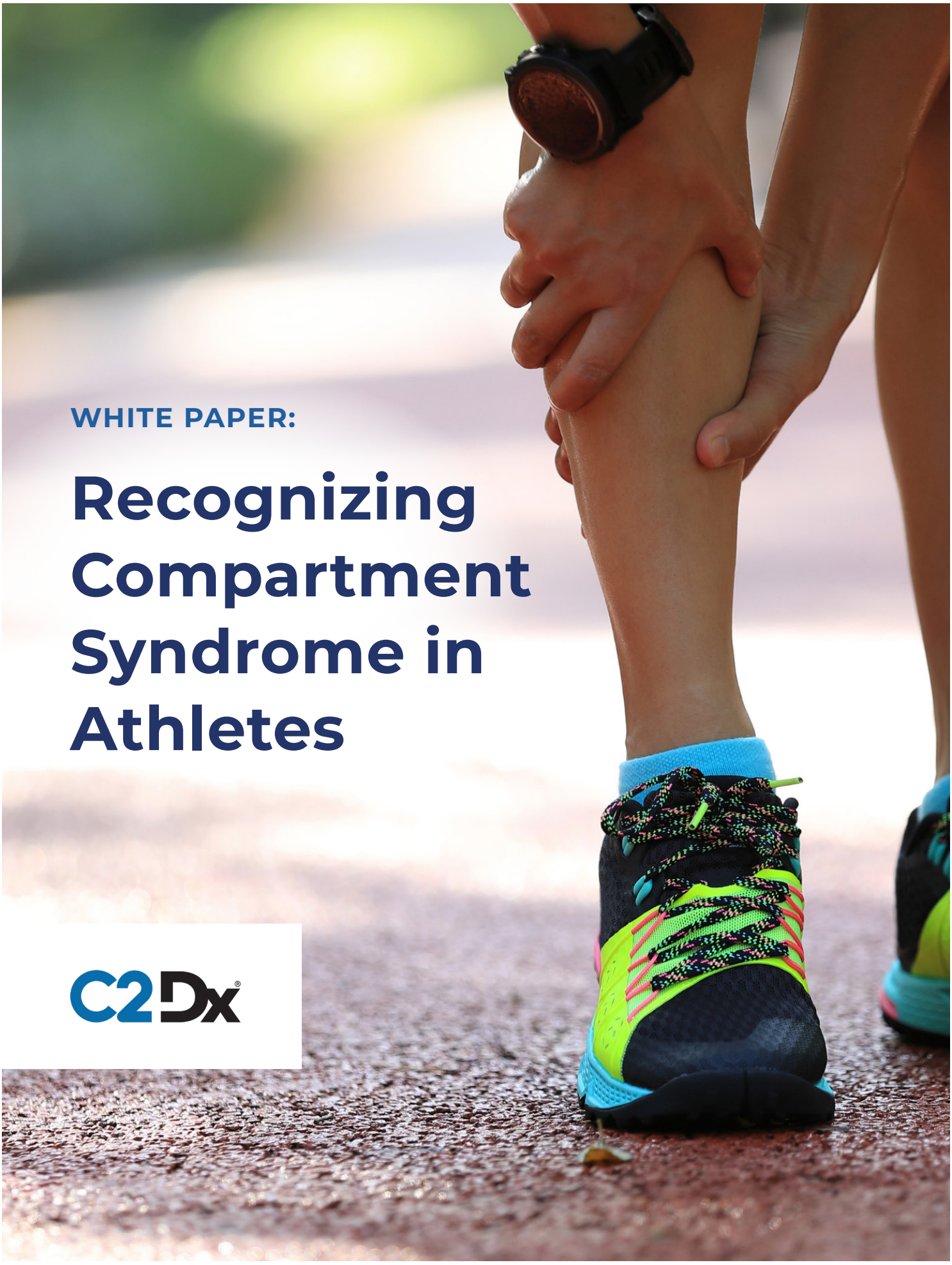

WHITE PAPER:

Recognizing Compartment Syndrome in Athletes

C2Dx®

The Challenge: Chronic Exertional Compartment Syndrome is a serious and painful injury that is often overlooked or misdiagnosed in athletes resulting in prolonged recovery, surgery, or a career-ending diagnosis.

Chronic Exertional Compartment Syndrome (CECS) is a disorder that most orthopedic surgeons and sports medicine specialists will likely encounter during their careers. It is a painful and potentially serious condition that can sideline an athlete or end their sporting career altogether.

Despite this, CECS is often misdiagnosed or overlooked for various reasons.

In a clinical study published in the International Journal of Sports Physical, an 18-year-old Division II student athlete on a women's field hockey team experienced a 3-year history of bilateral chronic lower leg pain with symptoms that included a dull ache, cramping, and elevated pain after running. After visiting the orthopedic surgeon and sports medicine specialists, the subject was diagnosed with "shin splints" or medial tibial stress syndrome. The patient was subsequently diagnosed with CECS and underwent a surgical fasciotomy. [1]

Awareness, early suspicion, and testing are needed to improve the high incidence of the delay in diagnosis. Practitioners of orthopedics, sports medicine, and therapy-related fields need to be conscious of the symptoms and effects of compartment syndrome to increase the chances of a quick recovery for patients.

Sources:

(1) https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC3924616/

Symptoms & Risk Factors:

With exertional compartment syndrome, anyone can develop the condition, but it's more commonly found in young athletes who participate in sports that involve repetitive impact.

The condition is caused by continual overexertion and usually affects those involved in endurance sports such as running, soccer, lacrosse, or football. Men and women can be equally affected. The lower leg is the most common area for compartment syndrome to develop with the forearm accounting for the next most common location.

CECS commonly occurs in the lower legs, bilateral 85% to 95% of the time, and occurs most often in running athletes. It is typically characterized by calf pain shortly after the initiation of exercise and resolution of the pain soon after rest.

Signs and symptoms can include:

- ☐ **Aching, burning, or cramping pain in a compartment of the affected limb**
- ☐ **Tightness in the affected limb**
- ☐ **Numbness or tingling in the affected limb**
- ☐ **Weakness of the affected limb**
- ☐ **Foot drop, in severe cases, if legs are affected**
- ☐ **Occasionally, swelling or bulging as a result of a muscle hernia**

Pain caused by chronic exertional compartment syndrome typically begins consistently following a certain time, distance, or intensity of exertion after an athlete starts exercising the affected limb. The pain progressively worsens with exercise, and it becomes less intense or stops completely within 15 minutes of stopping the activity.

Because CECS is a condition associated with sports-related injuries, athletes commonly report pushing through the pain until it becomes unbearable. It is not unusual for athletes to experience pain for months before seeking medical help. Often, the ER is the first point of contact for patients who then may be directed to physical therapy or a sports medicine practitioner. (1)

Non-surgical treatment, including activity modification may be effective. If not, successful treatment of compartment syndrome may require surgical decompression by performing a compartment fasciotomy. Surgery is successful for many people and might allow the patient to return to their sport. (2)

Sources:

(1) https://www.webmd.com/pain-management/guide/compartment-syndrome-causes-treatmentsh

(2) https://www.mayoclinic.org/diseases-conditions/chronic-exertional-compartment-syndrome/symptoms-causes/syc-20350830

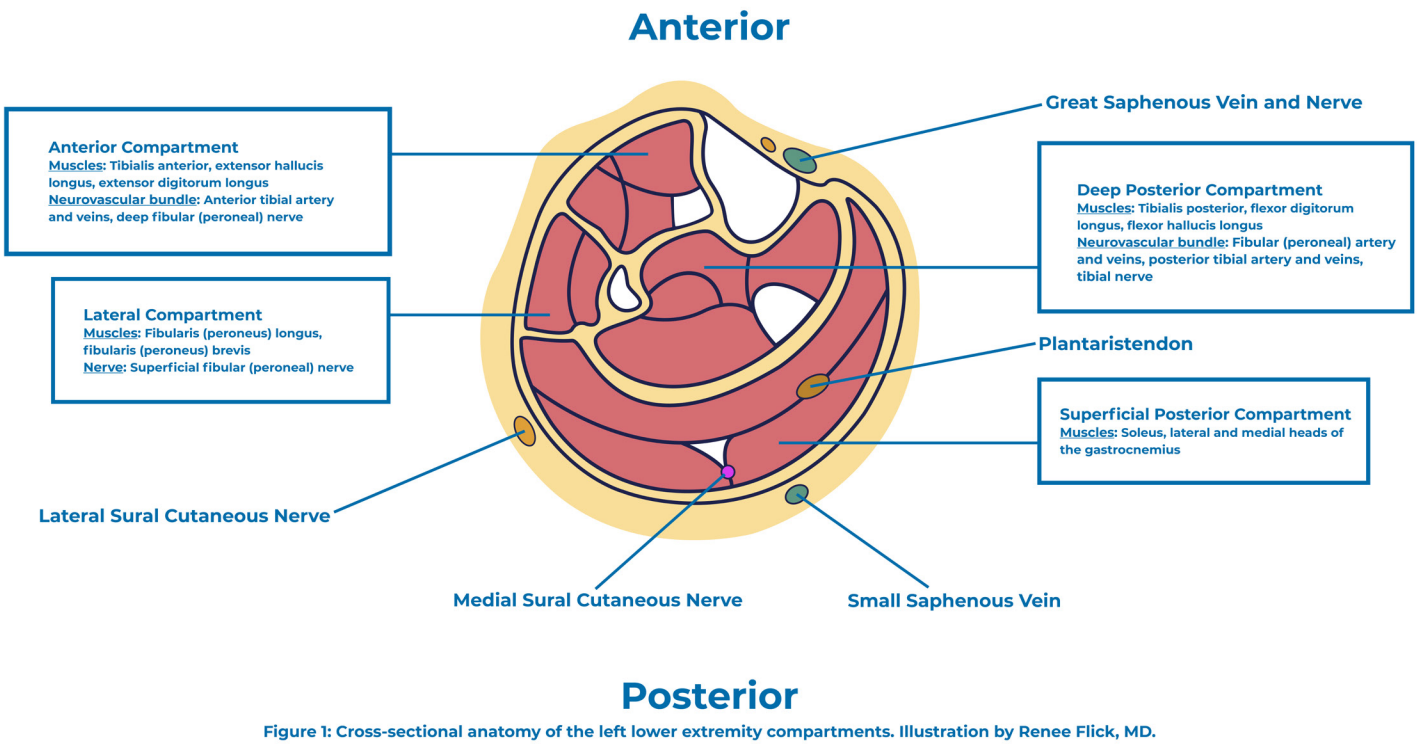

Figure 1: Cross-sectional anatomy of the left lower extremity compartments. Illustration by Renee Flick, MD.

Factors Contributing to Delays in Diagnosis

Compartment syndrome is a clinical diagnosis that is generally made as symptoms evolve rather than a diagnosis after a single evaluation.

CECS diagnosis may be delayed or missed entirely due to the lack of familiarity around compartment syndrome and the immediate pain attribution to other conditions. There is also an ambiguity of the clinical signs presented. (1)

In many cases, pain in the lower legs is believed to be shin splints, stress fractures, a pulled muscle, or other soft tissue damage. The initial treatment therefore may be time off for rest, and recovery. After the patient has completed recovery and still experiences unresolved pain, only then does it become clear that something more severe may be occurring. This is particularly true when there is any inconsistency between the significance of pain and the extent of the perceived injury. (2)

In one example published by the National Center for Biotechnology Information, a 13-year-old female competitive figure skater originally presented to physical therapy with right calf pain that had started about two months prior. Her initial therapy included wearing a walking boot for three weeks and progressing back into skating. When the pain never fully resolved and then intensified after returning to training, she was instructed to wear the walking boot for another three weeks and halt all training. After five and a half months since her initial report of pain, her patient evaluation data showed a consistent increase in symptoms that led to suspicion of chronic exertional compartment syndrome. (3)

Sources:

(1) https://www.webmd.com/pain-management/guide/compartment-syndrome-causes-treatments

(2) https://www.webmd.com/pain-management/guide/compartment-syndrome-causes-treatments

(3) https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC6822883/)

A common method used is a treadmill test combined with a pressure monitoring tool. According to established criteria, at least one of the three conditions should exist to diagnose CECS:

- ✓ Pre-exercise compartment pressure less than or equal to 15 mm Hg with borderline pressures from 16 to 24 mm Hg [1]
- ✓ One minute post-exercise compartment pressure of greater than or equal to 30 mm Hg
- ✓ Or a five-minute post-exercise compartment pressure of 20 mm Hg [2]

By measuring the compartment pressure of the patient before and after the patient exercises, the physician receives a definitive pressure measurement.

Persistent and recurrent symptoms of leg pain, cramping, and tightness in any athlete should raise awareness of underlying chronic exertional compartment syndrome (CECS) and warrant early intra-compartmental pressure measurements using a pressure monitor for an effective diagnosis. [3]

One element that must be present in a chronic exertional compartment syndrome diagnosis is an increase in the patient's tissue pressure.

Sources:

(1) Chronic Exertional Compartment Syndrome Testing, David Flick, MD, Renee Flick, MD, 2015

(2) Pedowitz R.A., Hargens A.R., Mubarak S.J., Gershuni D.H. Modified criteria for the objective diagnosis of chronic compartment syndrome of the leg. Am J Sports Med. 1990;18(1):35–40. [PubMed] [Google Scholar]

(3) https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC3924616/

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The STIC Intra-Compartmental Pressure Monitor has more than 30 years of trusted clinical history behind the brand.

The Trusted Solution

The STIC Intra-Compartmental Pressure Monitor brings valuable data to clinical assessments. Formerly made by Stryker and now available through C2Dx, STIC is recognized as the gold standard in intra-compartmental pressure monitoring devices.

Utilizing the Indwelling Slit Catheter Method, the STIC Monitor provides quick and continuous readings of intra-compartmental pressure for up to 24 hours and contains a side-ported needle for proven accuracy.

A medical study from Joseph Bowen, M.D. concluded that the side-ported needles and slit catheters are more accurate than straight needles for the measurement of compartment syndrome. (1)

STIC software enhancements include:
A self-diagnostics feature that runs a test every time the device is turned on to validate it's working properly.

Stored zero function, which preserves zero when power is lost, making continuous monitoring easier.

The STIC monitor is available at a low initial purchase price, allowing hospitals, clinics, or private practices to purchase multiple units.

For the best recovery outcomes, ensure that you have pressure monitoring equipment that's up-to-date and readily available. Pressure monitoring technology has advanced over the last 15 years, with newer models bringing added benefits of enhanced accuracy and ease-of-use.

The latest STIC enhancements include:

- A self-diagnostics feature that runs a test every time the device is turned on to validate it's working properly.
- Stored zero function, which preserves zero when power is lost, making continuous monitoring easier.
- Diaphragm chamber maintains sterile fluid pathway.

Sources:

(1) Jospeh Bowen MD Study

About C2Dx

C2Dx was formed in early 2019 when we took over the STIC Intra-Compartmental Pressure Monitoring System from Stryker. We are proud to carry on the legacy of the gold standard pressure monitor used to aid in the diagnosis of compartment syndrome with a commitment to our customers and our products.

Contact CD2x to learn more about how to recognize compartment syndrome and to schedule a demonstration of The STIC Intra-Compartmental Pressure Monitoring System.

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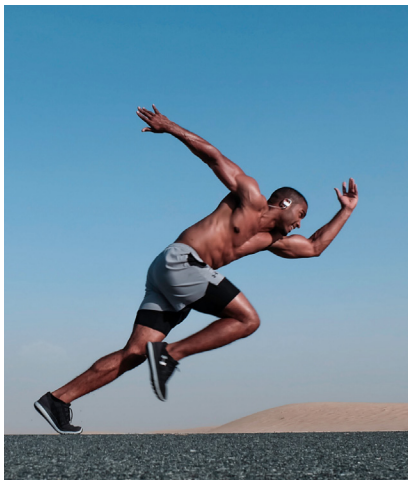

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