Chronic Exertional Compartment Syndrome

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• **Definition**
  - Exercise-induced, reversible increases in pressure within well-defined in elastic fascial compartments after muscle hyperemia and expansion leading to compromised tissue perfusion
  - Symptoms typically resolve when the activity ceases and there are usually no permanent sequelae.

• **Sports**
  - **ARM PUMP: Motorcycling** (Allen and Barnes, 1989; Garcia Mata et al., 1999; Goubier and Saillant, 2003; Jeschke et al., 2006; Zandi and Bell, 2005, Crouzet, Masmejean 2009)
  - Rowers (Volcke, 2014)
  - Weight training (Jawed et al., 2001),
  - Kayaking (Piasecki et al., 2008),
  - Tennis (Berlemann et al., 1998),
  - Gymnastics and Field Hockey (Wasilewski and Asdourian, 1991),
  - Climbing, Water Skiing (Zandi and Bell, 2005),

• **Pathophysiology**
  - Muscles expand up to 20% in volume against inelastic fascia and intracompartmental pressures rise.
  - Microvascular compromise and reduced venous return lead to ischemic pain, ultimately manifesting as workload intolerance and loss of function.
CHRONIC EXERTIONAL COMPARTMENT syndrome

• Anatomy: 4 compartments

  • **Volar** (++)
    - **Superficial**: flexor carpi ulnaris, pronator teres, flexor carpi radialis, and palmaris longus when present, flexor digitorum superficialis
    - **Deep**: flexor digitorum profundus, flexor pollicis longus
    - **Pronator quadratus compartment** (Schumer 2004, Gerber, Masquelet 2001, Sotereanos 1995)

  • **Dorsal** (-):
    - extensor digitorum communis, extensor digiti minimi, extensor carpi ulnaris, anconeus, supinator, abductor longus, extensor pollicis brevis, extensor pollicis longus, and extensor indici

  • **Lateral** (mobile wad):
    - brachioradialis, extensor carpi radialis brevis and longus
CHRONIC EXERTIONAL COMPARTMENT syndrome

• Diagnosis

• **Clinical presentation**
  • activities requiring prolonged, repetitive gripping motions with short periods of rest, such as rowing, and symptoms can present within 2 to 5 minutes of full exercise
  • pain, cramping, and tightness in the involved compartment
  • loss of grip strength
  • recurring at similar durations and intensities of exercise

• **Intracompartmental pressure measurements before, during, and after exercising**
  • resting pressure greater than 15 mm Hg,
  • pressure 1 minute after exercise > 30 mm Hg, and/or pressure 5 minutes after exercise greater 20 mm Hg

• **MRI** (Verleisdonk, 2001, van den Brand, 2005, Gielen, 2009)
  • Conventional and dynamic: T2 postexercise hyperintensity

• **EMG**
  • In case of neurologic symptoms
Non surgical treatment

50 to 80% of motocross riders can successfully be treated for chronic exertional compartment syndrome of the forearm nonoperatively through modification of their bike as well as physical therapy modalities (Humpherys, 2018)

- Handlebars, grip position, lever position, steering dampeners, gloves
- Training modification, mower limbs, stretching...

Brown (2011)

- patients who elected not to proceed with operative intervention after a failed nonoperative course continued to have symptoms at their 2-year follow-up. All had stopped motocross racing as a result of chronic exertional compartment syndrome of the forearm
- 90% of the patients who had operative intervention returned to their previous level of activity
• **Surgical treatment**
  • > 3 to 6 months non surgical TT

• **Methods:** FASCIOTOMY,
  • Wide open (Harrison 2013, Barrera-Ochoa 2016)
  • Min-open (Croutzet, Masmejean 2009, Zandi and Bell 2005, Brown 2011, Barrera-Ochoa 2016)

• **Controversies:** isolated superficial or superficial and deep compartment
  • No typical approach and controversies, due to contradictory findings regarding the characteristics of the forearm anterior compartment deep fascia
  • Entire forearm acts as a single muscle compartment (Gelberman, 1978)
  • Single superficial volar incision decompressed the superficial and deep volar compartment (Ojike 2012, Fontes 2003, or Chan 1998)

• **Results:** positive and resolution of symptoms with return to the same level of riding are in the 70% to 90% range (Barrera-Ochoa 2016)
A cadaver study into the number of fasciotomies required to decompress the anterior compartment in forearm compartment syndrome (Benamran, Masquelet, 2017)

Model: Acute compartment syndrome

Results
- Incision of the deep lamina of the deep anterior fascia had no noticeable impact
- Following incision of the superficial lamina of the deep fascia, a pressure decrease was noted in the superficial and deep compartments
- 2 successive incisions were necessary to decompress the anterior compartment in forearm compartment syndrome: the incision of the superficial lamina of the deep fascia and the incision of the intermuscular septum, identified posterior to the flexor carpi radialis

Incision of the superficial lamina of the deep anterior fascia +/- septum FCR
• Endoscopic procedure (Agee): M. Chammas
  • Aponeurotomy under endoscopy
  • Proximal and distal subcutaneous aponeurotomy
CHRONIC EXERTIONAL COMPARTMENT syndrome

• Postoperative management
  • Suction drain
  • Immediate rehabilitation allows expansion of the newly released compartment before fibrous scar tissue can constrict the muscle.
  • 2 weeks: Exercises against resistance
  • Racing 6 to 12 weeks

Complications
• Vein damage and hematoma
• Superficial nerve lesions
• Incomplete release
• Scarring