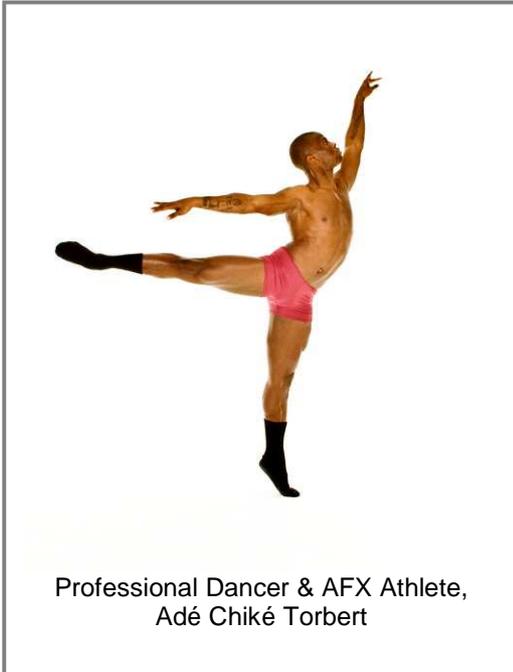


## Importance of Foot and Ankle Strengthening for Dancers



Dancers perform a multitude of incredibly complex movements utilizing jumps and positions requiring precise balance, so foot and ankle strength and mobility are a must - not only for optimal performance, but also to reduce the risk of foot and ankle injuries, which account for approximately 57% percent of all dance related injuries (Russell, 2012).

For example, the extreme joint positions created when dancing en pointe (i.e. on the tips of the toes), or in the demi-pointe position (i.e. on the balls of the feet with the ankle fully plantar flexed), can lead to both acute and overuse injuries of the foot and ankle (Kadel, 2006). A lack of well-cushioned or supportive footwear in most dance forms creates an even greater need for adequate strengthening of all the muscles in the feet and lower legs, to improve shock-absorption and joint stability.



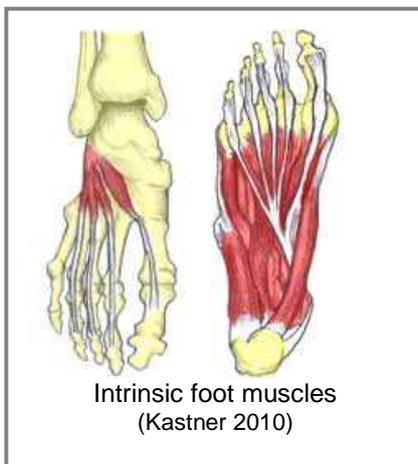
### Importance of Foot Strengthening

It has been reported that many common foot and ankle injuries in dancers occur as a result of poor “intrinsic” foot muscle strength

(Howell, 2012). The “intrinsic” foot muscles are small muscles that originate and insert within the foot, without crossing the ankle joint. In dance, the main functions of the intrinsic muscles are: 1) to help maintain the position of the dancer’s arch, and 2) to help stabilize the toes within the shoe while in the en pointe position. A biomechanical study showed that the muscles crossing the joints of the toes work 2.5 to three times harder than those crossing the ankle joint in dancers rising on to the full pointe position, placing these muscles and tendons at risk for overuse injuries (Dozzi and Winter, 1993). In addition, if the intrinsic muscles do not have sufficient strength or muscular endurance, larger muscles called the “extrinsic” foot muscles, which originate in the lower leg, end up having to take up more of the load, and can therefore become over-stressed as they attempt to take on two functions (i.e. movement



around the ankle joint and within the foot). This can lead to conditions such as Anterior Compartment Syndrome, Stress Fractures of the shin bone, or Medial Tibial Stress Syndrome (Howell, 2012). A lack of intrinsic foot muscle strength can also lead to conditions of the foot such as Plantar Fasciitis, due to increased loading of the connective tissue (fascia) that runs under the arch of the foot (especially during jumps), a condition that can be very debilitating and chronic in nature.



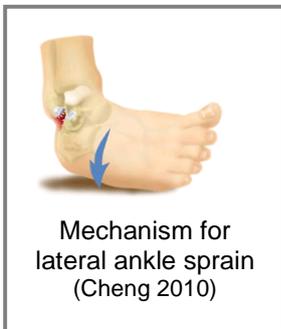
Stress fractures in the metatarsals, or long bones in the foot, are also common in dancers (Kadel, 2006; Russell, 2012) in part due to the lack of cushioning that is typically provided by footwear in most other sports. Another common injury that dancers sustain is called Cuboid syndrome or cuboid subluxation (dislocation) (Kadel, 2006), which is a condition that typically results from injury to the ligaments surrounding the cuboid bone (a small bone on the lateral side of the mid-foot). This injury can occur as a result of the increased pressure on the mid-foot when landing from jumps

in dance. Increased strengthening of the intrinsic muscles can help to improve shock-absorbing capabilities of the feet, thereby reducing the load on the metatarsals and mid-foot and, subsequently, reducing the risk of these types of injuries.

**How AFX helps:** with its flexible foot support, independent resistance that is applied to the toes in flexion and extension, ability to strengthen and stretch the toes through a full range of motion, and eccentric loading, optimal strengthening of the intrinsic foot muscles is attainable, while at the same time mobility is maintained.



## Importance of Ankle Strengthening

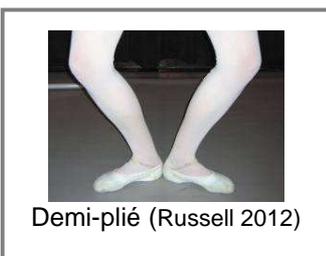


In addition to intrinsic foot muscle strength, the strength of the muscles in the lower leg, whose tendons cross the ankle joint, is critical for maintaining static and dynamic balance, and preventing injuries such as lateral ankle sprains, which is the most common injury amongst dancers (Kadel, 2006). A lateral ankle sprain occurs when the underside of the foot turns inward, and you roll over on the outside of your foot. This results in damage to the ligaments that support the lateral side of the ankle joint. With the fully plantar flexed ankle position that is seen often in many types of dance, the ankle is in a very weak position biomechanically, so loss of balance in this position can easily lead to lateral ankle instability, and a lateral ankle sprain. Most exercise equipment is not designed to strengthen the ankle plantar flexors through a full range of motion, and in fact the last 10% or so of the range of motion in plantar flexion is rarely exercised with standard exercise equipment.

**How AFX helps:** AFX is specifically designed to strengthen the peroneal (evertor) muscles that are responsible for lateral ankle stability, in a safe and effective manner. The mid-bar creates a lateral resistance component that allows for improved strengthening of the peroneal muscles, something that is not easily accomplished with traditional types of exercise. In addition, the ability to perform eccentric loading of the evtor muscles through a full range of joint motion, something that is not possible on other types of standard exercise equipment, allows for optimal strengthening to prevent injury. In addition, full range of motion strengthening of the ankle plantar flexors allows for strengthening near the end of the range of joint motion, a joint position that is relatively weak in most individuals.



Peroneal tendonitis, or inflammation of the tendons that cross the lateral side of the ankle joint, is another common injury amongst dancers, and can occur from the turned out foot positions in dance, which causes the peroneal muscles to remain contracted in a shortened position; this can lead to shortening of the muscle fibers, and potential injury due to the increased relative stress on the tendons (Schoene, 2005). Dancers who force their turnout will place increased stress on the Achilles tendon due to pronation of the mid-foot and hind-foot during this maneuver (Kadel, 2006). This can lead to overuse injuries such as Achilles tendonitis. Excess stress can also be placed on the Achilles tendon in a ballet position known as demi-plié, in which the dancer is weight-bearing while maintaining a position of maximum dorsiflexion, which results in a high eccentric load being placed on the Achilles tendon. It is therefore critical that the Achilles tendon is not only strong, but flexible in order to withstand the forces and extreme ranges of motion in dance.



**How AFX helps:** Full range of motion stretching of the peroneal muscles in a non-weight bearing position allows for safe and effective stretching of these muscles, to prevent any shortening that may occur from these dance positions. Eccentric loading of the Achilles tendon helps to maximize the strength of the tendon during eccentric contractions, which is critical for preventing injury.

## Muscle Imbalances

It has also been reported that it is very common for a dancer to have left and right-sided strength inequalities (Schoene, 2005). This muscle imbalance means that relatively more stress is being placed on the weaker foot/ankle, which can result in increased risk of injury, and less than optimal performance due to the asymmetrical strength between right and left sides.

**How AFX helps:** It is only natural that we develop a more dominant foot; however, over time a significant strength imbalance may result. By exercising each foot independently, with progressively increasing resistance, AFX enables you to address that imbalance directly. AFX has also been designed to provide balanced strengthening between agonists and antagonists, and proximal to distal muscles, in the foot and lower leg, which is critical for preventing injury and optimizing performance.

## Performance Enhancement

Foot and ankle strengthening with the AFX has been shown to significantly improve jumping ability and dynamic balance in varsity basketball players, after only 12 weeks of training (Mann et al, 2008). Dancers perform a multitude of complex movements utilizing jumps and positions requiring precise balance, with great mobility, so foot and ankle strengthening and stretching is essential for improving performance.

## Summary

The AFX has been designed for full range of motion strengthening and stretching of all the muscles that are utilized in the foot and lower leg of dancers, so that performance is optimized, and risk of injury is minimized. The foot support is designed not to slip, and by moving the handles into different positions, you can increase resistance, or vary the direction of loading for more effective strengthening or stretching. Equally important, however, is that AFX is incredibly easy to use - 10 minutes a foot, three times a week, and a dancer can be confident that she/he is significantly improving their foot and ankle strength.

~ By Rick Hall

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## References

Cheng R. (2010) Ankle Sprain Treatment: PRICE and more! Available from: <http://activespines.blogspot.com/>

Dozzi PA, Winter DA. (1993-94) Biomechanical analysis of the foot during rise to full pointe: Implications for injuries to the metatarsal-phalangeal joints and shoe redesign. *Kinesiology and Med for Dance*, 16(1), 1-11.



Evertor stretching

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Howell L (2012) How Ballet Dancers Can Avoid Common Foot Injuries. *The Ballet Blog*. Available from: <http://theballetblog.com/articles/specific-injuries/136-how-ballet-dancers-can-avoid-common-foot-injuries.html>

Kadel LM (2006) Foot and Ankle Injuries in Dance. *Phys Med Rehabil Clin N Am*, 17, 813–826.

Kastner E (2010) Anatomy of the Foot. Available from: <http://sportyfoot.blogspot.com/2010/02/anatomy-of-foot.html>

Mann SL, Hall RS, Terlicher (Nembhard) NA, Milner TE, Taunton, JE (2008) The Effects of Foot and Ankle Strengthening with the AFX (Ankle Foot MaXimizer) on Athletic Performance in Male Varsity Basketball Players. Presented at the 2010 International Foot and Ankle Biomechanics conference, Seattle, Washington, USA.

Russell JA (2012) Breaking pointe: Foot and ankle injuries in dance. *Lower Extremity Review Magazine*, January. Available from: [http://www.lowerextremityreview.com/cover\\_story/breaking-pointe-foot-and-ankle-injuries-in-dance](http://www.lowerextremityreview.com/cover_story/breaking-pointe-foot-and-ankle-injuries-in-dance)

Schoene, LM (2005) What You Should Know About Dance Injuries. *Podiatry Today*, 18 (1), January. Available from: <http://www.podiatrytoday.com/article/3468>