Göteborg, 2022

Intramuscular pressure in the lower leg

Studies on chronic exertional compartment syndrome and effects of external compression

AKADEMISK AVHANDLING

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademin,
Göteborgs universitet kommer att offentligen försvaras i R-aulan,
Sahlgrenska Universitetssjukhuset, Mölndal

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av
Sophia Halldin Lindorsson, leg. läkare

Fakultetsopponent:
Professor Björn Rosengren
Lunds universitet, Sverige

Avhandlingen baseras på följande delarbeten

I. Rennerfelt K, Lindorsson S, Brisby H, Baranto A, Zhang Q. Effects of exercise compression stockings on anterior muscle compartment pressure and oxygenation during running: A randomized crossover trial conducted in healthy recreational runners. *Sports Medicine* 2019 Sep;49(9):1465-1473.

II. Lindorsson S, Zhang Q, Brisby H, Rennerfelt K. Significantly lower intramuscular pressure in the posterior and lateral compartments compared with the anterior compartment suggests alterations of the diagnostic criteria for chronic exertional compartment syndrome in the lower leg. *Knee Surgery, Sports Traumatology, Arthroscopy* 2021 Apr;29(4):1332-1339.

III. Lindorsson S, Rennerfelt K, Brisby H, Zhang Q. The effect of gender on intramuscular pressure in patients with chronic exertional compartment syndrome of the lower leg. *Scandinavian Journal of Medicine & Science in Sports* 2022 Jan;32(1):202-210.

IV. Lindorsson S, Zhang Q, Brisby H, Rennerfelt K. Intramuscular pressures and patient-reported outcomes at follow-up in patients surgically treated for anterior chronic exertional compartment syndrome. *Submitted*

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Abstract

This thesis on intramuscular pressure (IMP) in the lower leg is concerned with two topics. The first of these is external compression; more specifically, the effect of compression stockings (CS). There are conflicting data on how compression garments such as CS affect IMP and muscle function during activity.
The second topic in this thesis covers different aspects of IMP in patients with chronic exertional compartment syndrome (CECS). CECS includes a pathological increase in IMP caused by muscle expansion, which leads to pain during exercise and reversal of symptoms at rest. The diagnosis is confirmed by IMP measurement, and the cut-off values are traditionally the same for all muscle compartments and both genders. The gold standard treatment for CECS is fasciotomy of the compartment(s) involved, but few studies have evaluated the postoperative IMP.
The aim of the present thesis was to examine how IMP in the lower leg is affected by external compression in healthy individuals during activity, whether IMP differs with regard to gender and the localization of the compartment in individuals with exercise-induced leg pain, and whether fasciotomy results in a normalization of IMP values in patients with CECS.

Study I evaluated the effects of external compression with CS on the anterior compartment of the lower leg among 20 healthy participants during and after running, in terms of IMP, muscle tissue oxygenation, and levels of serum biomarkers of muscle injury. The study concluded that wearing CS during and after this activity led to elevated IMP and decreased muscle tissue oxygenation, and did not reduce the levels of biomarkers for muscle damage post-exercise.
Study II investigated possible differences in post-exercise IMP between the compartments of the lower leg in 864 patients evaluated for exertional lower leg pain. The findings showed that IMP was significantly lower in the lateral and posterior compartments than in the anterior compartment.
Study III examined possible gender differences in post-exercise IMP in the lower leg compartments in 962 patients with suspected CECS. The study revealed that women with CECS had significantly lower IMP in all four compartments of the lower leg, compared to men with CECS.
Study IV evaluated the effects of anterior fasciotomy in 144 patients with anterior CECS, at a minimum of one year after the treatment. The findings showed that anterior fasciotomy resulted in a significant decrease in IMP and a patient satisfaction rate of 77%. Further, 83% of the patients reported a reduction of pain level and 94% participated in physical activities postoperatively.

Three conclusions can be drawn from this work. First, the use of CS during running affects the muscles in the lower leg negatively in healthy individuals. Second, in patients with CECS, different IMP cut-off levels for different compartments and for men versus women may be considered. Third, most patients treated surgically for CECS obtained a good result both subjectively and in terms of a lower postoperative IMP.

Keywords: intramuscular pressure, external compression, compartment syndrome, chronic exertional compartment syndrome, fasciotomy

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