The Acute Effects of Static Stretching on Leg Extension Power: Quadriceps Torque Production After a 30-Second Static Stretch Versus No Stretch

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Abstract. Introduction: Traditionally, static passive stretching has been used by coaches and athletes as a warm-up technique in an attempt to promote better performances. However, the results of recent research have shown that passive muscle stretching can diminish the peak force output of subsequent maximal concentric contractions of the quadriceps. Aside from clinicians' benefits, athletes competing in a competitive sport which involves explosive contractions (i.e. power lifting) would benefit from knowing if preexercise stretching of a particular muscle group will temporarily compromise its ability to produce a maximum force. The purpose of our study was to determine the effects of static stretching on peak torque production of the quadriceps. Our hypothesis states that static stretching would cause a decrease in peak torque and mean power output due to stretch-induced changes in the muscle fibers of the quadriceps. Experiment: The participants of this study consisted of forty-seven healthy male and female college students. Isokinetic quadriceps maximum torque of the subjects' dominant leg was measured prior to and after a thirty second passive static stretch. Results: There was no significant difference between the subjects' results prior to and after the thirty second stretch intervention. Further data analysis showed no significant difference in power values between age, height, weight or sex.

Introduction

Static passive stretching has been used by coaches and athletes for years without question as part of a warm-up to increase flexibility in an attempt to promote better performances. Athletic trainers and other rehabilitation professionals also recommend that their athletes or patients stretch before performing strengthening exercises or strength assessment tests.[1] Many athletes stretch prior to competitive activity with the notion that improved flexibility will enhance performance.[2] However, authors of recent systematic reviews[3,4] and many original studies[5-13] have suggested that preexercise stretching may temporarily compromise a muscle's ability to produce force. It is possible that this short-term effect of stretching on muscle force production may affect the performance of various rehabilitation strengthening exercises. More importantly, preexercise stretching may adversely affect the result obtained by muscle strength assessments and, in turn, influence a clinician's decision regarding rehabilitation progression or return to play. Before disregarding static stretching entirely (as a component of the warm up), it's important to take a closer look at the research. By no means have all studies found static stretches to have a negative effect on power performance.[14-17] In addition to this, in many studies that have found a negative association, the effects are often minimal.[18,19] Evidently, more research is needed to fill the gap of knowledge concerning the impact of static stretching on peak muscle torque.

The purpose of our study was to make an attempt to contribute our own conclusive evidence of the short-term effects that a thirty second static stretch has on quadriceps peak torque production. We hypothesized that the subjects would display a diminished peak torque measurement after the static stretch intervention. With this hypothesis, we can expect that examining the stretch-induced changes in quadriceps peak-torque will provide valuable information regarding the suitability of stretching as a warm up technique for relevant competitive sports and/or in a physical therapy clinical setting.

Experiment, Results, Discussion, and Significance

Experiment: Forty-seven WSU graduate students volunteered to participate in the study. The subjects, utilized as a sample of convenience, were healthy and indicated no current or recent knee-, hip-, or ankle-related injuries or pain and no apparent limits in knee range of motion. Prior to pre-testing, all students were given a medical screening questionnaire.

We used a within-subject design to compare the short-term effects of static stretching on peak torque production of the subjects' dominant quadriceps. The utilization of a within-subject design helped to control for subject variability, such as individual differences in flexibility and strength. During both laboratory trials (pre- and post-stretch), each subject completed four activities: (1) warm-up (2) pre-stretching isokinetic assessments, (3) static stretching procedure, (4) post-stretching isokinetic assessment. Each participant demonstrated this sequence of activities in a practice session one week prior to the actual testing in an attempt to familiarize the subjects with the experimental procedure and instruments.

Before the initial isokinetic testing, each subject completed a 2-minute warm up at 50 W on a stationary bicycle. Before and after the static stretching intervention, maximal concentric isokinetic peak torque for extension of the dominant leg (based on kicking preference) was measured at a velocity of $90° \cdot sec^{-1}$ throughout a 70° arch of 90°-20° of knee flexion. One minute prior to pre- and post-testing, a submaximal warm-up trial was performed by each subject which consisted of five consecutive concentric quadriceps contractions at the designated velocity, ranging from minimal to maximal effort. The

60-sec rest period allowed between the submaximal warm-up was chosen to avoid the potential for musculoskeletal fatigue. Immediately following the resting period, five maximal concentric contractions were performed and the peak torque was recorded by the isokinetic dynamometer. A paired t-test was used to determine if there was a mean significant difference between the corresponding observations.

Results: These results revealed no significant difference (p=.122) between the values of the two groups (pre-/post-stretch). The mean values (± standard deviation) of the strength tests are included in table 1. Further data analysis revealed no significant difference in peak torque values between sex, age, height, or weight.

Table 1: Demographics		
No. of Participants	47	
Gender	F = 32 (68%)	M = 15 (32%)
	Mean Values (n = 47)	**Range**
Age (yrs)	24.7 ± 1.8	22 – 30
Height (cm)	171.7 ± 10.7 (67.6 ± 4.2 in)	152.4 – 200.66
Weight (kg)	66.0 ± 13.6 (145.5 ± 30.0 lbs)	46.35 – 101.25
	Mean Values (n = 47)	**Range**
Pre-test (ft*lbs)	160.74 ± 42.9	94 – 259
Post-test (ft*lbs)	165.74 ± 46.8	101 – 276

Discussion and Significance: The main findings of this study demonstrated no significant difference in maximum quadriceps torque production before and after a 30-second static stretch. Subjects' peak torque measurements in the pre-stretch group were expected to yield a greater value than subjects in the post-stretch group.

Clinically, this research is relevant to practitioners who use strength assessments to influence their decisions regarding the rehabilitation progression or return-to-play status of athletes or patients under their care. The relatively small effect-size values in our studies suggest that application of the stretching-induced changes in performance may be context specific. Furthermore, this may imply the need for clinicians to consider a risk-to-benefit ratio when designing rehabilitation or training programs that incorporate preexercise stretching.

Conclusions

Because our subjects were free of any lower extremity injuries, further research is needed to examine the effect of preexercise stretching on muscle strengthening and/or strength assessments in athletes or patients who have experienced a muscle, tendon or joint injury

Acknowledgements

We would like to thank Wichita State University administration for the use of their laboratory facilities as well as the physical therapy students who volunteered to participate in this study.

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