

## Rehabilitation Guidelines Following Compartment Syndrome Release With Open Fasciotomy

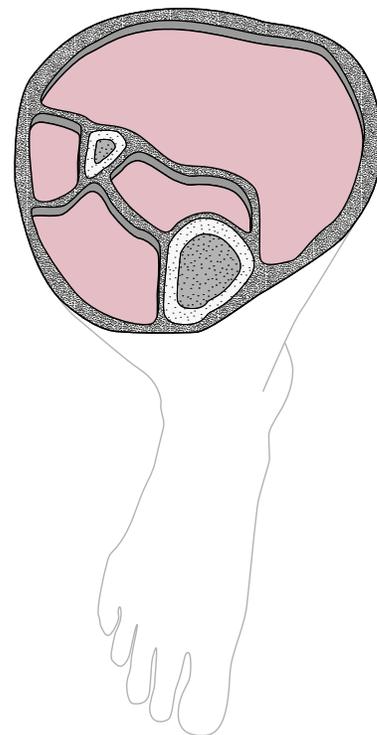
Chronic Exertional Compartment Syndrome (CECS) is a painful condition of the lower leg that affects many runners and other athletes involved in repetitive impact activities. The pain associated with this condition is thought to be abnormal pressure in the compartments of the lower leg. The lower leg is comprised of four universally described compartments— anterior, lateral, superficial posterior, and deep posterior (Figure 1). Bone and connective tissue structures define the various compartments in the lower leg. The compartments have relatively fixed volumes and surround muscles, arteries, veins and nerves.

Compartment syndrome occurs when increased pressure impedes blood flow impairing function of tissues within the lower leg. Unlike acute compartment syndrome, CECS is non-emergent. CECS is a reversible form of abnormally increased pressure in the compartment that occurs during exercise/exertion of tissues that are noncompliant with increased muscle volume during exercise. The exact physiological cause of CECS remains unclear but it is thought to be multifactorial. Contributors to CECS may include: increased muscle size, connective tissue thickness or stiffness, decreased blood flow, and microtraumatic injuries.<sup>3</sup> Factors inherent to the individual may

include leg length differences and malalignment of the lower leg. Other factors may include: muscle imbalances or weakness, lack of endurance, decreased flexibility, incorrect movement control patterns and training intensity or frequency.

The incidence of CECS in those with chronic exercise-induced leg pain ranges from 14-27%. 70% of patients with CECS in the anterior compartment are runners. The condition is nearly evenly split between males and females. CECS has been reported in the forearm, thigh, hand and foot. However 95% of cases occur in the lower leg. Symptoms in both legs occur in 85-95% of those affected.

Those affected with CECS often complain of dull, aching, or cramping pain localized to the compartment affected in the lower extremity at the same duration of time (minutes) following the initiation of each episode of exercise. Confirmation of the diagnosis is made with needle compartmental pressure testing at rest and following exercise. If rehabilitation is unsuccessful, surgical management may be the treatment choice for CECS in the active population. Specifics of surgical decompression vary, but many include: open fasciotomies or fasciotomies with partial fasciectomy. An open fasciotomy typically involves 1-2 large incisions where connective/



**Figure 1** Lower leg compartments

fascial tissue is cut. A partial fasciectomy describes a procedure in which a portion of the connective tissue/fascia is removed. Surgical treatment can be performed as an outpatient procedure under local anesthesia. A carefully planned and implemented rehabilitation program is important for a patient to achieve optimal functional outcomes post-operatively.

## Rehabilitation Guidelines Following Compartment Syndrome Release With Open Fasciotomy

### PHASE I (surgery to 4 weeks after surgery)

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Appointments</b>                   | <ul style="list-style-type: none"> <li>• Rehabilitation appointments begin within 5 days of surgery and continue 1 time per week for 4 visits</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Rehabilitation Goals</b>           | <ul style="list-style-type: none"> <li>• Administer Foot and Ankle Ability Measure (FAAM) both activities of daily living (ADL) and sport subscale</li> <li>• Protection of the post-surgical compartment</li> <li>• Minimize postoperative swelling; lower extremity circumference measurements at proximal and distal incisions. Subsequent measurements should not increase more than 0.5cm per session</li> <li>• Instruction in safe positioning and limb self-management</li> <li>• Restore normal knee and ankle range of motion (ROM)</li> <li>• Able to lift leg involved leg in all directions in standing without pain or compensation</li> <li>• Restore ability to control leg in open and closed kinetic chain during gait</li> <li>• Normal gait after 3 weeks of using boot</li> </ul> |
| <b>Precautions</b>                    | <ul style="list-style-type: none"> <li>• Use auxillary crutches for 2 weeks with non-weight bearing (NWB) status. Week 3 walking boot with weight bearing as tolerated (WBAT) and assistive device as needed</li> <li>• Dr. Scerpella patients wear a splint for the first 4-7 days post-operatively while using crutches and NWB</li> <li>• Avoid any activity which causes increased swelling</li> <li>• Avoid any friction on new scar</li> <li>• Avoid any impact activity including running, jumping or hopping</li> </ul>                                                                                                                                                                                                                                                                        |
| <b>Suggested Therapeutic Exercise</b> | <ul style="list-style-type: none"> <li>• Passive range of motion (PROM) of ankle starts 5 days post op once transitioned to walking boot</li> <li>• Quadriceps sets</li> <li>• Leg lifts for hip strength</li> <li>• Elevation, compression and icing, as needed, for swelling control</li> <li>• Active muscle pumping for swelling control</li> <li>• Gentle distal-to-proximal massage to assist with venous return and swelling</li> </ul>                                                                                                                                                                                                                                                                                                                                                         |
| <b>Cardiovascular Exercise</b>        | <ul style="list-style-type: none"> <li>• Upper body circuit training or upper body ergometer (UGE), as able</li> <li>• Begin with 5-10 minutes, 1-2 times/day, and progress as able</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Progression Criteria</b>           | <ul style="list-style-type: none"> <li>• Patient may progress to Phase II after meeting Phase I goals</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

## Rehabilitation Guidelines Following Compartment Syndrome Release With Open Fasciotomy

### PHASE II (begin after meeting Phase I criteria, usually 3-4 weeks after surgery)

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Appointments</b>                   | <ul style="list-style-type: none"> <li>• Rehabilitation appointments are 1 time per week on average</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Rehabilitation Goals</b>           | <ul style="list-style-type: none"> <li>• Lower extremity circumference within 1 cm of uninvolved side</li> <li>• Incision well healed</li> <li>• Minimize muscle atrophy and flexibility deficits in involved compartment</li> <li>• Single leg stance control with eyes open</li> <li>• Full flexibility/mobility of gastrocnemius/ankle</li> <li>• Maintain motion and strength of uninvolved muscle groups, as well as cardiovascular endurance</li> <li>• Perform active or gentle resisted exercises of the hip of the operated lower extremity and resistance exercises of the upper extremities</li> <li>• Proper lower extremity control and alignment with no pain during functional double leg squats</li> <li>• Non-antalgic gait on level surface with full weight bearing and no assistive device</li> <li>• 8 point (or greater) improvement on ADL portion of the baseline FAAM</li> </ul> |
| <b>Precautions</b>                    | <ul style="list-style-type: none"> <li>• Avoid over-stressing new scar formation by avoiding any friction over tissue (as per Phase I)</li> <li>• Avoid post-activity swelling by limiting prolonged weight bearing activity as appropriate; if swelling occurs, manage with rest, ice, elevation and compression (as per Phase I)</li> <li>• Avoid eccentric loading</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Suggested Therapeutic Exercise</b> | <ul style="list-style-type: none"> <li>• Scar massage/mobility and desensitization</li> <li>• Gentle stretching and nerve mobilizations to tissue in involved compartment.</li> <li>• No cross friction massage over incision</li> <li>• Progress open kinetic chain ankle strengthening, as tolerated</li> <li>• Balance and proprioception exercises: progression of bilateral to unilateral balance activities first on a level, firm surface, then on a soft/unstable surface</li> <li>• Gait drills: begin with sagittal plane and progress to frontal and transverse planes</li> </ul>                                                                                                                                                                                                                                                                                                              |
| <b>Cardiovascular Exercise</b>        | <ul style="list-style-type: none"> <li>• Upper body circuit training, UBE (as per Phase I)</li> <li>• May begin stationary bike if wound is healed</li> <li>• Begin treadmill or track walking if wound is healed; progress time and speed, as able</li> <li>• May swim or water walk if wound is FULLY healed</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Progression Criteria</b>           | <ul style="list-style-type: none"> <li>• Patient may progress to Phase III if Phase II goals are met</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Rehabilitation Guidelines Following Compartment Syndrome Release With Open Fasciotomy

### PHASE III (begin after meeting Phase II criteria, usually 6-8 weeks after surgery)

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Appointments</b>                   | <ul style="list-style-type: none"> <li>• Rehabilitation appointments are once every 7-10 days</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Rehabilitation Goals</b>           | <ul style="list-style-type: none"> <li>• Prevent post-operative recurrence of symptoms with all activity</li> <li>• Tolerate 15-30 minutes of continuous aerobic activity without the onset of symptoms/pain</li> <li>• Reinforce self-monitoring and review signs of recurrence and complications</li> <li>• Norman (rated 5/5) ankle strength and pain free</li> <li>• Proper lower extremity control and alignment and no pain with single leg functional movements including squats and lunges</li> <li>• No residual swelling 12-24 hours following all physical activity (including impact exercises)</li> <li>• No pain 1-2 hours following physical activity (including impact exercises)</li> </ul>                                                                                          |
| <b>Precautions</b>                    | <ul style="list-style-type: none"> <li>• Avoid friction over scar tissue (as per Phases I and II)</li> <li>• Avoid post-activity swelling (as per Phases I and II)</li> <li>• No strenuous activity until wound is fully healed</li> <li>• No running until 8 weeks post-operative (patient should be advised by sports rehabilitation provider or physician prior to initiation of any running)</li> <li>• Avoid pain with any exertional activity</li> </ul>                                                                                                                                                                                                                                                                                                                                        |
| <b>Suggested Therapeutic Exercise</b> | <ul style="list-style-type: none"> <li>• Lower extremity stretching and nerve mobilizations as appropriate (as per Phase II)</li> <li>• Lower extremity myofascial stretching/foam rolling</li> <li>• Progression of lower extremity closed chain functional strengthening including lunges, step-backs and single leg squats</li> <li>• Progress heel rise to single leg</li> <li>• Progress gait drills</li> <li>• Initiate plyometric exercises (with focus on lower extremity control and alignment at hip, knee and ankle) at 7 weeks. If no increased swelling, can initiate agility ladder impact. Then begin with 2 feet to 2 feet (jumping) progressing from 1 foot to other (leaping) and then 1 foot to same foot (hopping); and focus on proper landing/deceleration mechanics</li> </ul> |
| <b>Cardiovascular Exercise</b>        | <ul style="list-style-type: none"> <li>• Initiate or progress swimming or water walking if wound is fully healed (as per Phase II)</li> <li>• Progress walking time and speed (as per Phase II)</li> <li>• May begin elliptical trainer, as tolerated</li> <li>• Light jogging can be initiated at 8 weeks; initially begin on level surface while avoiding hills and speed work; runners should consider interval training involving walking; progress jog interval times, incline, and speed as appropriate for return to sport/activity goals; and for those returning to multi-planar sport, consider progression of multiplanar activity</li> </ul>                                                                                                                                              |
| <b>Progression Criteria</b>           | <ul style="list-style-type: none"> <li>• Patient may progress to Phase IV after meeting Phase III goals</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Rehabilitation Guidelines Following Compartment Syndrome Release With Open Fasciotomy

### PHASE IV (begin after meeting Phase III criteria, approximately 8-12 weeks after surgery)

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Appointments</b>                   | <ul style="list-style-type: none"> <li>• Rehabilitation appointments are 1 time every 2-3 weeks</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Rehabilitation Goals</b>           | <ul style="list-style-type: none"> <li>• Administer ADL and sport subscales on the FAAM prior to discontinuation of rehabilitation</li> <li>• 9 point (or greater) improvement on the sport subscale portion of the baseline FAAM</li> <li>• Proper dynamic neuromuscular control and alignment with eccentric and concentric multi-plane activities (including impact) for return to sport/work, without pain, instability or swelling</li> <li>• Within 90% of pain free plantarflexion and dorsiflexion strength</li> </ul>                                                                                                                                                                                                                                                                                        |
| <b>Precautions</b>                    | <ul style="list-style-type: none"> <li>• Avoid pain with any exertional activity</li> <li>• Avoid post-activity swelling (as per Phases I, II and III)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Suggested Therapeutic Exercise</b> | <ul style="list-style-type: none"> <li>• Biomechanical assessment of specific sport activity with video analysis as needed (running, biking, etc.)</li> <li>• Instruct in proper return to activity progression (incremental running, biking, etc.)</li> <li>• Progressive strengthening exercises using higher stability and neuromuscular control with increased loads, speeds and combined movement patterns; begin with low velocity, single plane activities and progress to higher velocity, multi-plane activities. Begin with forward and backward, progress to side-to-side, diagonals and transverse plane movements</li> <li>• Integrate movements and positions into exercises that simulate functional activities and initiate sport-specific training with low-intensity simulated movements</li> </ul> |
| <b>Cardiovascular Exercise</b>        | <ul style="list-style-type: none"> <li>• Replicate sport/work specific energy demands</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Progression Criteria</b>           | <ul style="list-style-type: none"> <li>• Patient may return to sport/work if they have met the above stated goals and have approval from the sports rehabilitation provider or physician</li> <li>• Precautions to reduce the risk of re-injury when returning to sports or high-demand activities, as appropriate. For collision/contact sport, may consider protective padding over area of scar tissue</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                  |

These rehabilitation guidelines were developed collaboratively by UW Health Sports Rehabilitation and the UW Health Sports Medicine Physician group.

Updated 2/2018

## REFERENCES

1. Styf, J. Definitions and terminology. Etiology and pathogenesis of chronic compartment syndrome. In: *Compartment syndromes: diagnosis, treatment, and complications*. 2004. Boca Raton, FL. CRC Press LLC.
2. Wilder, RP. Exertional compartment syndrome. *Clin Sports Med*. 2010;29:429-435.
3. Lecocq J, Isner-Horobeti ME, Dupeyron A, et al. Exertional compartment syndrome. *Ann Readapt Med Phys*. 2004;47:334-345.
4. Anuar K, Gurumoorthy P. Systematic review of the management of chronic compartment syndrome in the lower leg. *Physiotherapy Singapore*. 2006; 9:2-15.
5. Turnipseed WD, Hurschler C, Vanderby R Jr. The effects of elevated compartment pressure on tibial arteriovenous flow and relationship of mechanical and biochemical characteristics of fascia to genesis of chronic anterior compartment syndrome. *J Vasc Surg*. 1995;21:810-816. Anuar K, Gurumoorthy P. Systematic review of the management of chronic compartment syndrome in the lower leg. *Physiotherapy Singapore*. 2006; 9:2-15.
6. Bong MR, Polatsch DB, et al. Chronic exertional compartment syndrome: diagnosis and management. *Bulletin of NYU Hosp for Jt Diseases*. Winter-Spring 2005.
7. Shah SN, Miller BS, Kuhn JE. Chronic exertional compartment syndrome. *Am Jour Ortho*. 2004;335-341.
8. Gill CS, Halstead ME, Matava MJ. Chronic exertional compartment syndrome of the leg in athletes: evaluation and management. *Physician and Sportsmed*. 2010;38:1-7.
9. Wittstein J, Moorman CT III, Levin LS. Endoscopic compartment release for chronic exertional compartment syndrome. *Am Jour Sports Med*. 2010;20:1-6.
10. Hutchinson MR, Lloyd Ireland M. Common compartment syndromes in athletes: treatment and rehabilitation. *Sports Med*. 1994;17:200-208.
11. Kisner, C, Colby LA. Surgical interventions and postoperative management, the ankle and foot. In: *Therapeutic Exercise: Foundations and Techniques*. 5th Edition. 2007. Philadelphia, PA. F. A. Davis Company.
12. Schubert, AG. Exertional Compartment Syndrome: Review of the Literature and Proposed Rehabilitation Guidelines Following Surgical Release. *Intern Jour Sports Phys Ther*. 2011; 6: 126-141.

At UW Health, patients may have advanced diagnostic and /or treatment options, or may receive educational materials that vary from this information. Please be aware that this information is not intended to replace the care or advice given by your physician or health care provider. It is neither intended nor implied to be a substitute for professional advice. Call your health provider immediately if you think you may have a medical emergency. Always seek the advice of your physician or other qualified health provider prior to starting any new treatment or with any question you may have regarding a medical condition.

©Copyright 2018 UW Health Sports Medicine