Module 1: Lecture 3 & 4. Pain driven arthrogenic muscle inhibition-mechanisms, part 1 and 2

Introduction

Skeletal muscle weakness is an inevitable negative effect of injury, disease, or surgery of joints. Key factors of muscle deconditioning are 1) muscle atrophy and 2) arthrogenic muscle inhibition (AMI); however, their interaction and underlying mechanisms are not fully understood. The AMI originating from either knee or hip joint has been demonstrated to predominantly affect Quadriceps Femoris (QF) muscle. The role of AMI in development of weakness in various muscle groups and joint conditions remains equivocal. Physiotherapeutic modalities work through various physiological pathways; their efficiency thus depends on the primary cause of muscle weakness in each individual. In cases where AMI is predominantly caused by reflex neural inhibition, peripheral neuromuscular electrical stimulation used in conjunction with voluntary contraction and biofeedback has proven efficient. The pain-driven inhibitory neural inflow from the affected joint can be attenuated prior to or during muscle activation by application of cryotherapy or TENS over the affected joint. If AMI is primarily driven by inhibition of upper motor neurons, transcranial magnetic stimulation of motor cortex has been shown effective, however technical limitations hinder its more widespread clinical use. To tackle disuse muscle atrophy, the range of effective modalities is substantially narrowed due to AMI and limited tolerance of the affected joint for mechanical loading. Apart from neuromuscular electrical stimulation, muscle vibration exercise and low-load resistance exercise with blood flow restriction in active muscles (ischemic exercise) may have potential for counteracting development of disuse atrophy and tackle AMI.

Learning Outcomes Mapped to EFIC Pain Physiotherapy Curriculum

3.7.1 Critically discuss indications, efficacy, complications, management, and patient follow-up for treatment modalities related to pain physiotherapy.
3.7.4 Discuss appropriate follow up and proper outcome measurement for patients and how these can be implemented.

Preparation

Participants should read the systematic review of Norte et al (2021) to get an overview of the theme.

Content

A brief presentation of the contemporary concept of AMI treatment and a patient case with severe form of quadriceps femoris AMI will be followed by practical demonstrations of several evidence-based desinhibitory and muscle conditioning techniques and instrumental patient assessment used by Laboratory of Physiotherapy at Faculty of Health Sciences UL.

Follow up / suggestions for processing and practice

In-depth readings of reference material and introduction of the concept of AMI treatment to undergraduate study curricula.

Reference material

Buckthorpe M, La Rosa G, Villa FD. Restoring knee extensor strength after anterior cruciate ligament reconstruction: a clinical commentary. Int J Sports Phys Ther. 2019 Feb;14(1):159-172. PMID: 30746302; PMCID: PMC6350662.

Kacin A, Drobnič M, Marš T, Miš K, Petrič M, Weber D, Tomc Žargi T, Martinčič D, Pirkmajer S. Functional and molecular adaptations of quadriceps and hamstring muscles to blood flow restricted training in patients with ACL rupture. Scand J Med Sci Sports. 2021 Aug;31(8):1636-1646. doi: 10.1111/sms.13968. Epub 2021 Apr 26. PMID: 33837592.

Lepley AS, Lepley LK. Mechanisms of Arthrogenic Muscle Inhibition. J Sport Rehabil. 2021 Sep 1;31(6):707-716. doi: 10.1123/jsr.2020-0479. PMID: 34470911.

Norte G, Rush J, Sherman D. Arthrogenic Muscle Inhibition: Best Evidence, Mechanisms, and Theory for Treating the Unseen in Clinical Rehabilitation. J Sport Rehabil. 2021 Dec 9;31(6):717-735. doi: 10.1123/jsr.2021-0139. PMID: 34883466.

Sonnery-Cottet B, Saithna A, Quelard B, Daggett M, Borade A, Ouanezar H, Thaunat M, Blakeney WG. Arthrogenic muscle inhibition after ACL reconstruction: a scoping review of the efficacy of interventions. Br J Sports Med. 2019 Mar;53(5):289-298. doi: 10.1136/bjsports-2017-098401. Epub 2018 Sep 7. Erratum in: Br J Sports Med. 2019 Dec;53(23):e8. PMID: 30194224; PMCID: PMC6579490.