



Chronic Exertional Compartment Syndrome: *Identification, Causes, and Prevention*

During the past decade the occurrence of Chronic Exertional Compartment Syndrome in U.S. cross country skier athletes has risen. In 2009 the U.S. Ski Team began working with several physicians, physiologists, and physical therapists to determine potential causes, preventative methods, and treatment in an effort to reduce further occurrences within the sport of cross country skiing. This document is created as a starting point to further research.

Definition: Chronic Exertional Compartment Syndrome (CECS) is due to an abnormal and excessive increase in muscle compartment pressure during exercise, which results in muscle pain that ranges from mild to severe, and, occasionally, neurologic symptoms such as numbness, tingling, and weakness. The exact cause of the increased compartment pressure is unknown. Symptoms can occur in one or more of the four or five lower leg compartments and are probably due to a combination of decreased oxygen delivery to muscles and irritation of nerves, although the exact cause of the pain is unknown. The most common compartment to be involved is the anterior lower leg compartment, which is located in the front of the leg next to the shin bone (tibia). Cross-country skiers with CECS of the anterior compartment often experience a “dead leg” sensation in the front of the lower leg that occurs more commonly with the skating technique.

Athlete Risk Group: While exceptions exist, those afflicted with symptoms often fall into a category defined by athletes with muscular builds, with specific reference to the calf muscles. It is often the case that these athletes have very tight calf muscles, and physical imbalances including but not limited to weak hips, inward canting knees, and foot problems such as plantar fasciitis, weak arches, pronation, or supination. These imbalances can be detected with a functional screening by a physical therapist, or by the well-training eye of a coach.

Identifying the Injury: (source: Dr. Jonathan Finnoff, USST / Mayo Clinic)

Self Examination

- Pain with exercise but not with rest = vascular or CECS
- Pain worse with exercise but still present at rest = bone, muscle, tendon
- Pain with neuropathic quality, exacerbated by exercise but may be present at rest = nerve entrapment

Physical Examination

- No tenderness to palpation = vascular or CECS
- Tenderness = bone, muscle, tendon
- Neuropathic pain with palpation or percussion = nerve entrapment

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Chronic Exertional Compartment Syndrome Symptoms:

- Strong desire to remove boots or loosen buckles/laces during exercise
- Diffuse tenderness and possibly a tense swollen appearance of the symptomatic muscles immediately following exercise that resolves with rest
- Inability to flex ankle / drive knees while skiing with intensity
- Inability to turn sharply
- Dead-leg sensation
- Inability to glide sufficiently on a skate ski
- Mild to excruciating pain in the muscles next to the shin (more common) and/or calf pain (less common)

Causes: Athletes may be genetically prone to the condition. Regardless, they can train their bodies in a manner that creates the condition. Causes may include, but are not limited to:

- Tight calf muscles
- Lacking variation in training modes
- Significant changes in equipment, technique, or training volume
- Boots with stiff ankles that limit up and down foot movement
- Heavy skis
- Posture too far forward while skiing
- Biomechanical abnormalities such as weak hips, inward canting knees, and foot problems such as plantar fasciitis and weak arches
- Steep / acute shin angles in the V1 gear, accompanied by static movement or absence of a complete kick / extension of the foot. This may be identified if an athlete has trouble completely shifting their weight to each side in V1
- Unstable or “squirrelly” skating conditions
- Transitioning from dry land training to significant volumes of skiing. A gradual progression is recommended. If that is not possible, increased attention to the below-listed prevention methods is necessary.
- Running with a heavy heel strike
- Running on a flat or downhill surface (anterior compartment syndrome) or uphill surface (posterior compartment syndrome)

Prevention: The U.S. Ski Team recommends that cross country athletes training over 450 annual hours and those within the at-risk group should incorporate preventative methods into their daily training routine. Recommendations include but are not limited to:

- Regular stretching of both the Gastrocnemius and Soleus calf muscles
- Ice baths following intensity sessions, strength, or long runs or roller skis

- Self or professional massage of both calf and shin muscles. A foam roller can be used for the calf muscles, and stick massage rollers are effective for treatment of sore shins. These are also effective warming-up methods
- Thorough warm-up for all dry land and on snow workouts, including active exercise, and stretching / self-massage
- With regards to technique, static positions are very hard on the muscles, and may lead to muscle swelling and decreased blood flow. To prevent this, practice active, fluid movements. In skating, be sure to completely finish the final portion of the kick in order to release the affected muscles. Finishing the kick should provide the musculature with a short recovery phase. Consider a wider foot stance that initiates an immediate and active kick and weight transfer as well.

Diagnosis: CECS is diagnosed by performing compartment pressure testing before and after exercise. Compartment pressure testing involves placing a needle attached to a pressure transducer into the effected compartment. It is important to remember that many different diagnoses can mimic CECS. Therefore, a thorough evaluation to determine what is causing the leg pain is required.

Treatment: Patients with CECS are often sent immediately to surgery without exploring the underlying cause of the condition. While the operation can be successful, if biomechanical and/or training risk factors that contributed to the development of the condition are not identified and addressed, the CECS will often return. Therefore, even if an athlete opts for surgical treatment, it is important to identify and correct risk factors to prevent recurrence.

The non-surgical treatments for CECS are the same as the prevention methods described earlier. It is recommended that all non-surgical options be exhausted with the professional help of a physical therapist before considering surgery.