain. MRI radiographs and pedobarographs were performed on all subjects. MRIs were abnormal in 15/36 feet with navicular marrow edema, thickening of posterior tibial tendon at its insertion, and greater contrast. All the MRI abnormals were ectomorphs, significantly taller with decreased body mass index and decreased body fat (Figures 1a,b).[11]

Ossification

As the keystone of the longitudinal arch, the navicular is the most important bone in determining longitudinal arch morphology, yet it is the last bone in the foot to ossify. Ossification should take place at 30-36 months in boys and 18-24 months in girls (Figure 2).[12-14]

Navicular ossification times occur later in a clinical population perhaps due to attendant pathomechanical forces acting on this segment, thereby delaying ossification. Wheeless in his discussion on Kohler's disease believes the repetitive, compressive, deforming forces taking placed on the immature navicular during weightbearing make it susceptible to avascular necrosis.[15] In any event, it is interesting to note that the average age for the beginning walker is 12 months of age, and the established walker 2 years of age, at which time the navicular is not radiographically visible, but is being subjected to abnormal forces secondary to compensation for lower extremity structural deficiencies as well as the deforming effects of gravity on an immature, plastic segment (Figure 2).

By eight years of age, the basic form is complete; however, ossification of secondary centers do not take place until at least nine years in females and 12 years in males (Figures 3,4, and 5).[16] This is the age at which symptoms begin due to shoe pressure on the newly hardened accessory bone, excessive forces on the posterior tibial tendon, and attendant patho-mechanics.

Ectomorph body types are most likely to present with a painful accessory navicular and accompanying flatfoot deformity.

Identification

The identification and typing of an accessory navicular in a foot with medial arch pain consists of clinical presentation and examination, plain radiography, MRI, CT scans, and soft tissue ultrasonography.[17]

AP, lateral, and medial oblique radiographs are the most important views in the identification of the accessory navicular; however, plain radiographic identification is by itself insufficient to attribute symptomatology. Diagnostic ultrasonography allows for comparison with the asymptomatic side and localization of pain. It is particularly valuable in tendinopathies. Bone scinitigraphy has a high sensitivity, but positive findings lack specificity. Bone scintigraphy may be of value when the significance of the ossicle is uncertain.

Magnetic resonance imag-

Continued on page 145

Figure 2: Delayed appearance of navicular ossification center in 2 ½ year old female with associated excessively pronated flexible flatfoot

Figure 3: Ossification of the main navicular body in a 6 year old female

Figure 4: Secondary navicular ossification center in a 12 year old boy

Figure 5: Secondary navicular ossification center in a 9 year old female

Figure 6: Type I accessory navicular with small ossicle within tendon sheath

Figure 7: Type II accessory navicular with syndesmotic attachment of the accessory bone to the native navicular

ing is of high diagnostic value for demonstrating bone marrow and tissue edema as well as abnormalities in tendon insertion.[18,19] MRI tendinopathy is characterized by a contour deformity with intrasubstance signal intensity alterations. CT examination easily reveals cortical irregularity in type II cases along with fragmentation of the accessory navicular. Sclerosis involving both sides of the synchondrosis can also be observed. MRI demonstrates bone marrow edema within the accessory bone and occasionally the adjacent navicular, suggesting pseudoarthrosis.[7] There may be high signal intensity within the synchondrosis of T-2 weighted images.

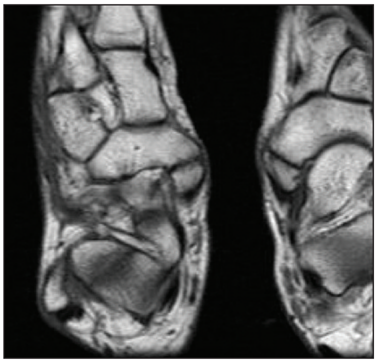

Figure 8: MRI revealing bilateral type II accessory navicular with syndesmotic attachment and TPT enthesopathy

Figure 9: Type III cornuate, gorilloid, or hooked accessory navicular in which the secondary ossification center has fused to the native navicular.

Types

Three types of accessory navicular have been described in the literature. Type I is a small, round separate ossicle, actually a sesamoid bone imbedded into the distal aspect of the posterior tibial tendon. The distance between the ossicle and the main navicular body is usually less than 3 mm.[20] It has been reported that only 2% persist, with the rest fusing to the navicular body. This type is rarely associated with symptomatology (Figure 6).

First described by Geist, type II is a larger (8-12mm), triangular ossification adjacent to the navicular tuberosity and connected by a sysostosis.[5,6] This type has been called the os tibiale externum. Fusion with the navicular body takes place in 50% of the cases. It is subject to traction and shear forces from the altered mechanics of the posterior tibial tendon (Figures 7,8).

Type III is an enlarged medial horn of the navicular itself. It was first described by Sella, et al. in 1986 and is better referred to as a cornuate, hooked, or gorilloid navicular (Figure 9).[21] In a recent MRI and CT study of 148 patients, (11.5% type I, 4.11% type II and 4.74% type III), multiple ossicle appearance was noted in 14.7% of the cases studied.[7]

The dilemma with identification of these types is that they are not radiographically visible in younger children and do not become visible until ossification has been completed during early adolescence (Figures 10,11,12). Clinically, there may or may not be a palpable navicular protrusion, but many times, this may also be due to a severely adducted talus in an excessively pronated foot.

Symptoms

As previously mentioned, symptoms begin in early adolescence as the secondary navicular ossification center solidifies. Clinically, patients can present with an associated flatfoot deformity with significant calcaneal eversion and "too many toes" sign.[22] There is acute midfoot pain, especially in unyielding footwear. Discomfort is not only due to direct shoe pressure but also from the medially displaced posterior tibial tendon insertion into the os navicularis instead of the main body of the navicular (Figures 13,14). There may be an associated enthesopathy as well.

Continued on page 146

Figure 10: 7 yr old female with normal navicular ossification

Figure 11: Same patient at 10 ½ years of age. Note beginning ossification of secondary center

Figure 12: Again at age 13. Note full ossification of secondary center revealing a type III accessory navicular

Clinical examination may reveal a localized point of maximum tenderness overlying the PTT insertion. There may be some rubor surrounding the accessory bone due to chronic irritation and accompanying callus formation. There is an observed prominence of the navicular, usually less than one centimeter in diameter (Figures 15a,b). Resisted inversion is sometimes painful. There may be tenderness along the course of the PTT indicating posterior tibial tendonitis or tensynovitis.[23-29] Not all accessory navicular bones are symptomatic, and its presence may be only incidentally noticed on clinical or radiographic examination. The presence of an accompanying flexible flatfoot should be noted since this component of the deformity will not be corrected by local excision or PTT advancement.

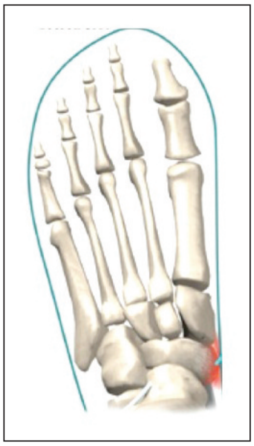

Figure 13: Pressure from footwear against the accessory navicular coupled with pathomechanical forces at TPT insertion resulting in pain and inflammation

Grogan and associates demonstrated areas of micro-fracture at the cartilaginous synchondrosis, acute hemorrhage, and chronic inflammation.[27] In no case was the accessory navicular completely separated from the primary bone. These changes were seen to be the result of chronic repetitive stress as seen in overuse syndromes. Since the posterior tibial tendon angle of application of force has been disturbed, thereby comprising medial push-off. Participation in sports such as ice hockey, figure skating, and rollerblading may precipitate, perpetuate, or aggravate symptomatology (Figure 16). Differential diagnosis includes: Kohler's disease, osteonecrosis, stress fracture, posterior tibial tendonitis,

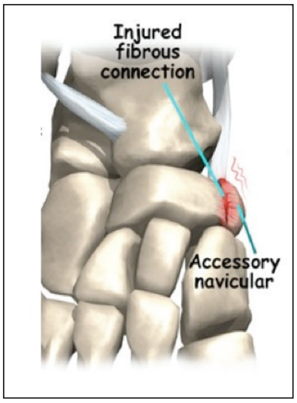

Figure 14: Inflammation of syndesmotic "pseudo joint" in type II accessory navicular

Kiter and associates performed an MRI investigation on 27 feet with a painful accessory navicular, and 22 normal feet.[19] Two major differences were observed in the feet with the accessory navicular.

Pathomechanics

Although the posterior tibial tendon has a complex insertion into most of the tarsal and metatarsal bones, from a clinical standpoint its primary and most important insertion is into the medial navicular. As a result of its extensive plantar insertions and advantageous application of force, the PTT is the strongest supinator of the foot, locking the tarsal bones by traction, stabilizing the longitudinal arch and allowing free forward passage of the superstructure (Figure 17). This supportive, stabilizing function is compromised by abnormal insertion of the tendon into the accessory navicular (Figure 18).

Kiter and associates performed an MRI investigation on 27 feet with a painful accessory navicular, and 22 normal feet.[19] Two major differences were observed in the feet with the accessory navicular. First, the PTT inserted directly into the accessory navicular bone without any continuity to the sole of the foot or with a slip. Secondly, its insertion was less than 1mm in thickness. In 20 out of 27 feet, there was a heretofore unreported mass of fibro-cartilagenous tissue, resembling resistant fibrocartilage between the tendon and the bone. The

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Figure 15a: Small but painful accessory navicular prominence in a 12 year old girl

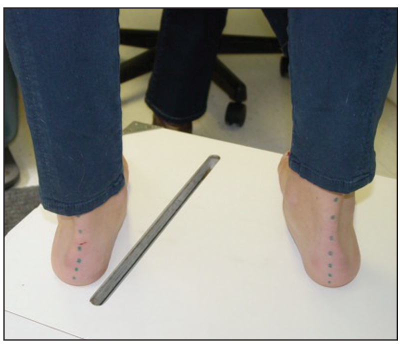

Figure 15b: Note the severely pronated flexible flatfoot accompanying this accessory navicular

Figure 16: Activities requiring medial push-off increase demands on TPT and increase risk of symptomatology

authors theorized that this thickening is due to inefficient function of the PTT, resulting in friction between the tendon and the bone because they come closer together in the pronated foot. These abnormalities were not present in the control group. These findings suggest that patients with an accessory navicular bone and flatfoot should undergo MRI testing for insertional abnormalities of the PTT. The authors further state that this condition mimics PTT dysfunction since the PTT has lost its supinator function without its distal attachments.

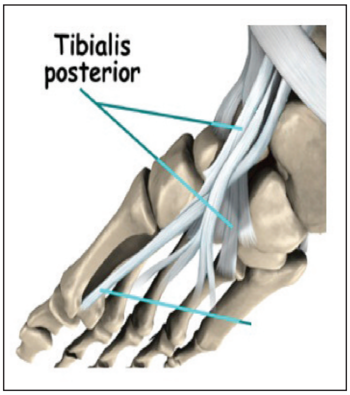

Figure 17: Extensive plantar insertions of the TPT into the tarsus and metatarsal bases which are not present in feet with an accessory navicular

Accompanying the loss of this function, the gastocnemius-soleus complex acts at the talonavicular joint causing the passive structures of the longitudinal arch to give way, with resultant flatfoot deformity.[19,30,31] The accessory navicular acts as if it were a native navicular, with the bulk of the posterior tibial tendon inserting into the accessory navicular. This not only displaces the tendon medially, thereby reducing its mechanical advantage, but also results in its insertion being more proximally placed. This proximal placement of the PTT decreases leverage action of the medial malleolus on the tendon, thereby increasing tendon stresses (Figures 18a,b).[22]

Since the posterior tibial tendon is not inserting its primary force on the main body of the navicular, there is an additional degree of movement that is present between Type II ossicles. This abnormal movement results in shearing stress forces at the synchondrosis, inadequate stabilization, resultant hyper-mobility, and subsequent pain and tenderness along the medial border of the midfoot. In Type II deformities, there is a loss of PTT strength, since part of its force is being attenuated by first having to stabilize the accessory segment before it is able to act on the main navicular body. Excessive demands placed on the tendon and resulting repetitive micro-trauma at the fibrocartilagenous junction result in pain and inflammation (Figure 14).

The accompanying internal limb rotation exerts an oblique torsional pull of the leg musculature on the tibia. Coupled with increased demands on the PTT to stabilize the supporting foot, thus predisposing it to medial tibial stress syndrome.

Relationship to Flatfoot

The relationship of the accessory navicular to flatfoot, originally advocated by Kidner in 1929 and 1933, has been refuted by some authors and endorsed by others.[32-34] Kidner attributed the accompanying flatfoot deformity to changes in leverage due to an increased medial insertion of the posterior tibial tendon, transforming it into an adductor instead of an elevator of the longitudinal arch.[1,36] Giannestras did not believe the accessory navicular was associated with pronated or flat feet and the majority of these feet were asymptomatic.[37]

The relationship of the accessory navicular to flatfoot, originally advocated by Kidner in 1929 and 1933, has been refuted by some authors and endorsed by others.[32-34]


Figure 18a: Medially displaced pull and altered angle of application of force of TPT due to type II or III accessory navicular (white arrow)

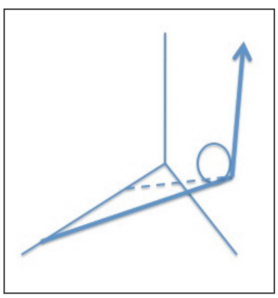
Figure 18b: The presence of a type II or III accessory navicular proximally displaces TPT insertion (dotted line) and reduces leverage action of the medial mallelolus Redrawn after Bernaerts

Strayhorn and Puhl in 1982, as well as Sullivan and Miller in 1979, suggest that the accessory navicular serves as an irritant and does not affect normal foot mechanics.[25,32] Sullivan and Miller studied 179 patients without accessory navicular and 49 patients with accessory navicular. Standing lateral radiographs were taken and the calcaneometatarsal angle was measured. Their results revealed no significant difference between the two groups.[32] In summary, they concluded that there was no evidence to substantiate the opinion that abnormal insertion of the posterior tibial tendon into the accessory navicular destroys its normal suspensory function since its broad attachments into the tarsus would continue to function. Kiter's 1999 MRI study refutes this theory by the demonstration of an absence of attachments or slips emanating from the posterior tibial tendon in patients with an accessory navicular.[19]

Citing Basmajian, Jones, Hicks, Mann and Inman, Sullivan and Miller further go on to state that muscles have been shown to be less than significant supporters of the longitudinal arch.[38-41] While this is true in a normal foot, in a pathologically functioning excessively pronated foot, the posterior tibial tendon is overworking in a futile attempt to counteract these abnormal forces and supinate the foot against the deforming forces thrust upon it. The difficulty lies in the inher-

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ent inability of one extrinsic muscle to be able to achieve this task while pitted against the deforming effects of gravity, which are dynamically being imposed on it by an advancing super-structure (Figure 19).

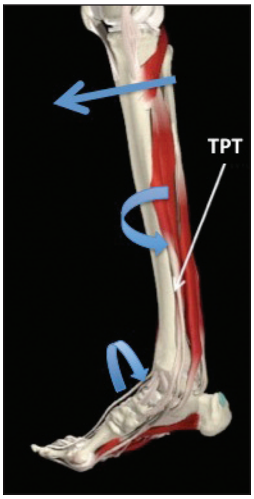

Figure 19: The inability of one extrinsic muscle to stabilize the longitudinal arch and supinate the foot as body weight is being dynamically imposed on it

Prichasuk also differed with Sullivan's findings noting a distinct lowering of calcaneal pitch in 28 symptomatic accessory navicular patients versus 200 non-affected individuals.[33]

Whether or not there is a one-to-one direct causal relationship between the presence of an accessory navicular and the development of a pathologically functioning flexible flatfoot can be debated; however, there is no doubt that the additional pathomechanical demands placed on the foot and ankle by its presence certainly do not benefit foot function.

Conservative Management

Conservative management of the painful accessory navicular begins with the identification of its specific type, attendant pathology, and accompanying patho-mechanics. Non-surgical measures can provide relief and may obviate the need for surgical intervention. Acute care would include activity modification or cessation, NSAIDs, local peritendinous, intersynchondrosis or insertional short to intermediate acting corticosteroid injections, ultrasound, strapping, immobilization, footwear modifications, and neutralization of structural deficiencies via prescription foot orthoses. The use of night splints with the foot and ankle held at 90 degrees is also helpful especially in those cases where discomfort is present upon arising.

The use of prescription foot orthoses with appropriate modifications is a mainstay in the conservative management of the symptomatic accessory navicular. Since the presence of an accessory navicular by itself disrupts the normal biomechanics of the foot and ankle, it is of paramount importance that existing structural deficiencies and their secondary compensatory patho-mechanics be addressed as well. The goal of mechanical therapy is re-alignment of the osseous and soft tissue structures, reduced PTT forces, and establishment of optimum foot function during all weight-bearing activities. Should this regimen prove unsuccessful, then short-leg cast or boot immobilization for up six to eight weeks should be considered.[25,42] Useful modifications to enhance control as well as allow adaptation to the device include: deepened heel seat, extended rearfoot post, reduced undercut, medial and lateral flanges, navicular flap, navicular dimple, aggressive rearfoot posting, Kirby skive, and Blake inverted cast correction (Figures 20a,b 21a,b).[43,44]

The shell or module for control of patho-mechanical foot function in patients with an accessory navicular should be non-compressible and non-deformable. This does not mean that the device has to be completely inflexible, but rather be sufficiently rigid to maintain control during all weight-bearing activities, including sports participation. Materials that possess these characteristics include: graphite composites, ortholene, subortholene, and high-density polyethylene (HDPE). Particularly useful, well-tolerated, and highly controlling is a sub-ortholene device with high medial and lateral flanges, aggressive rearfoot posting, forefoot posting extended to the sulcus, reduced undercut, heel raise and butadiene rubber longitudinal arch reinforcement (Figures 20 a,b)

Except for its increased length due to the extended forefoot posts, the resulting orthotic outwardly resembles the UCBL; however, functionally there is a crucial difference. The original UCBL functions by blocking all subtalar joint motion, whereas the functional UCBL acts as a true Root-type functional orthoses by optimally realigning the osseous and soft tissue segments of the foot and ankle during each segment of the gait cycle, thereby promoting normal function. I refer to this device as a functional UCBL (Figures 20a,b).[45]

Should conservative therapy fail to provide definitive relief within a four to six month period of time then surgical intervention should be considered.

Surgical Decision-Making

A variety of surgical procedures for treatment of the painful accessory navicular yield good results. Not only do these procedures address subjective concerns, but each one of them to a greater or lesser extent improves posterior tibial tendon function by at the least reducing slip, slide, and play at its insertion, thereby improving its mechanical advantage. These procedures include: ossicle excision, percutaneous drilling, Kidner procedure and its modifications, and arthrodesis of the ossicle to the main navicular body.

A variety of surgical procedures for treatment of the painful accessory navicular yield good results.

Grogan and associates reported complete relief in 16 out of 17 feet treated by simple excision, while Bennett reported good results in 45 (70 feet) of 50 patients (90%) operated on.[27,46] Simple excision of small ossicles and segmental fusion after removal of the synchondrosis for large ossicles yield good results.[47,49] A study of 22 adolescent patients comprising 34 feet with a diagnosis of symptomatic accessory navicular was performed. Five individuals had type I, 17 type II and 11 type III deformities. All subjects underwent simple excision. The mean follow-up was 5.6

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years. A questionnaire returned from 21 of the patients revealed that nine obtained total relief, eleven considerable, and one persistent. Complications occurred in two patients.[48] Nakievama, et al. performed percutaneous drilling on 31 feet in 29 patients with accessory navicular.[50] Excellent results were obtained in 77%, 19% had good results and 3% fair. Bone union was obtained in 80%.

Chung and Chu performed screw fusion on 31 consecutive patients, comprising 34 feet with a painful type II accessory navicular. Bone union as visible on radiographs were present on 82% (28 feet). Excellent results were obtained in 24 feet on 22 patients, good results in two patients. There was one fair result and 6 patients had non-unions considered as poor.[51]

Kidner Procedure

In 1929, Kidner stated that medial longitudinal arch support was compromised by abnormal insertion of the posterior tibial tendon into the accessory navicular. He theorized that the pull of the PTT was altered medially due to the presence of a pre-hallux, thereby increasing collapse of the longitudinal arch. The Kidner procedure consists of excising the accessory navicular and re-routing the PTT into a more plantar position. Murphy believes that any increase in the longitudinal arch post-Kidner procedure is due to continued growth in an immature foot.[42]

Prichasuk's study on 28 symptomatic patients with accessory navicular, all of whom underwent the Kidner procedure, revealed good results in 27 patients and fair in one patient. The procedure did not significantly restore the height of the longitudinal arch, improving in only 3 of 25 patients.[33] Leonard and associates, in 1965, reviewed 13 patients who underwent the Kidner procedure on 25 feet, all who presented with an accessory navicular and pes valgo planus, and reported satisfactory results in longitudinal arch restoration and correction of heel valgus.[48]

In a prospective study of 20 patients with symptomatic type II accessory navicular, 10 of whom underwent arthrodesis and 10 underwent Kidner procedures, the American Orthopedic Foot and Ankle Society pain score at 35 months improved from 50 to 93 with arthrodesis, while the Kidner score at 48 months improved from 52 to 80.[52] There were two non-unions, and persistent pain in three patients with progressive loss of the longitudinal arch. The authors concluded that arthrodesis is a reasonable alternative procedure in type II accessory navicular cases if the accessory bone is large enough to accept small fragment screws. Prichasuk and Sinphurmukskul reported good results in 27 out of 28 patients using the Kidner procedure; however, there was no noted change in the medial longitudinal arch post-operatively.[33]

Figure 20a,b: Functional UCBL device. Note high medial and lateral flanges, reduced undercut, heel raise, forefoot posts to sulcus and exceptionally deepened heel seat

Figure 20b

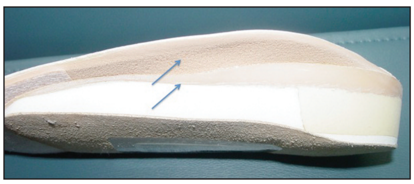

Figure 21a,b: Functional UCBL medial view with navicular dimpling and soft tissue flap.

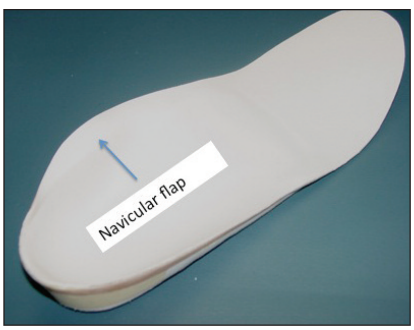

Figure 21b

Comparison of simple excision via Kidner procedure by Tan and associates found no advantage of one procedure over another, and therefore recommended the simpler procedure.[53] None of the above procedures directly and significantly address the flatfoot deformity that accompanies a large percentage of these cases.

Giorgini and associates have demonstrated that the modified Kidner-Cobb procedure is a useful treatment option for patients with accessory navicular and symptomatic flexible flatfoot with stage II posterior tibial tendon dysfunction (PTTD).[54] This procedure is actually a modification of the Pisani procedure in which the posterior tibial tendon is reinforced by weaving it through the medial segment of a split anterior tibial tendon, resection of the accessory navicular, and advancement of the posterior tibial tendon insertion.[55] A series if 39 patients (50 feet) with symptomatic flexible flatfoot, stage II PTTD, and accessory navicular were operated on. The results were good in 96% and fair in 4%. There were no poor results. The average follow-up was 4.6 years with 5.7 month recovery time in older patients and 3.7 months in younger ones. Manual muscle strength testing revealed no loss of tibialis anterior strength versus the contralateral limb, and all patients had an increased medial longitudinal arch. Complications were minimal.

Summary

The accessory navicular is a commonly occurring deformity that, because of its significant accompanying pathomechanical considerations, is closely associated with the pathologic flexible flatfoot. By recognizing and treating this progressive, debilitating deformity, both conservatively and surgically, the astute practitioner will be able to resolve discomfort, improve dysfunction, and restore quality of life. **PM**

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SEE ANSWER SHEET ON PAGE 153.

1) The reported incidence of accessory navicular is best represented by which one of the following choices?
   A) 1-4%
   B) 4-21%
   C) 33%
   D) 35-50%

2) All of the following are synonyms for the accessory navicular EXCEPT which one?
   A) os tibiale externum
   B) bifurcate navicular
   C) os vesalianum
   D) os naviculare secundarium

3) Navicular ossification is best represented by which one of the following?
   A) 12-18 months F and 18-24 months M
   B) 12-18 months M and 18-24 months F
   C) 30-36 months M and 18-24 months F
   D) 18-24 months M and 30-36 months F

4) Which one of the following best represents the age for secondary ossification centers in the navicular?
   A) 3 years F and 4 years M
   B) 3 years M and 4 years F
   C) 6 years F and 8 years M
   D) 9 years F and 12 years M

5) Which one of the following accessory navicular types is rarely associated with symptomatology?
   A) type I
   B) type II
   C) type III
   D) cornuate navicular

6) All of the following represent an enlarged medial horn of the navicular EXCEPT which one?
   A) cornuate navicular
   B) os tibiale externum
   C) hooked navicular
   D) type III navicular

7) Which one of the following accessory navicular types is most susceptible to shear forces from altered PTT mechanics?
   A) type I
   B) type II
   C) type III
   D) hooked navicular

8) Which of the following statements are true regarding accessory navicular symptomatology?
   A) Symptoms begin in early adolescence with solidification of secondary centers.
   B) The presenting complaint may be acute midfoot pain, especially with unyielding footwear.
   C) Participation in sports requiring medial push-off accentuates symptomatology.
   D) All of the above

9) Which of the following would be included in the painful accessory navicular differential diagnosis?
   A) osteonecrosis
   B) stress fracture
   C) Kohler's disease
   D) all of the above

10) Which of the following is often associated with a symptomatic accessory navicular?
   A) anterior tibial tendonitis
   B) posterior tibial tendonitis
   C) metatarsal/cuneiform synovitis
   D) plantar fasciitis

11) Conservative management of the painful accessory navicular may include which of the following?
   A) activity modification or cessation
   B) prescription foot orthoses
   C) strapping
   D) all of the above

12) What is the goal of mechanical therapy in the conservative management of the painful accessory navicular?
   A) realignment of the osseous structures
   B) realignment of the soft tissue structures
   C) establishment of optimum foot and limb function
   D) all of the above

13) Orthotic modifications useful in the management of the painful accessory navicular include which of the following?
   A) deepened heel seat
   B) aggressive rear and forefoot posting
   C) dimpled or bubbled out navicular
   D) all of the above

14) The primary patho-mechanical force in the type I or type II accessory navicular foot is best represented by which one of the following statements?
   A) distal displacement of PTT insertion
   B) lateral displacement of PTT insertion
   C) proximal and medial displacement of PTT
   D) proximal and lateral displacement of PTT

15) Which of the following statements are true regarding PTT insertion in the type I or type II accessory navicular foot?
   A) no change in insertion

Continued on page 152

B) inserts into plantar navicular and 2nd met base
C) inserts into dorsum of the navicular only
D) inserts into the navicular dorsum, tarsus and metatarsal bases

16) Which of the following procedures for the painful accessory navicular yield(s) good results?
A) Kidner
B) ossicle excision
C) percutaneous drilling
D) all of the above

17) Which of the following procedures for the painful accessory navicular directly and significantly addresses an accompanying pathologic flexible flatfoot deformity with stage II posterior tibial tendon dysfunction?
A) Kidner
B) Kidner-Cobb
C) ossicle excision
D) ossicle arthrodesis

18) The shell or module for prescription foot orthoses to control pathomechanical forces in the painful accessory navicular should be non-deformable, non-compressible and possess sufficient rigidity to maintain control during all weight-bearing activities. Which of the following materials possess(es) these characteristics?
A) graphite composites
B) subortholene
C) high density polyethylene HDPE
D) all of the above

19) The Kidner-Cobb procedure is a modification of which of the following procedures?
A) Silfverskiold
B) Austin
C) Pisani
D) Lapidus

20) Which one of the following body types would be most likely to present with a painful accessory navicular and accompanying flatfoot deformity?
A) endomorph
B) mesomorph
C) obese
D) ectomorph

See answer sheet on page 153.

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EXAM #6/13
The Accessory Navicular
(D'Amico)

Circle:

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

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