

Study Coordinator: Nina Moore, MS

Title: The Effect of Smoking on Muscle Adaptation to Exercise Stress

Smoking is prevalent in the general population. While smoking is most commonly associated with a number of diseases, smoking has also been shown to increase risk for musculoskeletal injury. Further, smoking prolongs recovery time after injury and surgery. The mechanisms through which smoking increases risk for injury and interferes with the repair process are unknown.

During exercise, skeletal muscle is subjected to stress that ranges from mild (low-intensity or endurance exercise) to severe (prolonged muscle lengthening contractions or very high intensity exercise). Greater stress can cause damage to the ultrastructure of the muscle, which is followed by repair. Because smokers have an increased risk for injury and prolonged recovery time, we determined to investigate differences between smokers and non-smokers in how they respond to a stressful muscle lengthening (eccentric) exercise.

The purpose of this study is to determine underlying molecular mechanisms of how smokers and non-smokers respond to eccentric exercise.

Methods and Outcome Measures:

Young men who were either non-smokers or smokers were recruited to participate in this study. We used the knee extensor muscles as our experimental muscle group. Strength was assessed pre-, 5 minutes, 1 day, 4 days, and 9 days post-exercise. Using a Biodex dynamometer, we measured isometric strength and isokinetic strength at two rates: 60 degrees/second and 180 degrees/second. Strength of both the knee extensors and flexors was measured. The exercise, also performed on the Biodex, consisted of 100 maximal isokinetic eccentric contractions at 30 degrees/second. This was divided into 10 sets of 10 repetitions with a 10-second rest interval between repetitions and a 1-minute rest between sets. This exercise produces a mild to moderate level of muscle damage.

48 hours after the exercise session a percutaneous needle muscle biopsy was taken from the vastus lateralis (thigh) muscle using a Bergstrom 5-6 mm biopsy needle. Muscle samples were taken from both the exercised and non-exercised legs, the latter serving as a control. Analyses of molecular alterations will be performed on these muscle samples. Using a PCR array (SABiosciences) we will investigate alterations in mRNA between the exercise and control legs as well as between smokers and non-smokers. These results will be followed by analysis of protein levels using the Western Blot technique and visualization of proteins using Immunohistochemistry. In addition to muscle biopsies, we also collected blood samples from the subjects at baseline and 20 hours post-exercise. We will use these blood samples to investigate potential differences in the levels of inflammatory cytokines between smokers and non-smokers following eccentric exercise, as well as blood creatine kinase activity.

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