

# Exercise Induced Chronic Compartment Syndrome of the First Dorsal Interosseous Compartment of the Hand: A Case Report

Rajat Chopra · Mike Hayton · P. J. A. Dunbar

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**Abstract** Exercise-induced chronic compartment syndrome in the first dorsal compartment is an uncommon entity and relatively rare condition which is not very well understood. It is a usually activity-related condition and is associated with decreased function of muscle with intra-compartmental swelling. We present a case with proven exercise-induced raised compartment pressure that responded well to surgical fasciotomy.

**Keywords** Compartment syndrome · Fasciotomy

## Introduction

Chronic ache in hands in a young healthy individual as a result of a repetitive activity has a limited diagnosis. The causes may be nerve compression, writer's cramps, or malingering. We present a patient with exercise-induced chronic compartment syndrome of the first dorsal interosseous muscle of the hand.

## Case Report

A 24-year-old right-hand-dominant manual worker presented to us with work-induced right hand pain. The pain was located over his right first dorsal web space between thumb and index finger, and the pain gradually increased in intensity with activity and settled slowly with rest. The pain was so severe that the patient even decided to change his occupation. On examination, the patient had bilateral, very well-developed, first dorsal interosseous muscles, while the remainder of the examination was unremarkable. Nerve conduction studies performed by an experienced neurophysiologist excluded any peripheral nerve compression or any intrinsic nerve pathology.

A working clinical diagnosis of exercise-induced chronic compartment syndrome of the first dorsal interosseous muscle was established and confirmed with compartment pressure measurements. At rest, the patient's resting compartment pressure measured 12 mmHg, and within 10 min of hand exercise, it rose above 60 mmHg. This coincided with the onset of his symptoms. On ceasing exercise, the muscle relaxed, and the pressure steadily returned to the baseline, with an associated resolution of symptoms. This evidence confirmed the diagnosis of compartment syndrome of first dorsal interosseous muscle. We proceeded to release the first compartment with two separate incisions under local anesthetic. On incision of the investing fascia, the muscle bulged out excessively (Fig. 1). The wound was closed with subcuticular monocryl suture.

The patient's symptoms improved significantly following the release of the compartment under local anesthetic. The patient was asymptomatic within 4 weeks. He was able to return to his original occupation. His quick Disabilities of the Arm, Shoulder and Hand (DASH) score has improved

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R. Chopra (✉) · M. Hayton  
Wrightington Hospital,  
Appley Bridge,  
Wigan WN6 9EP, UK  
e-mail: choprarajat@hotmail.com

P. J. A. Dunbar  
Framework Clinic,  
109 Henderson St, Bridge of Allan,  
Stirling FK9 4HH, Scotland  
e-mail: janedunbar@doctors.org.uk



**Figure 1** The dorsal interossei muscle bulging out on incising the investing fascia.

from 38.3 to 20 in 3 months post surgery. This was a significant improvement of his quick DASH scores [1].

## Discussion

Volkman, in 1881 [2], described posttraumatic contracture as an ischemic phenomena rather than a neurologic entity. He opined [2] that these contractures were a result of muscle necrosis. In 1911, Bardenheuer [3] presented with one of the earliest descriptions of fasciotomy which he described as “aponeurectomy” for prevention of Volkman’s contracture. Rowlands and Lond [4] and later Brooks et al. [5] advanced the premise that not only ischemia but also the re-establishment of blood flow were contributory to contracture after injury. Griffiths [6] argued that arterial injury and spasm rather than pressure were the cause. In his writings on the topic, Griffiths [6] introduced his original four Ps: pain with passive extension, painless onset, pallor, and puffiness. This has since evolved to the five Ps, which still are cited today as clinical hallmarks.

Anatomically, the hand is divided into at least ten compartments: the four dorsal interossei, the three palmar interossei, the hypothenar and thenar compartments, and the adductor pollicis. Halpern and Mochizuki [7] have demonstrated by injection studies that the four dorsal interossei are distinct compartments without interconnections. However, DiFelice et al. [8] found more variability in the compartments of the hand. DiFelice [8], in his study of 21 cadaveric hands, injected gelatin into compartments and revealed that the adductor pollicis and first dorsal interosseous compartments were discrete compartments in 71% of hands.

Compartment syndrome is caused by an elevation of interstitial pressure in a closed fascial compartment. It can occur wherever a compartment is present. Therefore, the upper and lower limbs are most commonly affected. The acute compartment syndrome of the interosseous muscles of the hand after trauma or a burn is well described [9]. The pathophysiology of the compartment syndrome is an increase in local tissue pressure leading to increased venous pressure leading to a decrease in the local arteriovenous gradient. The diminished capillary flow results in decreased oxygen delivery to the tissues. When the tissue pressure increase rises above 30 mmHg, ischemic changes occur in muscles and nerve [10].

Chronic or exertional compartment syndrome refers to the condition of activity-related pain and decreased function of muscle with intracompartmental swelling. This condition is well described for the lower extremities, but there are only a few upper limb case reports in the literature on chronic exercise-induced compartment syndrome [9, 11].

Exercise-induced compartment syndrome of the hand is an uncommon condition that is not properly understood. The diagnosis is often suspected from reproducible pain occurring during some type of activity and is confirmed with intracompartmental measurements before and during exercise. The increase of intracompartmental pressure is temporary and reversible. Pain occasionally is present bilaterally and is often present over a specific compartment [12].

In our patient, compartment pressures measured in the first dorsal interosseous compartment pressures rose from 12 to 62 mmHg with activity. Similar increase in compartment pressure on exercise has been reported in literature also [11, 13]. We feel that the exercise increases the blood flow to muscle, and the resultant muscular swelling leads to an increased volume within a closed compartment. Repetitive activities can lead to muscular hypertrophy that, when coupled with increased blood flow, further increases intracompartmental volume and therefore pressure. Our patient benefited from the use of a fasciotomy, and his quick DASH score improved significantly. Dellon and Fine [14], in a case report, described a noninvasive pinch test for diagnosis of chronic compartment syndrome of the first dorsal compartment. They measured the pinch strength after repeated pinching with pinch meter. However, we did not use this technique and depended on pressure measurements to confirm the diagnosis. The wick catheter technique, we used to measure the compartment pressure is a standard technique and it allows measurement of fluid pressure before, during and after a muscle contraction without the interference of positional artifacts [13].

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