THE EFFECT OF MASSAGE AND HEAT THERAPY COMBINED ON THE GENERATION OF MAXIMUM ISOKINETIC FORCE IN YOUNG AND ELDERLY SUBJECTS

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INTRODUCTION

Massage and heat therapy have been routinely examined in the past to determine their effectiveness on human performance. Generally, anecdotal information exists concerning the effectiveness of massage therapy on increasing motor skill performance. For example, the Director of a Hospital in Downey, California has provided information concerning the effectiveness of electrical stimulation on post-polio patients. It was determined that a post-polio patient was able to regain the use of his or her limbs following treatment with electrical muscle stimulation. Further, utilizing the H-reflex technique, massage and heat therapy have been shown to decrease motoneuron excitability in both young healthy adults (Morelli et al., 1990; 1991; Sullivan et al., 1991; Goldberg et al., 1992), as well as in special populations (Goldberg et al., 1994). However, in these studies the time course of the effect of massage has been shown to last for only a very short period of time. Further, whereas the effectiveness of massage and heat therapy has been studied on the reflex system, their combined effects on the voluntary motor system, and specifically on the generation of maximal force development, has yet to be studied. Therefore, the purpose of this study was to examine the effectiveness of massage and heat therapy on the force production of the quadriceps muscle in both young and elderly subjects. This study was an attempt to corroborate or answer many questions related to massage therapy.

METHODS

Subjects consisted of 10 young and 13 elderly subjects. The descriptive statistics for average age, height and weight are shown in Table 1. Each subject reported to the lab for one day of testing, and each test session required approximately 45 minutes. Initially, subjects completed a Subject Information Questionnaire detailing their past involvement in activities, their use of medications, and their general assessment of health and fitness. Subjects were then seated in a Cybex II dynamometer, and familiarized with the apparatus. Subjects were asked to perform five submaximal

repetitions with the quadriceps muscle of their dominant leg, at an intensity equal to approximately 50 percent of their maximal effort, in an attempt to warm-up as well as familiarize them with the procedures. Subjects were then administered five minutes of vigorous surface massage of the quadriceps muscle. This was immediately followed by five minutes of heat, as applied with a standard heating pad. After this treatment, without delay, subjects were then given an additional five minutes of massage. Subjects were next tested for five maximal isokinetic voluntary contractions at 60 degrees per second, with approximately 15 seconds between each trial. On each maximal voluntary trial, peak force (in ft-lbs) and time to reach peak force (in ms) were calculated. After the five contractions, the quadriceps muscle was cooled with ice, until skin temperature returned to baseline level, as measured subjectively with touch. After skin temperature returned to normal, five maximal voluntary contractions were repeated, to be used as a baseline measure. On one subject, the control condition (no massage or heat treatment) was administered first to determine the effect of treatment order. In this subject, it was determined that there was no difference in the order of the experimental treatments. On two subjects, a heat thermister was used on the quadriceps muscle to monitor muscle temperature. Also, on two subjects additional massage and heat therapy were extended to 10 minutes each, in an attempt to determine the role of longer duration massage and heat on force production.

Table 1. Means and standard deviations for age, height and weight of all subjects.

Group	n	Age (yrs)	Height(cm)	Weight (Kg)
Elderly Women	6	63.2 (3.4)	165.1 (10.2)	62.7 (9.8)
Elderly Men	6	71.5 (4.4)	177.8 (12.1)	88.5 (8.2)
Young Women	5	24.1 (3.2)	145.6 (10.1)	59.0 (6.7)
Young Men	5	27.2 (5.1)	170.5 (7.7)	75.5 (9.2)

RESULTS

The results for this study are shown in Tables 2 and 3. Specifically, the elderly women showed a 2.74 decline in maximal force with massage and heat therapy (70.02 ft-lbs vs 68.10 ft-lbs) and a 1.32 percent increase in force development time (391.6 ms vs 396.8 ms) with heat and massage

therapy. The elderly men, on the other hand, demonstrated a 2.27 percent increase in peak force (89.58 ft-lbs vs. 91.62 ft-lbs) and a 2.02 percent increase in force development time (362.64 ms vs 370.00 ms) with massage and heat therapy. In the elderly male group, it is worth noting that five of the seven subjects tested increased their maximal force following the massage and heat therapy treatment. The results for both the elderly subjects are shown in Table 2.

Table 2. Means for peak force, force development time and force impulse in elderly subjects.

	Peak Force (ft-lbs)	Force Development Time (ms)	Impulse (ft-lbs)*ms
Women			
Massage/Heat Therapy	68.10	396.84	27024.80
Control	70.02	391.61	27420.53
Men			
Massage/Heat Therapy	91.62	370.00	33899.40
Control	89.58	362.66	32487.08

In the young group, there was a 0.71 percent increase in peak force for (92.46 ft-lbs vs 93.12 ft-lbs) and a 0.43 percent decrease in force development time (370.0 ms vs 368.40 ms) in the women, and a 4.7 percent decrease in peak force (137.40 ft-lbs vs 131.22 ft-lbs) and a'0.36 percent decrease in force development time (326.48 ms vs 324.40 ms) for the men. The results for the young subjects are shown in Table 3.

Table 3. Means for peak force, force development time and force impulse in young subjects.

	Peak Force (ft-lbs)	Force Development Time (ms)	Impulse (ft-lbs)*ms
Women			
Massage/Heat Therapy	93.12	368.40	34305.40
Control	92.46	370.00	34210.20
Men			
Massage/Heat Therapy	131.22	324.40	42567.78
Control	137.40	326.48	44858.35

It is interesting to note that whereas the young women demonstrated a slight increase in peak force with the massage and heat therapy, the elderly women demonstrated a slight decline in force production with massage and heat therapy. The opposite effect was found with the men; that is, the young men demonstrated a decrease in peak force with massage therapy whereas the elderly men demonstrated an increase. It is suggested that future studies be undertaken to examine the reasons for these differential effects of massage and heat therapy in men and women.

DISCUSSION

The result of this study demonstrated marginal effects of massage and heat therapy combined on the generation of maximal isokinetic force in young and elderly subjects. It appears that, if effective, massage and heat therapy may be beneficial for the elderly male group, in which five of the seven elderly males tested produced greater peak force following the massage and heat therapy. Several considerations seem warranted. First, the present study was limited in that skin temperature was not directly measured, but rather it was assessed through the use of subjective means, with the exception of two subjects. It is recommended that future studies monitor skin temperature to determine its role in determining the effectiveness of massage and heat therapy. Second, it appears that the massage and heat therapy was less beneficial for the elderly women. It is speculate that perhaps a deeper type massage therapy may be superior for these women. Alternatively, additional measure should be taken to ensure that only the quadriceps muscle is being used to exert maximal force, as other upper body muscles (arms, shoulders) may contribute biomechanically to the generation of knee extension torque. Finally, it is recommended that additional time be given to the application of both the massage and heat therapy, to increase its potential effectiveness.

From this study, it is recommended that future implications center around the use of massage and heat therapy as it relates to rehabilitation of injured athletes, and as it relates to atypical subjects with muscular and/or neurological disorders. Further, the use of electrostimulation techniques to administer deep muscle massage, as opposed to the superficial massage used in this study seems warranted. It is believed that the increased fatty tissue associated with aging, particularly in the female group, prevented the superficial massage used in this study from being effective. Finally, it is recommended that future studies examine the role of massage and heat

therapy on skilled performance rather than force production. It should be noted that medical researchers have indicated to the present authors that many studies can be generated in various aspects of this area in the future.

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