Comparison of Oxygen Kinetics Using Near infrared Spectroscopy in the Upper Trapezius in Normal Subjects and Patients with Chronic Neck Pain and Myofascial Trigger Points

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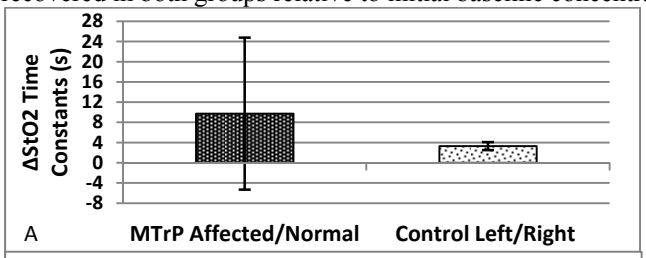
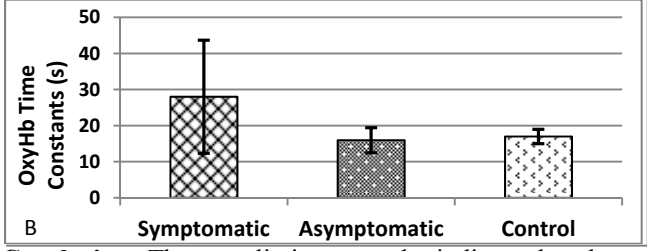
Introduction: Myofascial trigger points (MTrPs) are one of the most prevalent causes of musculoskeletal pain, associated with 95% of chronic soft tissue pain disorders in the United States. MTrPs are hyperirritable nodules found in a taut band of muscle often causing referred pain and motor dysfunction. One hypothesis for the pathophysiology of MTrPs involves local ischemia and possible hypoxia caused by muscle contracture. The goal of this preliminary study is to investigate differences in kinetics of oxygen recovery after exercise between healthy individuals and patients with MTrPs in the upper *trapezius* using near infrared spectroscopy (NIRS).

Materials and Methods: Five healthy volunteers (3 men and 2 women; 32.0±8.5 years) and five patients with chronic neck pain and symptomatic (active) MTrPs (2 men and 3 women; 27.4±5.0 years) in their upper *trapezius* were recruited for this study following approved procedures. Subjects were asked to perform a left and right shoulder shrug with a self-selected weight of 12, 14, or 18 lb depending on their comfort level. Oxygenated hemoglobin (OxyHb) and oxygen saturation (StO2) kinetics were measured using a NIRS system (ISS OxiplexTS, Champaign, IL). All subjects were seated upright with the NIRS sensor placed in the medial third of the upper *trapezius*. Two trials were performed per side, with each trial consisting of a 30-sec baseline period during which the head was in neutral, shoulders relaxed and arms at side; followed by a 30-sec isotonic contraction of the upper trapezius with head in neutral and a weight lifted, and a 60-sec recovery period with head in neutral and shoulders relaxed and arms at side. The rates of exponential increase for OxyHb and %StO2 were analyzed for both groups using time constants. Recovery was also compared between patients' symptomatic and asymptomatic side where the symptomatic side is defined as having an active MTrP producing spontaneous pain, and the less symptomatic side as either normal muscle tissue or having a latent (asymptomatic) MTrP.

Results and Discussion: No significant difference was seen between recovery rates for trials with varying weights in StO2 ($p = 0.58$) and OxyHb ($p = 0.87$). Time constants (OxyHb) in healthy volunteers were repeatable ($ICC=0.916_{Left}$, 0.871_{Right}, $p<0.05$) between trials bilaterally in the upper *trapezius*. The difference between time constants for the affected (symptomatic) side compared and the less symptomatic side for both OxyHb and StO2 were not significantly different in our small sample ($p=.287$), although a trend towards a slower recovery on the symptomatic side was noted. No significant difference ($p=0.196$) was found between left and right sides in healthy volunteers (Fig.1A). MTrP patients had a slower OxyHb recovery (29.92± 15.68 s) on their affected side compared to the opposite side (19.05±9.13 s) (Fig.1B). Time constants for both OxyHb and StO2 were greater in patients with MTrPs than in healthy volunteers. StO2 baseline values recovered after 60 sec post-exercise in healthy volunteers, but not in the affected side in MTrP patients, while OxyHb fully recovered in both groups relative to initial baseline concentration (Fig.1C).





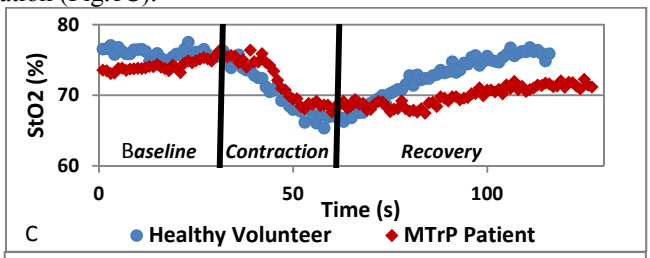


Fig1A. Comparison of the average difference between the symptomatic and asymptomatic sides in patients to the average difference between left and right sides in healthy volunteers. Fig1B. Time constants for OxyHb between symptomatic and less or asymptomatic side in patients. Fig1C. StO2 recovery kinetics for MTrP patient and control.

Conclusion: These preliminary results indicate that there might be differences in oxygen delivery and metabolism in the upper *trapezius* in patients with MTrPs compared to healthy volunteers. The more symptomatic side showed a trend towards slower recovery compared to the less symptomatic side in patients with neck pain. Studies are ongoing to confirm these observed differences in oxygen recovery kinetics between healthy individuals and patients with MTrPs.