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Comprehension Review

Diagnostic Imaging of the Chronic Exertional Compartment Syndrome in the Lower Extremities. Two Steps MRI Imaging for an Accurate Diagnosis

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Definition

- Chronic exertional compartment syndrome (CECS) is defined as reversible ischemia within a closed fibro-osseous space, which leads to decreased tissue perfusion and ischemic pain.
- It is often recurrent and associated with repetitive physical activity.
- Pain symptoms occur during physical activity Tissues became tight and painful.
- The pain disappears quickly with rest.

Objectives of the Study

- Provide guidance on how to perform an MRI study in a patient with a CECS clinic.
- Show MRI findings in compartment syndrome.
- Demonstrate the clinical-radiological correlation.

Epidemiology

- Chronic exertional compartment syndrome (CECS) may present at any age and at any level of activity, with no clear sex predilection.
- High incidence in runner as well as athletes in jumping and cutting sports.
- 70 - 80% bilateral.

CECS in different activities

Runners

Militaries

Soccer

Rowing

Motorcycling.

Figure A

Epidemiology

- The area most commonly affected by CECS is the lower leg. It can also occur in other locations and has been described in the thigh and forearm, however, the clinical features, diagnosis, and treatment strategies are similar for all locations.
- 95% lower 5% forearm.

Mean age 24 years old.

Figure B

Lower leg.

Figure C

Anatomy lower leg

The lower leg is divided into 4 compartments: anterior, lateral, superficial posterior, and deep posterior.

Figure D

Anterior: Affected Compartment

Lateral: Anterior 45% (Most Common)

Superficial posterior: Deep Posterior 40%

Deep posterior: Lateral 10%, Superficial Posterior 5.

Chronic Exertional Compartment Syndrome. Christopher A. George, MD, Mark R. Hutchinson, MD* Department of Orthopaedic Surgery, University of Illinois Hospital at Chicago, 835 South Wolcott Avenue, M/C 844, Chicago, IL 60612, USA. Clin Sports Med 31 (2012) 307-319.

Physiopathology

- Recruitment of muscle fibers during activity results in increased interstitial water content, which leads o localized increased T1 and T2 relaxation times. In the normal patient, this increased muscular water content is transient, returning to normal within minutes, but in patients with CECS, there is a delay in the muscular egress of water. The degree of abnormal T2 signal correlates well with increased intracompartmental.
- The anterior and lateral compartments of the leg are most commonly affected [1,2].

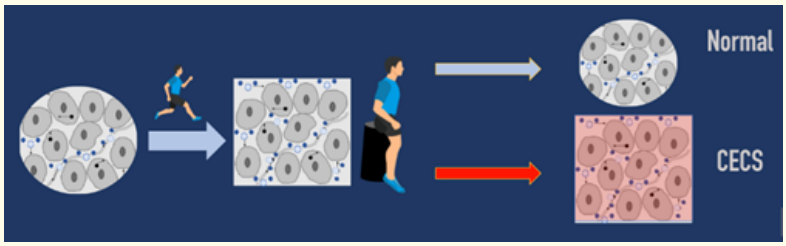

Figure E

Physiopathology

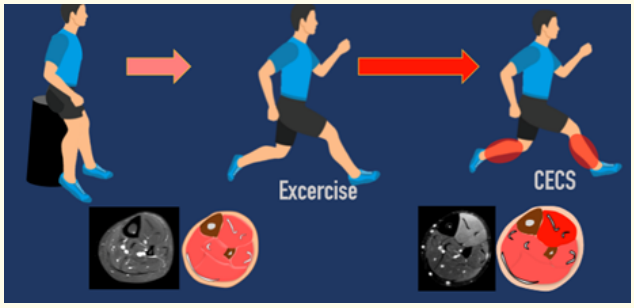

Figure F

Diagnosis

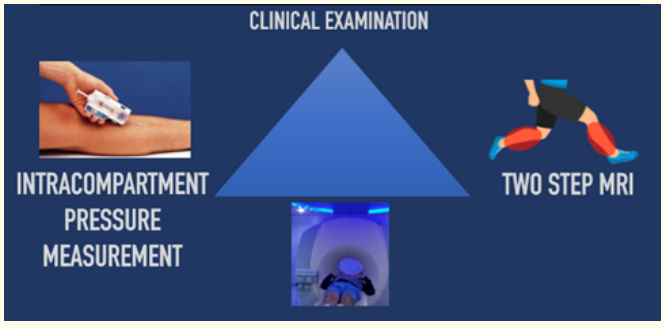

Figure G

Clinical examination

- Pain symptoms occur during physical activity
- Tissues became tight and painful

- The pain disappears quickly with rest
- It is often recurrent and associated with repetitive physical activity.

Intracompartmental pressure measurement

The pressure criteria described by Pedowitz and colleagues:

- A resting, pre-exercise pressure greater than or equal to 15 mm Hg; 1-minute postexercise pressure greater than or equal to 30 mm Hg; 5-minute postexercise pressure greater than or equal to 20 mm Hg.
- Critical compartment ischemia occurs when the compartment pressure increases to within 20 mm Hg of the diastolic pressure.
- The pressure may remain elevated for 30 minutes or longer in patients with CECS.

This could explain why we should wait until 20 minutes for our final MRI imaging, so as to search the delayed increased T2 signal which appears in CECS.

MRI protocol

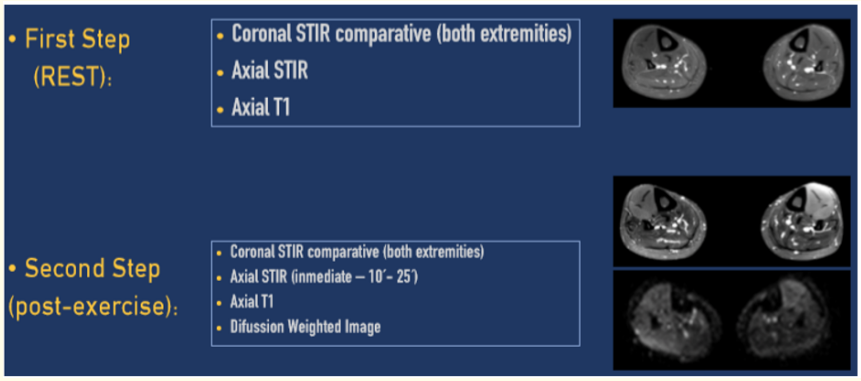

Figure H

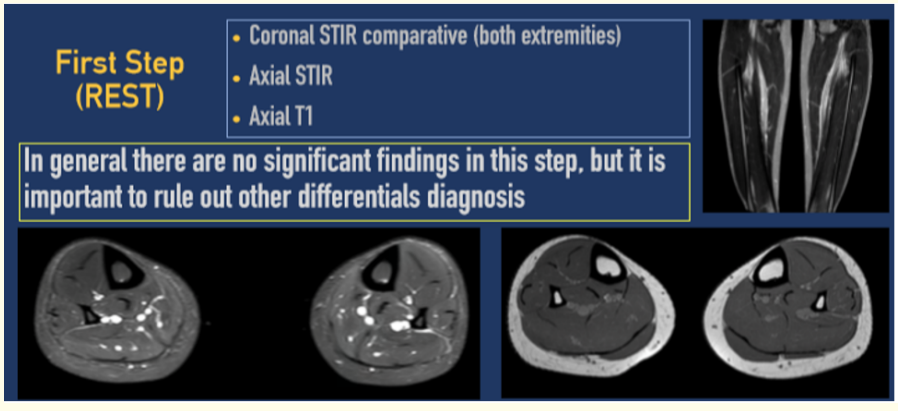

Figure I

Exercise (Muscle activation)

The goal is to replicate the activity that generates more pain, being essential that the patient attend wearing comfortable sportswear. Once the pain is on its peak, the second step imaging protocol begins.

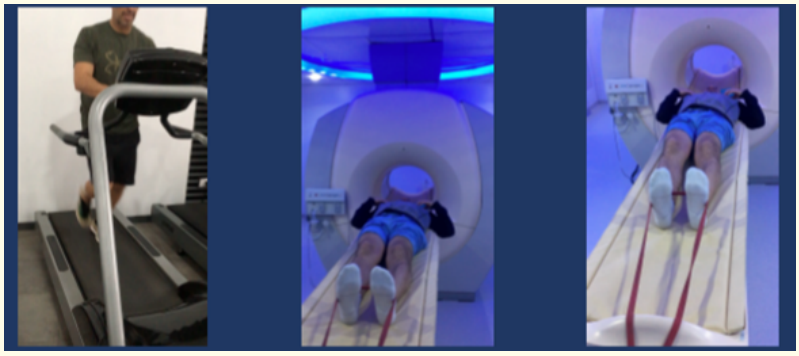

Figure J

MRI protocol

Second Step (post-exercise)

- Increment in T2-weighted signal in the affected muscular compartment (muscle edema) in step II images.
- Fascial swelling may or may not be present
- No bone marrow edema.

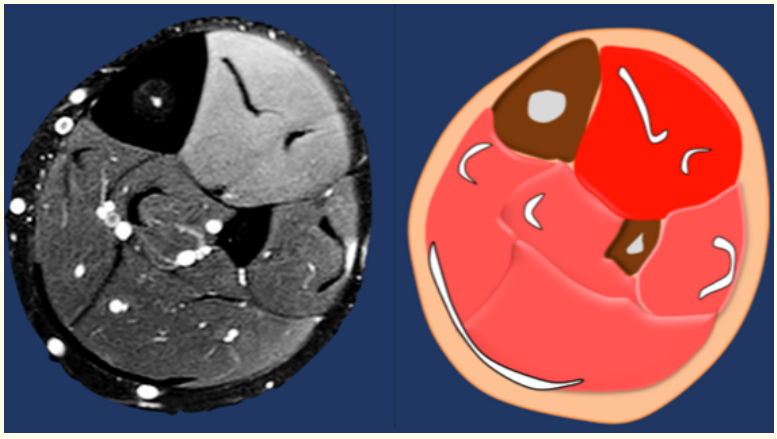

Figure 1: *Patient with CECS clinical diagnosis with compartment pressure of 70 mm Hg, showing muscle edema after exercise in the anterior compartment.*

MRI findings

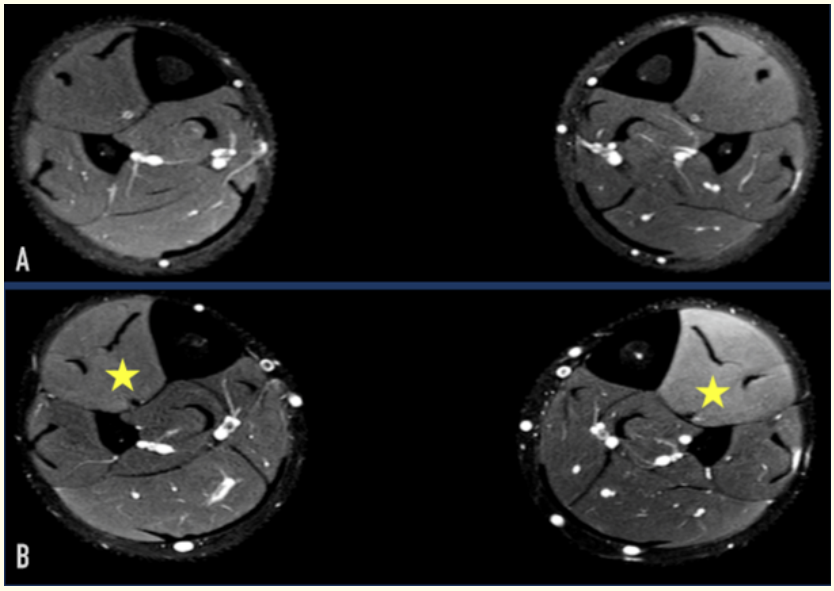

Figure 2: *Axial DP FS MR. 19 years old soccer player with pain in the anterolateral compartment of both legs during physical activity. A. MR Images at rest, show no abnormalities. B. Images MR after exercise show signal increase in the muscles (star).*

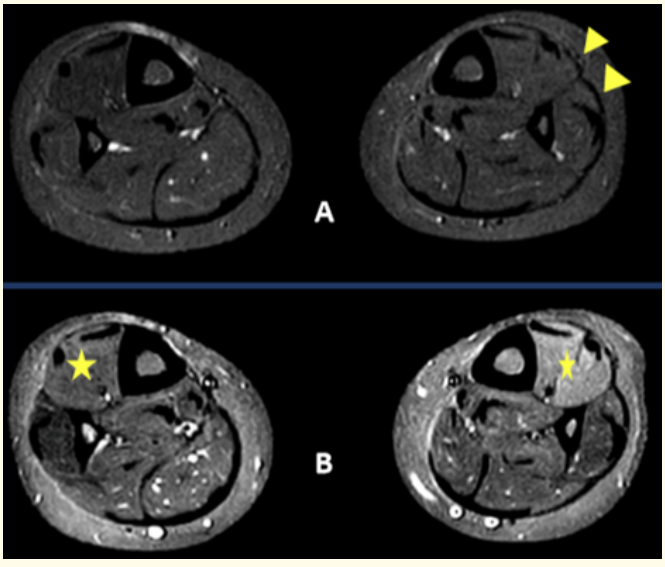

Figure 3: *Axial STIR MR. 22 years old soccer player with pain in the anterolateral compartment of both leg during physical activity, predominately on left side. A. MR Images at rest, show slight thickening of superficial aponeurosis (arrow head). B. Images MR after exercise show signal increase of the anterolateral compartment of legs, that indicates muscle.*

Role of DWI

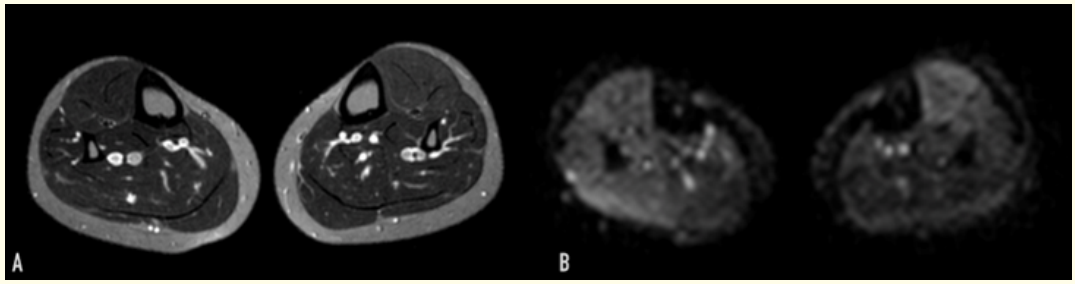

Figure K

Differential diagnosis

- Medial tibial stress syndrome
- Stress fracture
- Peripheral nerve entrapment nerve tumours
- Other (Deep vein thrombosis - Soleus tear) [3-7].

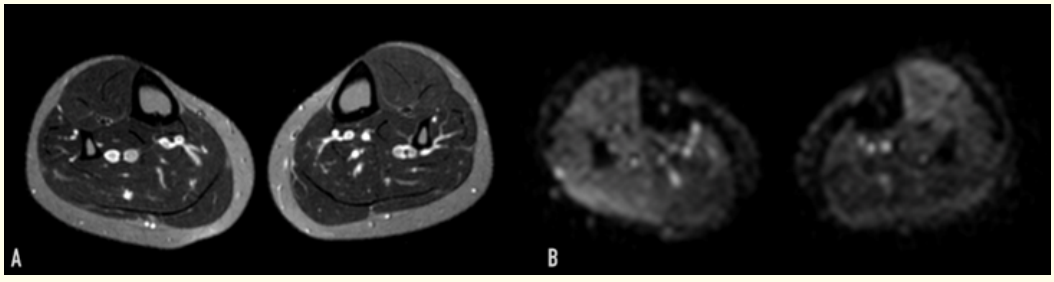

Figure L

Conclusion

- Magnetic resonance is a complementary method that assists in the clinical diagnosis of CECS.
- It is essential to adjust the image protocol to the CECS study in order to avoid false negatives.
- A good magnetic resonance study can in many cases avoid the need for other invasive diagnostic procedures.
- It allows discarding other differential diagnoses.
- It can guide the surgeon to the pre-surgical.

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