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PILOT STUDY

A pilot study of balance performance benefit of myofascial release, with a tennis ball, in chronic stroke patients

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Abstract *Background:* We hypothesised that the balance of spastic chronic stroke patients is related to myofascial problems. We performed myofascial release (MFR) with a tennis ball on the affected limb, as suggested by Myers.
Purpose: This study investigated the benefits of 8 weeks of MFR using a tennis ball on the balance of spastic patients.
Methods: Eight stroke patients were enrolled voluntarily after providing informed consent. All subjects received 8-week interventions with MFR using a tennis ball three times per week. The patients were evaluated using the Berg Balance Scale (BBS) and Timed 'Up & Go' (TUG) test before and after 4 and 8 weeks of the intervention.
Results: There were significant differences in the BBS scores ($p = 0.001$). The TUG time decreased significantly at 4 and 8 weeks ($p = 0.034$).
Conclusion: Myofascial release appears to improve the balance of spastic chronic stroke patients; however, further studies should evaluate the effective of MFR on walking in stroke patients and determine the mechanism of the effect of MFR.

Introduction

Fascia is connective tissue found throughout the body, in all muscles, bones, vessels, and organs. It provides support, stability, and cushioning (Schleip et al., 2012; Langevin and Huijing, 2009). Fascia is integral to the continuity of the body and is essential in human posture and movement

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(Schleip, 2003). In addition, the fascia distributes forces so that they are absorbed over a larger area, rather than having the force focused at one point (Findley and DeFilippis, 2005).

Tightness of the fascia is related to physiological and biomechanical guarding mechanism to protect from trauma. However, the fascia can lose pliability, restricting movement and placing tension on body parts (Barnes, 1997). Trauma to the fascia can lead to the production of reorganised fascia that is thicker, shorter, and oriented differently from the fascia before injury (Myers, 2001; Schleip, 2003; Stecco, 2004; Hammer, 2007; Chaitow, 2008; Masi and Hannon, 2008).

Repeated inflammation can alter the alignment of connective tissues depending on the direction of forces, and compromise human kinetics (Goodman et al., 2003; Findley and DeFilippis, 2005). In addition, poor posture, injury, and stress can cause malalignment of the body, resulting in thicker fascia as compensation (Findley and DeFilippis, 2005).

Rolf (1977) reported that the characteristics of fascia were similar to those of collagen fibres, which are formed in the ground substance, a shapeless, semifluid, and the collagen fibres slowly alter the arrangement of the chemical substances within them. The recent definition of fascia suggested by the Third International Fascia Research Congress is as follows. "...fibrous collagenous tissues which are part of a body wide tensional force transmission system." The latest definition of fascia also includes the following ones: dense planar multidirectional connective tissue, loose planar connective tissue, other loose (e.g. fatty layers within subcutaneous tissue) connective tissue, joint capsules, organ capsules, muscular septi, retinaculi, tendons, ligaments, epimysium, perimysium, endomysium, epineurium, dura mater, periosteum, mediastinum, mesentery, annulus fibrosus in spinal discs (Schleip et al., 2012). These fascial tissues appear to be an interconnected tensional network which is adapted to fibre arrangement and density and determined by local tensional demands (Pilat, 2012; Schleip et al., 2012).

The water in a cell is differs from that in a glass. There is unexpected large 'exclusion zone' (EZ) inside the water in a cell which is called EZ which is physically different from bulk water, the characteristics of which are more restrictive and viscous than bulk water: (Pollack, 2010; Pollack et al., 2011). Extracellular Matrix (ECM) is believed to contain a form of EZ, which contributes to the structural and biomechanical support of the cells (Gurvan et al., 2010).

Reddy et al. (1979) suggested that pressure could create flow in the extracellular matrix and interstitial fluids. Several authors insisted that the therapeutic mechanism of the pressure could be related to viscous flow and a piezoelectric phenomenon which would allow the elongation of the viscoelastic fascia when the gentle pressure with light weight is applied (Pilat, 2003; Castro-Sánchez et al., 2011a,b).

Sherman et al. (2006) defined MFR therapy as a clinical massage technique that concentrates the manipulations on muscles or fasciae. MFR is based on the principle that trauma, inflammation, infection, and structural imbalance cause fascial strain (Barnes, 2004). Fascial strain from continuous traction or tension leads to fascial entrapment of neural structures, which might induce dysfunction and symptoms (Bruno and Emiliano, 2014; Myers, 2001). MFR has been used to treat patients with myofascial pain syndrome involving the lower back, shoulder, and other body areas.

Few studies have examined MFR in chronic stroke patients. Continuous traction or tension in the fascia can occur in stroke patients with spasticity, hypertonicity, or muscle stiffness. Several authors insisted that spastic hypertonia causes mechanical stiffness of the muscles (Dietz, 1992; Brown, 1994; Ada et al., 1998). This stiffness might cause permanent structural changes due to the mechanical effects on muscles and connective tissues (Katz and Rymer, 1989; Carey and Burghardt, 1993). In addition, some authors hypothesised that fascia such as the perimysium might move actively, but the thickness of the perimysium might be increased by muscle immobilisation, especially in tonic muscles, resulting in increased passive muscle stiffness (Schleip et al., 2006). Furthermore, myofascial force transmission demonstrates that around 40% of tensional forces are transmitted via adjacent fascial structures opposed to via the muscular tendon (Huijing et al., 2007).

Most of the studies of MFR have examined myofascial pain syndrome, and none has examined MFR in stroke patients. Whisler et al. (2012) report on MFR in six children with cerebral palsy. Therefore, this study investigated the effects of myofascial release in the lower extremity performed with a tennis ball on the balance of chronic stroke patients.

Subjects and methods

Ten individuals with hemiplegia were recruited from S rehabilitation centre in Busan, Korea. The subjects complained of stiffness in the affected lower limb while walking. We initially recruited seven males and three females, but two of the males dropped out, leaving six with right hemiplegia and two with left hemiplegia. The demographic characteristics of the patients are summarised in Table 1.

Inclusion criteria were (a) a diagnosis of hemiplegia due to haemorrhagic or ischaemic stroke, (b) more than 6 months post stroke, (c) the ability to follow simple instructions, (d) a modified Ashworth score for the affected lower extremity greater than 1, (e) the ability to walk independently or with assistive devices, and (f) no orthopaedic problems involving the lower extremities that would affect gait. The exclusion criteria were (a) a stroke involving more than one hemisphere, (b) a flaccid lower extremity, and (c) premorbid problems that would impede patterns.

Informed consent was acquired from the subjects before conducting the study according to the requirements of the Declaration of Helsinki. Ethics approval for the study was granted by Kaya University in South Korea.

Intervention

A tennis ball was used to obtain myofascial release (MFR) in the sole (plantar fasciae), triceps surae, hamstring, and sacrotuberous ligament, all parts of the superficial back