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Chapter 12

Surgical Treatment of the Accessory Navicular (Os Tibiale Externum) in Dancers

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Abstract
This study is to draw attention to a relatively common anatomical anomaly and its possible operative treatment in dancers. The accessory navicular, or os tibiale externum, is an accessory bone on the medial side of the navicular of the foot at the insertion of the posterior tibial tendon (PTT). It can cause obvious hyperpronation, medial foot pain, and a limited and painful relevé in dancers. To the best of our knowledge, this is the first report on the operative treatment of the accessory navicular exclusively in dancers. Six dancers (10 feet) were treated in our clinic for a symptomatic accessory navicular Type II. Five of them (eight feet) underwent surgery, two unilaterally and three bilaterally (at the same time). All five had an excellent result at mean follow-up of 4.7 years, given that they fully resumed their professional dance activities without restriction, discomfort, or residual symptoms. One patient stopped dancing for unrelated reasons and became symptom free without further (surgical) treatment. Although no conclusions can be drawn from a retrospective case series and other treatment modalities were not considered, simple excision of a symptomatic accessory navicular Type II seems to be a good choice in dancers.

Figure 1: Relevé position in a dancer.

Case 2: Case 6. The prominence of the accessory navicular on both feet is clearly visible in relevé position.
Chapter 12

Introduction

The foot (16%) and ankle (27%) are the most common injury sites in the dancers consulting our clinic. Among these are injuries to the accessory navicular, which has many synonyms, such as the os tibiale externum, os naviculare secundarium or navicular secundum, accessory scaphoid of the foot, prehallux, and bifurcated hallux. It is the primary accessory ossicle of the foot and was first described by Bauhin in 1605. It is located on the medial side of the navicular at the insertion of the posterior tibial tendon (PTT). This accessory ossicle is often an asymptomatic anatomic variant, being present in 4% to 21% of the population. In 50% to 89%, it occurs bilaterally, most often in females. There have been several reports on accessory naviculars, but none mentioning it in dancers were found. The prevalence of a chronic, symptomatic os tibiale externum in our dancer-patient population is unknown, but it is our observation that in dancers this can be a severe handicap, especially in adolescence. The dancers are usually referred because of a painful and limited relevé (Fig. 1) and severe hyperpronation (“rolling-in”) of the feet. There are several theories about the etiology of this condition. A few of these involve posterior tibial tendinitis, pressure with irritation of the bony prominence, abnormal biomechanics of the foot, a trauma (eversion sprain) to the synchondrosis between the accessory navicular and the navicular itself, or even a (stress) fracture of the accessory navicular itself.

Ossification of the accessory navicular takes place between 9 and 11 years of age, while the ossicle becomes symptomatic mostly in the second decade of life. The accessory navicular is easily diagnosed at first glance as a prominence on the medial side of the foot (Fig. 2). It is confirmed by physical examination and plain film radiography. The patient is usually physically active and complains of acute or chronic pain over the medial side of the foot. This pain occurs during physical activity or when wearing narrow shoes. The sign on physical examination is a painful palpable prominence of the navicular. Resisted foot inversion will reproduce the pain. Palpation (translation) can give a sense of the mobility of the extra ossicle. The imaging of first choice is plain film radiography. Usually an anteroposterior (dorsoplantar) view is sufficient, and, if needed, a 45° inversion oblique view of the foot. It has been stated that an inversion oblique view of the foot (routine standard) is the most important diagnostic tool (Fig. 3). A division into three types can be made, as follows:

1. Type I is a sesamoid bone in the PTT. Some investigators give only this specific type the name "os tibiale externum." It is usually asymptomatic.
2. Type II is a larger triangular structure loosely attached to the navicular by fibrous tissue (synchondrosis, non-fusion, bifurcature, or bipartite type). Type II is the most prevalent and the most likely to be symptomatic.
3. Type III is a fusion of a large secondary ossification center resulting in a large medial portion of the tuberosity of the navicular, referred to by some as “cornuate navicular.”
Clinical presentation and physical examination are sufficient to differentiate between a symptomatic and an asymptomatic accessory navicular. Specific diagnosis and categorization of the problem (type of accessory navicular) does require plain film radiography. Bone scintigraphy is not reliable for diagnosing a symptomatic accessory navicular because it has a sensitivity of 100% and specificity of 50%. Conservative treatment, such as a cast or a period of relative rest (reduced physical activity), can be effective, but, according to the literature, for patients who remain symptomatic surgery can provide good long-term results. Surgery can be simple excision of the accessory bone or the Kidner procedure can be used. The Kidner procedure involves both the excision of the accessory bone and the reinsertion of the PTT. Transposition of the PTT is supposed to restore its function as an elevator of the medial side of the tarsus, which is lost due to the accessory navicular. However, re-routing of the PTT is not necessary to achieve good results in treating the pain symptoms of the accessory navicular. In several studies, no relationship was found between developing a pes planus and the accessory navicular. Compression due to pronation of the foot can make an accessory navicular symptomatic.

After surgery for an accessory navicular, some investigators prefer a walking boot cast for 8 weeks; the Kidner procedure requires immobilization in a cast for 6 weeks. In addition to excision, a few other operative techniques have been described in the literature. In young athletes, long-term pain relief was achieved by inducing bony union of the accessory navicular Type II with the os navicular by percutaneous drilling of the synchondrosis. A return to full sports

Figure 3 Case 2. A, Anterior-posterior view x-ray with the accessory navicular visible. B, Oblique (45° eversion) view x-ray; the accessory navicular is hidden behind the calcaneus. C, Oblique (45° inversion) view x-ray with a clearly visible accessory navicular.
activity in 3 months has been claimed using this technique. However, it is only suitable for adolescents with open epiphyses; it can result in a non-union and has not been tested in large study groups. A technique for screw-fixation osteosynthesis of the extra ossicle has also been described. This is only suitable for larger ossicles, can produce problems with the hardware, can result in a non-union, and compared to simple excision, it does not give better results or additional advantages. In all surgical techniques, except excision, the accessory navicular remains prominent and often symptomatic. To the best of our knowledge, this is the first report on successful operative treatment of an accessory navicular (os tibiale externum) in dancers.

Materials and Methods
The patient files and radiographs of a consecutive case series of six dancers (10 feet) who were treated in our clinic for a symptomatic accessory navicular were studied. The final outcomes were well documented in the files and confirmed by telephone interview, during which we asked whether the patients were able to resume their dance activities without complaints or restrictions and if they had residual symptoms.

Operative Technique
After preparing the patient in the operating room, an incision is made over the prominence of the accessory navicular in line with the course of the PTT. The PTT is split longitudinally in the middle of the tendon, preserving the insertion of the tendon, which fans out over a broad
area. The accessory navicular is cleared by sharp dissection and removed. If still prominent, the medial portion of the tuberosity of the navicular is removed using an osteotome, working in a proximal direction (Fig. 4). Cutting the bone in a distal direction may inadvertently lead the osteotome too deep laterally into the navicular. Any sharp edges are removed, and the cancellous bone surface is sealed with a thin layer of Ethicon bone wax after rinsing the operation area with a 0.25% bupivacaine solution containing 1:200,000 adrenalin, for postoperative analgesia and hemostasis. The split PTT is closed with absorbable sutures only. A pressure dressing is applied with the foot in neutral position. During the first 6 postoperative weeks, mobilizing exercises and partial weightbearing in firm shoes with well-molded arch supports are allowed. These insoles are custom made preoperatively.26 At 6 weeks, the dancer proceeds to full weightbearing and starts a dancespecific rehabilitation program.27 At 3 months postoperatively, the dancer is allowed to participate fully in dance activities, including jumping and running.

Results
Of the ballet students who have been treated in our clinic for a symptomatic accessory navicular, five were female and one male between 14 and 22 years of age. Four of them had bilateral complaints, the other two were symptomatic on a single foot. They all suffered from medial foot pain, especially when performing relevé, with the duration of these complaints varying between 2 months and 5 years before the first consultation in our clinic. On physical examination, pain could be provoked by resisted action of the tibialis posterior muscle (inversion, adduction, and plantar flexion) or tapping on the (visible) prominence of the accessory navicular. All had hyperpronation of both feet; none of them had loss of strength or sensation. The radiographs showed a Type II accessory navicular in all patients in this report. Three patients, who had had their complaints for 6 months or more, were scheduled for excision of the accessory navicular at the first consultation in our clinic. Three patients received insoles as a conservative treatment, but these provided insufficient pain relief, and two of them proceeded to operative treatment. Thus, five of these dancers (eight feet) underwent surgery. All operations were performed by the first author. Follow-up ranged between 2 and 7 years. There were no postoperative complications. All five operated patients were able to dance professionally after surgery, meeting the high demands of professional dance without restriction, discomfort, or residual symptoms. We consider this to be an excellent result. In four patients the rehabilitation period to dancing fully took 3 months. In one patient, rehabilitation was prolonged to 1 year due to a painful PTT insertion, in spite of resuming full dancing at 5 months. Finally, she had an excellent result, becoming a professional modern dancer in a Dutch neoclassical dance–company. One patient was not operated: he was treated conservatively.
with a cast and insoles for 6 weeks. Half a year after removal of the cast, he was still unable to
dance fully without problems, and he was scheduled for operative treatment. However, due to
insufficient progress in his dance technique, the vocational dance academy did not allow him
to pursue his training, even if he were to be operated successfully. Hence, he decided to stop
dancing entirely and became symptom free after eliminating the high demands of dance. He
was not operated because his other physical activities, such as school sports, did not provoke
the medial foot pains like dancing used to do. These six cases are summarized in Table 1.

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A, Case number; B, Age (years) at first consultation in our clinic; C, Gender (Male/Female); D, Side foot (Right/Left); 
E, Duration of complaints (months) before first consultation in our clinic; F, Type accessory navicular; G, Conservative 
treatment; H, Surgery (Yes/No); I, Time of rehabilitation to dancing fully (months); J, Follow-up (years); K, Result 
(excellent, good, fair, poor): E = Excellent; L, Type of dance on first consultation.

**Discussion**

After the first description of the accessory navicular by Bauhin, it became known as os tibiale 
externum. Many other names were proposed but were never adopted. With English as an 
upcoming language in the medical world, accessory navicular has become the most common 
terminology. The current investigators think it is undesirable to reserve the term “os tibiale 
externum” only for a Type I ossicle. The accessory navicular (os tibiale externum) is a clinical 
diagnosis based on physical examination that finds a bony prominence on the navicular bone 
of the foot, with or without complaints. Careful history taking and examination may suffice for 
diagnosis; radiological evaluation confirms the diagnosis and allows for a division into three
types. Reviewing the literature and this retrospective study of the patients and their complaints provides a clear picture of a diagnostic, imaging, and treatment protocol:

1. **Physical examination:** On physical examination, the following aspects of the accessory navicular should be checked: pain on tapping the prominence, pain on mobilization (translation) of the prominent medial portion of the tuberosity of the navicular, resistance to pain when using the PTT (resisted adduction and inversion), and hyperpronation of the feet.

2. **Imaging:** The suggestion of some investigators for diagnosing the accessory navicular is an eversion oblique view of the foot. In this (routine standard) view, the accessory ossicle is hidden behind the body of the navicular and is not visible (Fig. 3). Other imaging techniques, such as MRI and bone scintigram, are redundant since they neither make the diagnosis more secure nor influence the choice of treatment. A simple anteroposterior (dorsoplantar) radiograph of the feet usually reveals the accessory bone clearly, and if needed, a 45° inversion oblique view of the foot is made.

3. **Treatment:** The literature describes successful conservative treatment, such as a cast, but in physically active people, surgical treatment appears to be the better option. If there is a history of acute onset of the complaints or trauma (in the unusual case of an eversion sprain; landing in a “turned out” position with incorrect foot position), conservative treatment seems to fail in dancers (one case report describes successful conservative treatment in a post-traumatic case of a dancer but with a short follow-up). Although a small case series, such as ours, does not allow for firm conclusions and no comparison with other therapies was made, simple surgical excision, as described, seems to be a reliable treatment in a Type II accessory navicular in dancers. It should be noted that the advice to stop dancing is not a “treatment” option in these motivated, passionate patients. The necessity for immobilization after surgery for an accessory navicular (a walking boot cast for 8 weeks or 6 weeks in a plaster cast after the Kidner procedure) is a disadvantage for an active dancer. Rehabilitation to full dancing after prolonged immobilization takes much longer than the average 3 to 5 months experienced in our clinic. The percutaneous drilling procedure is a valued technique, which can only be used in a specific age group at a specific stage of epiphysis growth. It might have provided a good comparison group to the technique described in this study; however, a prospective clinical trial was not an option given the small cohort size of professional dancers. If an osteosynthesis is used, the screws and other hardware can produce discomfort and may require a second operation for removal. The surgical technique used in removing the accessory navicular in this group of dancers is simple excision, shelling out the accessory bone, and leaving the insertion...
of the PTT intact, albeit sometimes “weakened.” If in doubt, a plaster of Paris boot may be given immediately postoperatively for 6 weeks. The dancer patient is warned before the operation that this may be necessary, but in none of our cases was it required. In our opinion, it is unnecessary to divide the PTT entirely (transversely) and repair it anatomically, as suggested by some investigators.22

Conclusion
A patient’s history can provide a clue to the presence of a symptomatic accessory navicular (os tibiale externum), which can be diagnosed by physical examination. The presence and type of the accessory bone is confirmed on plain anteroposterior radiography of the foot and, if needed, a 45° inversion oblique view of the tarsus. Although this is a retrospective case series of six dancers (10 feet) and no comparison with other treatment modalities is made, in our clinic the simple excision of a symptomatic accessory navicular Type II has proven to be a reliable treatment for professional dancers. Even in acute trauma or in the case of short-term symptoms, conservative treatment seems to fail in dancers. Although active young people, such as one of our patients, may become symptom free by eliminating the high demands of dance, this, of course, is no “treatment” option in committed dancers. All five dancers (eight feet) operated in our clinic had an excellent result, given the fact that they were able to resume fully their professional dance careers, without restrictions, discomfort, or residual symptoms.
Reference List

24 Chung JW, Chu IT. Outcome of fusion of a painful accessory navicular to the primary navicular. Foot Ankle Int. 2009 Feb;30(2):106-9.
Surgical Treatment of the Accessory Navicular (Os Tibiale Externum) in Dancers