In vivo relationship between pelvis motion and deep fascia displacement of the medial gastrocnemius: anatomical and functional implications

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Abstract

Different authors have modelled myofascial tissue connectivity over a distance using cadaveric models, but in vivo models are scarce. The aim of this study was to evaluate the relationship between pelvic motion and deep fascia displacement in the medial gastrocnemius (MG). Deep fascia displacement of the MG was evaluated through automatic tracking with an ultrasound. Angular variation of the pelvis was determined by 2D kinematic analysis. The average maximum fascia displacement and pelvic motion were 1.50 ± 0.78 mm and 6.55 ± 2.47 °, respectively. The result of a simple linear regression between fascia displacement and pelvic motion for three task executions by 17 individuals was \( r = 0.791 \) \((P < 0.001)\). Moreover, hamstring flexibility was related to a lower anterior tilt of the pelvis \( (r = 0.544, P < 0.024) \) and a lower deep fascia displacement of the MG \( (r = 0.449, P < 0.042) \). These results support the concept of myofascial tissue connectivity over a distance in an in vivo model, reinforce the functional concept of force transmission through synergistic muscle groups, and grant new perspectives for the role of fasciae in restricting movement in remote zones.

Key words: fascia; musculoskeletal; tracking motion; ultrasound.

Introduction

Fascia is a term derived from Latin meaning band or bandage (Benjamin, 2009). Within the field of anatomy, no area creates more confusion in terminology than the fasciae systems. For some authors, ‘fascia’ only includes densely banded connective tissues, where fibres have more than one dominant direction (Benetazzo et al. 2011). Other authors include within ‘fascia’ sheets of soft, transparent tissue, such as the hypodermis or subcutaneous tissue (Schleip et al. 2012). Importantly, Stecco (2015) defined the aponeurotic fascia as the deep fascia. Anatomically, two types of fasciae are generally considered: the superficial fascia, which is part of the subcutaneous tissue; and the deep fascia, which considers the connective tissue surrounding muscular groups (Benjamin, 2009). The term aponeurosis is used to describe flattened tendon fibres, whether intra- or extramuscular (Dauber, 2007). Aponeurosis is generally found within muscular tissue, such as a developing tendon. Moreover, in some wide muscles, such as the oblique abdominal muscles, the aponeurosis extends beyond the muscular tissue, thus making it visible upon dissection. For the purpose of this study, fascia was defined as the connective tissue constituted by irregularly arranged collagen fibres, as represented by a superficial fascia, present within the subcutaneous tissue, and a deep fascia, distinguished as the connective tissue surrounding and splitting the muscle groups. Moreover, fasciae are distinct from the parallel arrangement of collagen fibres present in structures, such as ligaments, tendons or aponeurosis (Stauding, 2008).