Acute Back Muscle Fatigue and Recovery: Influence on Trunk Sensorimotor Control

Jean-Alexandre Boucher, DC, et al.

Objective: The aim of this study was to evaluate trunk repositioning sense after an acute muscle fatigue protocol and during a 30-minute recovery period.

Methods: Twenty healthy participants were asked to reproduce a 20° and 30° angle in trunk extension. Participants were tested before and after a Biering-Sorensen fatigue protocol was performed. Movement time, peak angle variable error, constant error and absolute error in peak angle were calculated and compared between four temporal conditions in both 20° and 30° extensions.

Results: The statistical analysis revealed a main effect of angle between 20° and 30° extension condition for variable error, absolute error, and movement time. A main effect of time was also found and was characterized by a significant increase in variable error between the prefatigue condition and the first postfatigue condition. During recovery, a significant decrease in variable error was observed between the first postfatigue condition and the 30-minute postfatigue condition, indicating that the variable mean scores were similar to initial values.
**Conclusion:** Lower back muscle fatigue induced changes in trunk repositioning sense indicators immediately after the fatigue protocol. However, the observed changes did not last for more than a few minutes.

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**Optimized Prediction of Contact Force Application During Lumbar Manipulation**

*Casey A. Myers, MSc, et al.*

**Objectives:** The purposes of this study included the following: (1) to predict L3 contact force during side-lying lumbar manipulation by combining direct and indirect measurements into a single mathematical framework; and (2) to assess the accuracy and confidence of predicting L3 contact force using common least squares (CLS) and weighted least squares (WLS) methods.

**Methods:** Five participants with no history of lumbar pain underwent 10 high-velocity, low-amplitude lumbar spinal manipulations at L3 in a side-lying position. Data from five low-force criterion standard trials where the L3 contact force was directly measured were used to generate participant-specific force prediction algorithms. These algorithms were used to predict L3 contact force in five experimental trials performed at therapeutic levels. The accuracy and effectiveness of CLS and WLS methods were compared.

**Results:** Differences between the CLS-predicted forces and the criterion standard–measured forces were 621.0 ± 193.5 N. Differences between the WLS-predicted forces and the criterion standard–measured forces were -3.6 ± 9.1 N. The 95% limits of agreement ranged from 234.0 to 1008.0 N for the CLS and -21.9 to 14.7 N for the WLS. During both the criterion standard and experimental trials, the CLS overestimated contact forces with larger variance than the WLS.

**Conclusion:** This novel method to predict spinal contact force combines direct and indirect measurements into a single framework and preserves clinically relevant practitioner-participant contacts. As advanced instrumentation becomes available, this framework will enable advancements in training and high-quality research on mechanisms of spinal manipulative therapy.

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**Myofascial Trigger Points in Patients With and Without Chronic Neck Pain**

*Ana De-la-Llave-Rincon, PT, PhD, et al.*
**Objectives:** The purpose of this study is to describe differences in the presence of masseter and temporalis muscle trigger points (TrPs) and jaw opening between individuals with mechanical neck pain and healthy controls.

**Methods:** Twenty patients with mechanical neck pain (60% women) without symptoms in the orofacial region, aged 20 to 37 years old, and 20 matched controls participated. Temporalis and masseter muscles were examined for the presence of TrPs in a blinded design. Trigger points were considered active if the subject recognized the pain as a familiar symptom, whereas the TrPs was considered latent if the pain was not recognized as a symptom. Jaw opening was assessed with a ruler.

**Results:** A greater number ($P < .001$) of TrPs in the masticatory muscles were found in patients than in controls. None of the patients or healthy controls recognized the referred pain as familiar; thus, latent rather than active TrPs were found. The distribution of TrPs between groups was different for the masseter (left odds ratio [OR], 3.4; right OR, 8.1; $P < .001$) and temporalis (left OR, 2.8; right OR, 5.7; $P < .001$) muscles. Patients with neck pain had smaller jaw opening than controls ($P < .001$). A negative correlation between active jaw opening and the number of TrPs within the masticatory muscles ($rs = -0.6; P < .001$) was found: the greater the number of TrPs, the smaller the jaw opening.

**Conclusions:** For the subjects in this study, those with mechanical chronic neck pain had more latent TrPs in the masticatory muscles and reduced jaw opening compared to healthy controls. These findings may suggest the spread of sensitization from the cervical segment to the trigeminal brain stem sensory nuclear complex.

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**Dry Needling the Trapezius: Impact on Muscle Blood Flow and Oxygenation**

*Barbara Cagnie, PT, PhD, et al.*

**Objective:** The purpose of this study was to investigate the effect of dry needling on the blood flow and oxygen saturation of the trapezius muscle.

**Methods:** Twenty healthy participants participated in this study. One single dry needling procedure was performed in the right upper trapezius, at a point located midway between the acromion edge and the seventh cervical vertebrae. Using the oxygen to see device, blood flow and oxygen saturation were evaluated at the treated point and three distant points (similar point in the left upper trapezius and 30 mm
laterally from this midpoint). Measurements were taken at baseline and in the recovery period (0, 5, and 15 minutes posttreatment).

**Results:** After removal of the needle, the blood flow and oxygen saturation increased significantly from the pretreatment level in the treated point ($P \leq .001$), and these values remained high throughout the 15-minute recovery period. There were only minor changes in the distant points.

**Conclusions:** These results suggest that dry needling enhances the blood flow in the stimulated region of the trapezius muscle, but not in a distant region used in this study.

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### Passive Upper-Extremity Joint Mobilization for Carpometacarpal Osteoarthritis

*Jorge H. Villafañe, PT, MSc, PhD, et al.*

**Objective:** The purpose of this case series is to report on the effects of passive joint mobilization (PJM) of the shoulder, elbow, and wrist on pain intensity, pain sensitivity, and function in elderly participants with secondary carpometacarpal osteoarthritis (CMC OA).

**Methods:** Fifteen inpatients from the Department of Physical Therapy, Residenze Sanitarie Assistenziali, Collegno (Italy), with secondary CMC OA (70-90 years old) were included in this study. All patients received PJM of the dominant arm (shoulder, elbow, and wrist) for four sessions for two weeks. Pain severity was measured by visual analog scale, and pain sensitivity was measured with pressure pain threshold (PPT) at CMC joint, at the tubercle of the scaphoid bone, and at the unciform apophysis of the hamate bone. Tip and tripod pinch strength were measured by a pinch gauge.

**Results:** Passive joint mobilization reduced pain severity after the first follow-up by 30%, in addition to increased PPT by 13% in the hamate bone. Strength was enhanced after treatment. Tripod pinch increased by 18% in the dominant hand after treatment.

**Conclusions:** This case series provides preliminary evidence that PJM of upper extremity joints diminished pain and may increase PPT tip and tripod pinch in some participants with secondary CMC OA.

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