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The Effects of Photobiomodulation on Muscle Performance of the Shoulder External Rotators

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Purpose/Hypothesis: The purpose of this study was to compare the effects of photobiomodulation delivered via therapeutic laser (TL) and placebo "sham" laser (PL) on performance of the shoulder external rotator muscle group during high intensity isokinetic resistance exercise. The null hypothesis was that no difference would be found in muscle performance between TL and PL for the variables examined (peak torque [Nm], peak torque normalized by body mass [Nm/kg], average torque [Nm], total work [J], and power [W]).

Number of Subjects: Twenty-four subjects were recruited from a voluntary student population. Four individuals screened were excluded due to past shoulder injuries. Twenty healthy subjects participated in a double blind, cross-over study, approved by the University of Tennessee at Chattanooga IRB. Informed consent was obtained from subjects meeting the inclusion criteria which included: no past or present shoulder injuries, no upper extremity exercise in the 3 days before testing, and no supplements that could have an impact on performance.

Materials/Methods: Subjects were trained and tested using a BIODEX System 3 Pro isokinetic dynamometer. The protocol consisted of a 5 minute warm-up on an upper extremity ergometer (Borg scale of 3), followed by training or testing. During all training and testing, subjects had their dominant arm positioned at 30° of shoulder horizontal adduction and 45° of shoulder abduction, and performed 21 continuous concentric contractions of external rotation in each of 16 sets, at 60°/second with standardized recovery periods between sets. Subjects were acclimated to the isokinetic testing to eliminate a possible training effect prior to being entered into the testing phase of the study. Subjects entered the testing phase of the study when values in measured variables between training sessions had less than a 10% difference. In the two testing sessions, subjects randomly received TL or PL. The laser had a dual wavelength of 810 nm and 980 nm with a combined output power of 10 watts (1.8 W/cm^2 irradiance) applied in a continuous mode to the infraspinatus and teres minor muscles for a total dose of 10 J/cm^2, 30 minutes prior to testing. The sham treatment (PL) was identical in treatment time and undistinguishable from the active treatment (TL) by the participants (p=.63).

Results: A factorial analysis of variance was used to compare TL to PL for all dependent variables in all 16 sets. While there was an overall main effect of TL vs PL, significance levels varied based on the dependent variable and exercise set with peak torque [Nm] ranging from (p=.03-.78), peak torque normalized by body mass [Nm/kg] (p=.02-.91), average torque [Nm] (p=.01-.77), total work [J] (p=.01-.86), and power [W] (p=.02-.92).

Conclusions: Photobiomodulation delivered via therapeutic laser applied thirty minutes before exercise increased performance of the shoulder external rotators during endurance exercise compared to placebo laser.

Clinical Relevance: Photobiomodulation administered to skeletal muscle before high intensity resistance exercise may provide ergogenic benefits.