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PILOT, SINGLE-BLIND, RANDOMIZED STUDY

Changes in co-contraction during stair descent after manual therapy protocol in knee osteoarthritis: A pilot, single-blind, randomized study

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Knee osteoarthritis;
Manual therapy;
Electromyography;
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Summary *Introduction:* Manual therapy has shown clinical results in patients with knee osteoarthritis. However, the biomechanical aspects during functional tasks have not been explored in depth.
Methods: Through surface electromyography, the medial and lateral co-contractions of the knee were measured while descending stairs, prior and posterior to applying a manual therapy protocol in the knee, with emphasis on techniques of joint mobilization and soft-tissue management.
Results: Sixteen females with slight or moderate knee osteoarthritis were recruited (eight experimental, eight control). It was observed that the lateral co-contraction index of the experimental group, posterior to intervention, increased by 11.7% ($p = 0.014$).
Conclusions: The application of a manual therapy protocol with emphasis on techniques of joint mobilization and soft-tissue management modified lateral co-contraction, which would have a protective effect on the joint.

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Introduction

Osteoarthritis (OA) is one of the most common forms of arthritis (Felson, 1990), with one of the most affected weight-bearing joints being the knee (Muraki et al., 2012). In individuals older than 55, severity tends to be greater in females (Srikanth et al., 2005). Osteoarthritis is characterized by pain and decreased range and strength, affecting the activities of daily life (Bedson et al., 2007; van Dijk et al., 2010). Among functional tasks, one of the most demanding is the ascent and descent of stairs, which generates a peak knee adduction moment (KAM), with subsequent medial overload in the knee (Hall et al., 2013). For these types of demanding tasks, co-contraction, the expression of simultaneous activities from opposing muscle groups, provides greater stability at the expense of placing greater joint overload on the knee (Hodges et al., 2015; Lloyd and Buchanan, 2001). In this regard, lateral co-contraction contributes towards better load distribution, translating into a protector effect of the medial cartilages, whereas increased medial co-contraction contributes towards greater overload and less volume of the joint cartilage in the medial compartment of the knee (Hodges et al., 2015; Maly et al., 2015). Likewise, alignment, both valgus or varus, influences the pattern of muscular activation, where varus alignment would have greater medial musculature activation (Lloyd and Buchanan, 2001). Therefore, due to the role that co-contraction play in joint load, it is relevant to determine the biomechanical effects of therapeutic interventions on the adaptive muscular pattern.

Among the types of interventions, manual therapy has been shown to have clinical effects in patients with OA (Courtney et al., 2016; Moss et al., 2007). Diverse studies have explored the analgesic effects of techniques for joint mobilization as compared to placebos (Courtney et al., 2016). Likewise, previous studies have reported clinical improvements in the mid-term through protocols of manual therapy and exercises in patients with reported knee OA, as determined by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (Deyle et al., 2005). Nevertheless, the biomechanical changes associated with these effects remain unknown. Furthermore, knee OA is determined by multifactorial variables, where not only local biomechanical aspects, such as patellar congruence, femorotibial alignment, and quadriceps weakness, would be involved; other biomechanical variables of the trunk, hip, and ankle would also be associated with the severity of OA (Astephen et al., 2008a, 2008b; Chang et al., 2005; Maly et al., 2015; Mundermann et al., 2005). Moreover, the observed presence of myofascial trigger points in the periarticular musculature of the knee could induce early fatigue (Alburquerque-Garcia et al., 2015).

Previous studies have reported on the favorable clinical effects of manual therapy protocols based on the mobilization and treatment of soft-tissues, such as through stretches and the release of tense bands, together with exercises (Abbott et al., 2015; Deyle et al., 2005). While these manual therapy protocols have been reported to have significant clinical effects, the neurophysiological and biomechanical effects are inconclusive.

The objective of the present study was to determine changes in the co-contraction index (CCI) while descending stairs posterior to a physical therapy protocol.

Our hypothesis was that manual therapy would favorably modify co-contraction, reducing pain and improving functionality.

Methods

Study participants

Ethical approval was obtained from the Northern Metropolitan Health Service of Santiago, Chile, and informed consent from each participant was required.

The inclusion criteria were a diagnosis of slight or moderate knee OA, confirmed through clinical and radiography examinations; radiographic signs of OA in the medial compartment; female; older than 50; a body mass index <35; did not require assistance to descend stairs; and did not have prior experience with joint mobilization or soft-tissue management as treatments.

For this study, subjects were excluded if they presented other forms of arthritis, non-arthritic disease, intra-articular therapies, previous knee surgeries, or acute or chronic injuries of the spine, hip, or ankle. The incapacity to alternately descend stairs was also considered an exclusion criterion. Likewise, patients were required to have sufficient language skills to understand and respond to the WOMAC survey regarding pain, stiffness, and functionality.

Participant selection

From a sample universe of 74 subjects recruited from the Hospital San José (Santiago, Chile), 36 subjects met inclusion criteria. Twenty-four subjects agreed to participate in the study. Of these, four patients decided to abandon the study for personal reasons, and four patients could not perform the task according to inclusion criterion. Therefore, 16 subjects were finally evaluated (Fig. 1). The participants were randomly allocated to the intervention group or the control group using randomization software (www.randomization.com).

Measurement protocol

The subjects from both groups were measured and weighed on arrival to the Motion Analysis Laboratory of the Department of Physical Therapy at the University of Chile. Pain was quantified using the Numerical Rating Scale (NRS). In a standing position, electrodes (Ag/AgCl) with a surface recording area of 3.8 cm^2 were positioned according to Surface EMG for Non-Invasive Assessment of Muscles (SENIAM) (Hermens et al., 1999) on the Vastus Lateralis (VL), Vastus Medialis (VM), Biceps femoral (BF), and Semitendinosus (ST) muscles. To ensure good contact and low electrical interference, skin preparation included shaving and rubbing and cleaning with alcohol.

All participants were asked to descend stairs five times to practice task execution. If the subjects were unable to

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