Posterior Ankle Impingement in the Dancer

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Abstract
Dancers spend a lot of time in the relevé position in demi-pointe and en pointe in their training and their careers. Pain from both osseous and soft tissue causes may start to occur in the posterior aspect of their ankle. This article reviews the potential causes of posterior ankle impingement in dancers. It will discuss the clinical evaluation of a dancer and the appropriate workup and radiographic studies needed to further evaluate a dancer with suspected posterior ankle impingement.

Introduction
Dance has continued to amaze and impress audiences worldwide with its grace and athleticism. Many agree that part of this enchantment comes from dancers’ ability to dance in positions known as relevé, or “lifted,” on the ball of the foot or on the toes, positions of the foot called demi-pointe and en pointe, respectively. The English translation of the French phrase en pointe is “on the tips of the toes” (Fig. 1).

Dance athletes are unique in their ability and desire to dance on relevé, which includes demi-pointe and en pointe. To become a pointe dancer, these athletes must have adequate flexibility in the foot and ankle complex to achieve full pointe, sufficient training to achieve proper placement, and strength to achieve postural control. They need balance, proprioception, proper alignment, and technique to prevent injury (31).

Dance is a demanding sport and leads to many injuries, especially around the foot and ankle. Dancers who dance in en pointe and demi-pointe positions require their ankle to be in extremes of plantarflexion (Figs. 2 and 3). These positions of maximum plantarflexion can lead to excessive compressive forces on the posterior ankle, resulting in pain, restriction, and disability. This condition is termed “posterior ankle impingement.” This ankle impingement can be caused by both osseous and soft tissue structures. A compressive force of up to 12 times the body weight is applied to the foot and ankle when the dancer is en pointe (8,19,23,31). Studies reporting purported causes of this impingement have been published (1,6,7,9–11, 13,14,16,19,24,26–28,30). This article reviews the many possibilities of posterior ankle impingement in the dancer.

According to the literature, ankle pain or injuries in dancers account for 4.7% to 31% of all injuries that occur in ballet and modern dance companies (2,3,33,37). These numbers are magnified by the fact that dance is one of the most popular sports for children, with more participants than Little League Baseball or Pop Warner Football (31). Thus, clinicians need to have broader knowledge of dance-related injuries and conditions. It has been reported that the United States has over 11,000 dance schools (20), with dancers starting at an age as young as 3 or 4 years (40).

Causes of Posterior Ankle Impingement in the Dancer
Many causes of posterior ankle impingement in the dancer have been reported in the literature. These can be categorized as soft tissue or osseous structures, and all potentially causing symptoms during plantarflexion of the dancer’s ankle. Posterior ankle impingement in the dancer is underrecognized and requires knowledge of the potential causes in order for the clinician to diagnose and treat the dancer appropriately.
Osseous Causes

Dancers are required to perform in the plantar-flexed position continually throughout their career or training, including relevé in the en pointe and demi-pointe positions. Posterior ankle impingement can occur due to the formation of osseous structures. When the dancer is in the demi-pointe or en pointe position, the talus rotates in the tibial mortise during plantarflexion, the posterior calcaneus approaches the posterior articular margin of the tibia, and the talus often is seen to hinge posteriorly and open anteriorly. A bony prominence extending from the posterior talus may be the source of compression (17). The posterior process sometimes is ossified from an independent growth center, thus remaining separate from the talus. This is the os trigonum.

Os trigonum. The os trigonum was described first by Rosenmüller (29) in 1804 and later by Shepherd (32) in 1882. The first description of the os trigonum as a secondary ossification center was by Turner (35), also in 1882.

An os trigonum appears in 13% to 25% of adults (34), while some studies show prevalence of 5% to 11% (30). It has been reported that this may be a separate remnant of ossification posterior to the lateral tubercle or a nonunited fracture of the Stieda process, a large posterolateral talar process (14). It also is speculated in some reports that repetitive plantarflexion trauma of training in the dancers' skeletally immature years prevents proper closure of the trigonal ossification center (22,26). The ossicle can appear smaller than it actually is, as a result of part of the os's being cartilaginous in younger dancers (21) (Figs. 4 and 5).

Hamilton (8) reports that an os trigonum may remain asymptomatic until it is irritated or stressed by a traumatic event. The author of this article suggests that it may be irritated or stressed by biomechanical faults in the dancer as well. These data have yet to be published.

Stieda process. The Stieda process is the extended lateral tubercle of the talus. The posterior process of the talus is composed of a medial and a lateral tubercle (Stieda process), which are separated by a groove in which lies the flexor hallucis longus tendon. The bifurcate talocalcaneal ligament forms a roof over this groove and inserts onto each tubercle. The posterior talofibular ligament inserts onto the lateral tubercle of the talus and may be involved with avulsion fractures of this tubercle. The posterior talotibial portion of the deltoid ligament inserts onto the lateral tubercle. These structures also can be affected by repetitive

Figure 2: First position, demi-pointe.

Figure 3: Fourth position, en pointe.

Figure 4: MRI findings of an os trigonum in a ballet dancer.

Figure 5: MRI findings suggesting a symptomatic os trigonum, represented by marrow edema within the os trigonum.
trauma. This prominent lateral process can form a bony block with plantarflexion, causing symptoms in the posterior ankle in the dancer. This process also can be fractured if enough force is applied (2).

**Other osseous causes.** This author suggests that a dancer can have signs of posterior ankle impingement on examination not only from an os trigonum or Stieda process but also from osseous injury to the talus and/or calcaneus (Fig. 6). Repetitive trauma to any bony structure, including those of the posterior ankle, can lead to a stress injury.

Prior injury predisposing the dancer to posterior ankle impingement is an important concept to consider. There has been speculation by some authors, including this one, that an injury to the ankle of a dancer will predispose the otherwise asymptomatic osseous structure to become symptomatic (9,10). This previous direct injury causes the os trigonum or posterior articular surfaces of the ankle to elicit pain when placed in the weight bearing plantar-flexed position.

Lateral ankle sprains result in lateral instability and thus can lead to the talus moving anteriorly from under the tibia. This can occur during relevé. At the extreme of relevé, anterior translation of the talus occurs causing approximation of the tibial plafond and superior calcaneus leading to osseous impingement (9,10).

This author speculates that recurrent injury to the ankle may lead to not only an osseous type of impingement but also soft tissue impingement.

**Soft Tissue Causes**

**Ganglion cysts and synovial hypertrophy.** Soft tissue masses, hypertrophic masses, or synovial hypertrophy may contribute to posterior ankle impingement as well. The soft tissue masses may be ganglion cysts (Figs. 7 and 8) that potentially are created due to repetitive trauma, as is speculated in other athletes, especially gymnasts, known to have repetitive trauma to their wrists. This author suggests a similar phenomenon may exist in the posterior ankle of certain dancers, leading to impingement symptoms secondary to the cyst or soft tissue mass. The soft tissues undergo inflammatory changes and repeated entrapment, and eventually, thickening and fibrosis (12).

**Tendon causes.** It has been reported that the differential diagnosis for posterior ankle impingement caused by tendons in the athlete and dancer includes Achilles, peroneal, tibialis posterior, or flexor hallucis longus tendonitis (41). However, for these conditions, the symptoms rarely are aggravated by passive plantarflexion.

Flexor hallucis longus (FHL) tendonitis rarely is seen in other activities besides ballet. Extreme plantarflexion in the demi-pointe and en pointe positions and with subsequent movement through the plié or grand plié position in one repetitive motion over time can cause irritation and inflammation.
of the FHL tendon and tendon sheath. With the foot in active plantarflexion, the flexor hallucis longus functions as a primary dynamic stabilizer. The FHL is part of the spectrum of impingement given its approximation with the lateral talus and its tubercle or an os trigonum (11). This FHL tendinopathy or pathology can be an isolated entity but also can coexist with posterior impingement. Secondary degenerative changes can occur within the tendon with repeated inflammation. Cyst formation, fraying, and fusiform thickening also have been known to occur at the fibroosseous canal. This can lead to a triggering effect and posterior ankle pain in the dancer (11). Hamilton (11) describes that an FHL tenosynovitis can occur simultaneously with posterior ankle impingement due to other causes such as an os trigonum.

**Ligament causes.** Ligamentous structures situated in the compartment adjacent to the tibia, talus, and calcaneus have been speculated to be at risk for impingement and implicated in several studies and case reports. The posterior talofibular ligament, the posterior intermalleolar ligament, and the posterior tibiotalar ligament all have been implicated in posterior ankle impingement (5,11,24). The primary source of impingement may be ligamentous structures caused by scarring and fibrosis from repetitive plantarflexion or from the bony approximation while in extreme plantarflexion (30).

However, it should be noted that some of these studies were radiologic studies and did not seem to include examining the patients to eliminate other potential causes of posterior ankle impingement.

**Clinical and Radiologic Evaluation**

The clinical presentation and examination of the dancer are extremely important when evaluating for posterior ankle impingement. In addition to a thorough examination, a proper history of the injury and past injuries to the foot and ankle must be completed. This history needs to include past injuries to the ankle that can predispose it to subsequent injuries and should include questions regarding prior surgeries on the affected limb. These prior surgeries potentially can affect range of motion, strength and proprioception, and potential pain syndromes. A thorough clinical examination and history also would include asking if any prior effective therapy or treatments had occurred before or after being diagnosed with posterior ankle impingement.

Pain in the posterior aspect of the ankle is the prominent symptom with impingement when the dancer is in a relevé position. The pain progressively increases with demi-pointe and en pointe work.
Clinical examination of the dancer with suspected posterior ankle impingement reveals pain to the posterior ankle, more often laterally than medially, when actively placed in the en pointe or demi-pointe position or in passive plantarflexion by the examiner (Figs. 9–11).

When examining the dancer, the evaluation should include demi-pointe and en pointe positions because the symptomatic structure, such as an os trigonum or Stieda process, will impinge and cause pain in these positions (Fig. 12).

This also may impede the relevé position. When evaluating the dancer, a noticeable restriction in these positions also may be observed (Fig. 13).

Pain will be elicited in the posterior aspect of the ankle when the examiner places the dancer in a passive plantarflexed position (Figs. 14 and 15).

Weight bearing x-rays are obtained in the dancer who meets the criteria of posterior ankle impingement on examination. These include anterior-posterior, lateral, oblique, and lateral demi-pointe positions, with the foot in full plantarflexion. These films will help to view the amount of bony approximation and show the size and dimensions of the os trigonum or Stieda process (Fig. 16).

Magnetic resonance imaging (MRI) of the ankle also is recommended when a dancer presents with posterior ankle impingement to further evaluate the extent and dimensions of the os trigonum, Stieda process, stress injury, and/or soft tissue mass or synovial hypertrophy causing the impingement (Fig. 17). The MRI can be used to further identify the areas of edema and inflammation, and, consequently, the structures in the posterior aspect of the ankle being impinged.

**Treatment**

Treatment for posterior ankle impingement in the dancer can be surgical or nonsurgical depending on the cause. When symptomatic, osseous structures such as an os trigonum or Stieda process may require surgical intervention.
When this condition is unrecognized and consequently not treated appropriately, the dancer’s career and long-term abilities, potential, and success will be compromised.

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References


