Pilates for Ultrarunners
with
Special Focus on Achilles Injury Prevention

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Abstract

Running is a very popular recreational activity that has many cardiovascular, muscular and mental benefits. However, running, particularly ultramarathons puts many physical stresses on the body. Mountainous terrain, spending hours on ones feet, history of prior injury, and poor lower limb biomechanics may result in gait compensations and/or acute injury, particularly to the Achilles tendon. This paper will explore the pathology of Achilles tendinopathy in runners and how best to prevent re-injury in a male ultrarunner using a Pilates conditioning program. A review of the gait cycle and skeletal and musculature of the lower limb aids in understanding the impact of running long-distances on the Achilles tendon, and how Pilates may benefit runners.
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Anatomy & Biomechanics


The gait cycle and coordinating muscle groups (Puleo & Milroy, 2010).

A discussion of running and prevention of Achilles tendonopathy would not be complete without a review of the musculature and skeletal structure of the lower limb, as well as the gait cycle. The posterior view of the calf muscle illustrates how the gastrocnemius joins with the soleus to form the Achilles tendon, inserting at the calcaneus. These muscles act as the primary plantar flexors of the foot, while the tibialis anterior and extensor digitorum longus are the primary dorsiflexors of the foot. The tibialis anterior and tibialis posterior work to produce inversion, while the peroneal muscles and extensor digitorum longus produce eversion (BASI Study Guide, 2013).

The bony structures of the ankle and foot are seen in the skeletal view. The talocural (ankle) joint, located at the talus, medial malleolus of the tibia and lateral malleolus of the fibula, allows for
plantarflexion and dorsiflexion. Inversion and eversion occur at the midtarsal joint between the talus, navicular and calcaneous bones, while supination and pronation occur at the subtalar joint (between the talus and calcaneous).

The illustration depicting the gait cycle demonstrates the involvement of the subtalar joint, the gastrocnemius, soleus and Achilles tendon. The phases that make up the gait cycle are the Stance Phase and the Swing Phase. The Stance Phase is further broken into three distinct phases: contact, midstance and propulsive phase. During the stance phase the foot moves through a stable, supinated position (calcaneal inversion, talar abduction and dorsiflexion), then to a more adaptable, pronated position (calcaneal eversion, talar adduction and plantarflexion) as the foot makes contact with the ground. The gastrocnemius and soleus contract to produce plantarflexion, which in turn, exerts force on the Achilles tendon with each step. Injuries to the Achilles tendon may fall anywhere on a wide spectrum from inflammation, microtearing to rupture of the tendon, which then requires surgical repair. Recovery is a slow process due to the limited blood supply to the area so injury prevention during training and racing is a high priority (BASI Study Guide, 2013, Puleo & Milroy, 2010).

**Introduction**

Ultrarunning refers to any distance beyond the marathon (26.2 miles). Races are typically 50 kilometers (31 miles), 50 miles, 100 kilometers (62 miles), or 100 miles and beyond. The majority of ultramarathons are run on trails, many of which are located in mountainous areas with significant amounts of vertical ascent and descent. Terrain can vary from a smooth, groomed trail or road to a very technical rocky, rutted or root infested trail. Training and competing for ultradistance events require a significant amount of continuous time on the feet. Depending on the course, an average, middle-of-the-pack runner may take 8-10 hours to run 50 miles or 25-30+ hours to complete 100 miles.
The effects of ultrarunning on the lower limbs and rest of the body can be substantial. For example, while running the gastrocnemius, soleus and Achilles tendon are heavily recruited during the stance phase of the gait cycle. Additionally, uneven and hilly terrain requires constant inversion and eversion at the midtarsal joint, and hilly descents strain the anterior muscles of the calves to help absorb impact (Puleo & Milroy, 2010). Clearly, the importance of good alignment cannot be understated as deviations may result in detrimental compensations or injury.

During ultras, being able to maintain an upright posture for a long period of time requires core muscle strength and endurance in postural muscles of the abdominals and upper back. Better posture allows for the lungs to expand fully and more oxygen being delivered to the working muscles. Although aid stations are standard in most races, they may be hours apart and ultra runners usually carry additional hydration and nutrition either in one or two handheld bottles (up to 40 ounces) or in a hydration pack worn on the back (up to 2 liters). While amounts vary during a race due to fluid consumption, a runner wearing a hydration pack with 1-2 liters of fluid will be carrying 2 to 4-1/2 pounds, which over the course of a race fatigues postural muscles, upper back, shoulders and arms.

The following case study investigates the use of a Pilates conditioning program as part of the training regimen for a male ultrarunner with a history of Achilles tendinopathy. Munteanu and Barton (2011) cited a number of extrinsic and intrinsic factors related to Achilles injuries, including weight bearing activity such as running on slippery, uneven surfaces. Abnormal alignment and lower limb biomechanics, such as excessive pronation and reduced ankle dorsiflexion were also cited. Weakness in the gluteus medius and rectus femoris may also result in excess impact placed on the Achilles by not being able effectively dissipate forces through the hip and the knee during the stance phase of the gait cycle. Achilles tendinopathy is more prevalent in men and makes up between 8 and 15% of running related injuries. Currently, exercises focusing on eccentric loading (e.g. heel drops) are recommended
for reducing pain and improving function (Sussmilch-Leitch, et al, 2012). Incorporating a Pilates conditioning program into an ultrarunning training program may be beneficial for increasing core and overall strength, increasing flexibility and range of motion in impacted joints, and strengthen the musculature of the lower limb for more efficient, stable movement.

**Case Study**

Jeff is a 37 years old, father of three and works as the head of finance in his family business. Jeff is also my husband. He has been a runner for over 20 years, competing in races of varying distances. He is generally fit and his typical exercise regimen consists solely of running 4-5 days per week, averaging 40+ miles per week. His prior Pilates experience consists of one reformer class. He is currently training for two ultra trail races: a 50 mile and a 100 kilometer (62 miles). He reports a history of chronic hamstring, calf and Achilles tendon tightness, which has resulted in several episodes of acute Achilles tendonitis throughout his running career, as well a torn gastrocnemius a number of years ago. Jeff hopes Pilates training will increase his general flexibility and core strength, but most importantly reduce his susceptibility to running related injuries.

Postural assessment in the sagital view did not reveal any significant deviations from the plumb line. However, significant Genu Varum (bow legs) and moderate pronation was noted in the frontal/coronal view. During his Roll-Down, tightness in the hamstrings was noted. The following conditioning program is an example of a typical session after five sessions on the apparatus. The aim is to continue to improve overall strength to support his ultrarunning activity and minimize risk of further Achilles injury.
Pilates Conditioning Program

Roll-Down

*Warm-up* – Mat Fundamental: Pelvic curl, spine twist supine, chest lift, chest lift with rotation. Rationale: Fundamental movements selected for spinal articulation, rotation and flexion to warm up and prepare body for further work. Emphasis placed on linking breath with movement and activating desired musculature for each exercise, as well as building deep abdominal strength.

*Foot Work* – Reformer: Parallel heels/toes, V position toes and Open V heels/toes, Calf raises, Prances, Prehensile, (Double and Single leg Calf Stretch held 3-5 breaths each), Single leg heels/toes. Rationale: Selected for continued warm-up of lower limbs, focusing on hamstring and quadriceps strength and ankle plantar flexor strength. Emphasis on eccentric contraction during calf raises and prances, as well as subtalar joint range of motion for Achilles management. Client given an opportunity for additional calf stretching after Prehensile.

*Abdominals* - Wunda Chair: Standing Pike. Reformer: Hundred Prep or Hundred. Rationale: Standing Pike on the Wunda allows client to feel a low back and hamstring stretch as well as using breath to activate deep abdominal work. The Hundred Prep on the Reformer gives client additional opportunity to work abdominals on a higher resistance load for strength gains.

*Hip Work* (Feet in Straps) - Frog, Circles Down/Up, Openings. Rationale: Exercises chosen to increase hip adductor and hamstring strength, adductor stretching, as well as pelvic lumbar stability.

*Spinal Articulation* - Reformer: Bottom lift. Mat: Spine Stretch. Rationale: Exercises in this block were selected for their applicability to ultrarunning. Strong abdominals, hamstrings and back extensors help a runner maintain good posture and alignment during long periods of time on their feet. Spine stretch offers an additional hamstring stretch.
**Stretches** – Reformer: Standing lunge. Rationale: This stretch was selected for stretching client’s tight hamstrings, and hip flexors, which tend to shorten in runners.

**Full Body Integration I** - Reformer: Up 1, Elephant. Rationale: Emphasizing co-contraction of abdominals and back extensors to work postural muscles and increase muscle endurance for ultra-running. Additionally, the hamstring stretch will continue to improve lower limb flexibility.

**Arms** – Reformer: Arms Sitting Series. Rationale: Seated arm series chosen to promote trunk stabilization while strength training upper limbs.

**Leg Work** – Mat: Gluteals Side Lying Series with 1-2 pound ankle weights. Rationale: Selected for emphasis on gluteus medius and pelvic lumbar stability, which may aid in preventing Achilles re-injury.

**Lateral Flexion/Rotation** – Wunda Chair: Side Stretch. Rationale: Selected for increasing strength of abdominal obliques to help maintain good posture and alignment while running.

**Back Extension** – Mat: Back Extension and Cat Stretch. Rationale: Exercises selected to increase strength of back extensors and for a lumbar stretch (Cat Stretch). Client’s occupation has him at a desk on a computer for the majority of the day. Emphasizing thoracic extension and lumbar flexion helps to minimize the effects of sitting all day.

**Rest Position and Roll-Down**
Conclusion

Ultrarunning is a growing niche within the sport of running. However, running for long period of time over mountainous and technical terrain may put runners at risk for injury. This paper endeavored to look at the potential benefits of Pilates as part of an ultrarunning training program, with an emphasis on Achilles tendinopathy prevention. Imbalances created by biomechanics, previous injury, the repetitive nature of running and the type of terrain on which athletes run may contribute to increased risk of re-injury. The program developed for Jeff was designed with exercises to support his participation in the sport and prevent injury and chosen based on available research regarding factors that contribute to Achilles injury (gait deviations, muscle imbalance, etc). Although only 5 sessions have been completed, Jeff reports feeling greater strength in his core and less stiffness in his calves and hamstrings. As his Pilates practice progresses, I would expect greater strength and flexibility in the lower limbs and postural muscles, and increased range of motion in the ankle joint. Incorporating Pilates conditioning into an ultra running training plan is an excellent way to help mitigate the effects of a grueling sport through increased muscle strength and endurance, improved running posture and remaining injury free.
References


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