ORIGINAL RESEARCH PAPER

Physical Education

LEG INJURIES IN LONG-DISTANCE RUNNERS

KEY WORDS:

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ABSTRACT

Long-distance running (greater than 3000 m) is frequently recommended to maintain a healthy lifestyle Between 37% to 56% of recreational runners who steadily train and participate in a long-distance run periodically will sustain a running-related injury each year. While training errors lead to the majority of running injuries, biomechanical factors, such as foot insufficiency, muscle weakness, genuvarum, and high Q-angle, contribute to 40% of running injuries.

Many of the skeletal, musculotendinous, and vascular running ailments can be explained by anatomy and basic biomechanics. A recent Cochrane review found little evidence for the effectiveness of stretching and/or conditioning for the prevention of lower limb soft tissue running injuries. However, knee braces and custom insoles were effective for reducing anterior knee pain and medial tibial stress syndrome in runners, respectively. Overall, evidence for interventions reducing lower limb pain and injury after intense running was considered weak.

1. Medial Tibial Stress Syndrome

Medial tibial stress syndrome is thought to be a periostitis caused by abnormal traction by the deep flexor and/or soleus muscles. A recent review cautions that histologic studies have failed to provide evidence for periostitis as an underlying etiology. Mismatch between bony resorption and formation with resultant overloading of the tibial cortex is a likely etiology of medial tibial stress syndrome. Anatomic evidence suggests that either the soleus or an aponeurotic band connects the medial soleus to the posteromedial tibia and can impart traction stress to the periosteum when the soleus contracts and stretches.

Figure 1. Medial Tibial Stress Syndrome

Subjects with medial tibial stress syndrome had significantly greater visual analog pain levels and slower gait velocity. Medial tibial stress syndrome is associated with an imbalance of foot pressure (greater on the medial foot), excessive pronation, sudden increase in intensity and/or duration of training, and an uneven training terrain. These factors increase soleus strain by eccentric contraction to resist pronation. In a separate study, decreased hip internal rotation, increased ankle plantar flexion, and positive navicular drop were associated with medial tibial stress syndrome.

2. Noninsertional Achilles Tendinopathy

The gastrocnemius-soleus complex allows the Achilles tendon, the strongest tendon in the body, to absorb tremendous energy before strain injury occurs. The tendon fibers spiral 90° instead of vertically increasing potential elongation and energy production. The tendon can stretch up to 4% before microscopic damage occurs; macroscopic rupture occurs at strain levels greater than 8%. Overuse and lack of flexibility increase tendon strain surpassing the energy-absorbing ability and leading to microtears. Training errors (technique, inappropriate footwear, inconsistent surfaces) are associated with degeneration. Excessive lateral heel strike and compensatory foot pronation can result in uneven force generation from the gastrocnemius and soleus muscles and overloading certain areas of the Achilles tendon. Altered knee kinematics and reduced proximal muscle activity (rectus femoris and gluteus medius) are associated with Achilles tendinopathy.

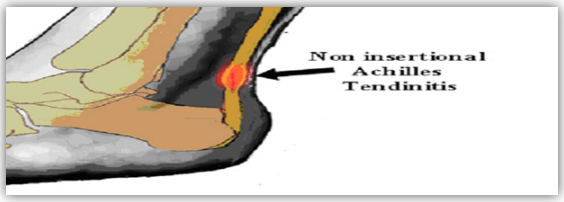


Figure 2. Noninsertional Achilles Tendinopathy.

3. Tibial and Fibular Stress Fractures

The tibial shaft is the most common site of lower extremity stress fracture in runners and accounts for nearly 50% of all stress fractures in athletes. Stress fractures along the anterior cortex are associated with the radiographic "dreaded black line" and sluggish healing often necessitating operative treatment Fibular stress fractures occur less frequently and represent 4.6% to 21% of all athletic stress fractures.

Risk factors for tibial stress fractures in male runners are difficult to predict; low bone mineral density and lean mass in lower limb, menstrual imbalance, and low-fat diet are associated with stress fractures in female runners. Menstrual irregularities and high weekly training mileage place runners at high risk of recurrence. Biomechanical abnormalities (leg-length discrepancy, peak hip adduction, rearfoot eversion angles during stance phase of running) have also been linked to tibial stress fractures in women. Vertical instantaneous load rate and peak knee adduction and internal rotation forces do not appear to play a role in development of tibial stress fractures.

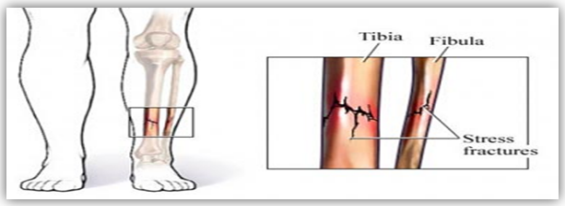


Figure 3. Tibial and Fibular Stress Fractures

4. Gastrocnemius-Soleus Strain/Rupture

The multipennate gastrocnemius and soleus muscles are commonly strained due to their complex structure. The medial head of the gastrocnemius originates from the medial femoral condyle and fuses with the smaller lateral head before joining the soleus aponeurosis to form the Achilles tendon. The gastroc is a "fast action" muscle composed largely of type IIb fibers and spans 2 joints, making it susceptible to strain injuries. The soleus only crosses the ankle joint and consists largely of type I slow-twitch fibers and is less likely to be injured.

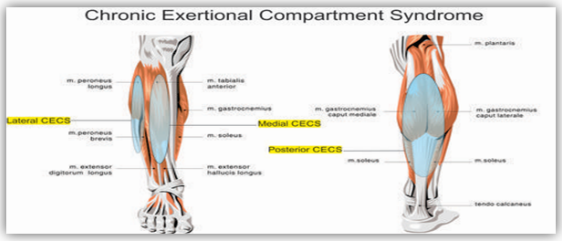
Injury to medial head of the gastrocnemius is caused by sudden dorsiflexion of a plantar flexed foot with the knee in extension or sudden extension of the knee with the ankle dorsiflexed. Running studies indicate that this injury occurs near touchdown and is associated with faster-than-normal running speeds and inappropriate body posture, which causes altered muscle length and shock absorption. The injury has a predilection for the poorly conditioned, middle-aged athlete with "thick calves" who is engaged in strenuous activity.

Figure 4. Gastrocnemius-Soleus Strain/Rupture.

5. Chronic Exertional Compartment Syndrome

During heavy exercise, fluid accumulates within the interstitial space of skeletal muscle, increasing mass up to 20%. The buildup of interstitial fluid combined with limited expansion of the fascial compartments, especially the anterior and lateral leg compartments, may lead to elevated intramuscular pressures, causing capillary occlusion. The decreased blood flow can result in cell hypoxia, increased dependence on anaerobic metabolism, production of lactate, and eventual cell death. Recent studies have failed to link stiffness and thickness of muscle fascia to chronic exertional compartment syndrome. However, low muscle capillary supply is a possible pathogenic factor.

There are limited data on risk factors for chronic exertional compartment syndrome. The mechanism remains elusive though landing style, muscle type composition, and capillary density within skeletal muscle may be contributors.



Conclusion

Chronic exertional compartment syndrome, tibial stress fractures, posteromedial tibial stress syndrome, popliteal artery entrapment syndrome, gastrocnemius-soleus strains/tears, and Achilles tendinopathy are common running ailments. While no clear evidence exists that these injuries can be prevented, most can be treated successfully by considering underlying anatomical and biomechanical causes. The majority of tibial stress fractures, gastrocnemius-soleus strains/tears, Achilles tendinopathy are effectively managed with an appropriate balance of relative rest and therapy. Chronic exertional compartment syndrome and popliteal artery entrapment syndrome, both thought to be caused by anatomic abnormalities, are often remedied by surgical intervention.

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