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Comparing the Effects of Massage and Rest on Fatigue and Strength Recovery Following Exhaustive Concentric Contraction

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Abstract

Purpose: The purpose of this study was comparing the effects of massage and rest on fatigue and recovery of strength following exhaustive concentric contraction.

Material and Methods: In this research, 10 subjects (age 20.7 ± 0.94 yrs, body mass 59.5 ± 5.89 kg, height 173 ± 3.6 cm ,body mass index 20.5 ± 1.37 m/cm 2) from 60 male, non-athlete students of Ferdowsi University of Mashhad, participated voluntarily and based on the specific inclusion/exclusion criteria of the study. The subjects participated in two testing sessions during a week (with an interval of 48 hours between the first and second session).

Subjects did warm-up at the beginning of each session. In the first session, maximum strength of quadriceps was measured by leg extension machine. In the second session (the rest session) the participants initially did exhausting concentric contractions with 50% of their maximum strength after the warm-up, then quadriceps muscle strength was measured before and after 6 minutes of rest, using evaluation instrument of isometric strength in 90 degree knee angle. In the third session the participants received classical massage techniques instead of resting for 6 minutes. The data regarding fatigue and strength recovery, between passive rest and massage sessions have been analyzed using paired sample t-test. All the data analyses were done using SPSS software. P <0/05 was considered as significant.

Results: The results of t-test indicated a significant difference in the average rate of recovery from fatigue (pre= 0.812 , post= 0.002) and muscle strength (pre= 0.150, post= 0.000) between pre and post-tests following the passive rest and massage sessions.

Discussion and Conclusion: Massage was an effective intervention for enhancing muscle performance and reducing fatigue but rest did not have such an effect.

Key words: Massage, Fatigue, strength Recovery, Concentric contraction

Introduction

Massage is a systematic form of mechanical manipulation of soft body tissues performed by hand as a treatment, health restoration and relief[1, 2]. This intervention is broadly used in many fields including medical treatments, rehabilitation, etc, because of its unique functions. One of the most important functions of massage is manifested in athletes' preparation programs [2]. As the number of people participating in training programs grow, exercise-related injuries grow as well [3]. Following the incidence of fatigue during exercise, variations occur in muscle tissues. In progressive, maximal and exhaustive training programs, the body may not have enough time to recover between the training sessions or even between the stages of a single training session or competition, which reduces the individual's performance [4].

Evidently, fatigue affects the athlete's functional accuracy [5] so that it, not only reduces the athlete's physical and mental performance[6] but also creates mental and physical disorders and exercise-related injuries [7].

Research has shown that injuries are most prevalent in ankle, knee and shin [8]. From among the skeletal muscles, quadriceps is involved in almost all physical activities Such as running, walking, kicking, etc. It is also involved in the reduction of reactive forces from the ground during walking so that, its continual contractions during

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activities create muscular fatigue. Therefore, it is necessary to investigate the mechanism of fatigue and strength restoration of this muscle in order to increase the efficiency and avoid injuries in athletes [9]. There are various procedures including electrotherapy, cold and hot compress and massage to remove fatigue following exercise. Massage is one of the common procedures used by athletes to remove fatigue and recover [10]. Recent findings suggest that massage is broadly used during major sports competitions to prepare athletes before and between the competitions and to restore the strength after the events [11]. Galloway and Watt (2008) reported that almost 45 percent of athletes' physiotherapy during major tournaments is allocated to massage therapy [11].

It is believed that, as one of the best advantages of massage therapy, massage positively affects the athletes' performance and reduces the recovery time, which improves the performance in subsequent competitions. Trust in the advantages of massage is so ingrained in the athletes that some of them attribute part of their success to it [11]. Investigating the effects of combined recovery interventions, Monedero and Donne (2000) compared the effects of three types of intervention: massage, active recovery and combined intervention (i.e. massage and active recovery). They reported that a combined recovery intervention significantly improved the athletes' performance and records as compared to the other isolated interventions of massage or active recovery. Though, massage duration was short in their study (7.5 minutes), the results confirmed the advantages of massage when it was combined with a short active recovery intervention [12].

However, research findings still do not support the positive effects of massage on performance decisively, so there is no general consensus over the efficacy of massage on fatigue reduction and recovery following exhaustive contractions. Even though there have been various studies to investigate the effects of massage on these factors, lots of questions still remain to be answered about the efficacy of massage in sports competitions. Some researchers believe that massage reduces muscular fatigue and improves performance via affecting various body mechanisms [10, 11, 13]. On the other hand, some scholars believe that massage improves some physiological indices though it does not improve muscular performance [14-16]. Considering the fact that massage currently plays a crucial role in reducing fatigue and restoration of muscular strength, the present study sets to investigate the effects of massage on fatigue and recovery following exhaustive contractions.

Material and Methods

The participants' anthropometric characteristics included: Age= 20.7±0.94 years, Height=173.1±3.6 cm, Weight=59.5±5.89 kg, BMI=20.5±1.37 kg/m^2. From 60 male, non-athlete students of Ferdowsi University of Mashhad, who volunteered to participate in this study, 10 students were chosen based on the inclusion/exclusion criteria of the study. The criteria for the exclusion of subjects included: having any pain or injury in ankle or knee joints, thigh and lower extremities; use of doping substances, narcotics and alcohol; a history of fracture or luxation in the lower extremities during the last year; a history of cardiovascular and pulmonary diseases; a history of neurological and muscular diseases; any systematic disease like rheumatism or diabetes. Subsequently, the volunteers who passed all the requirements, were selected as the participants. Before completing an informed consent, the participants were informed of the nature, procedures and requirements of the study.

The participants were to avoid doing heavy exercise from 24 hours before the beginning of the first testing session to the end of the study.The subjects participated in two testing sessions during a week (with 48 hours of interval between the first and second session). At the beginning of every session, the subjects performed two stages of warm up. In the first stage, they did static stretching exercises and in the second, they did cycling exercise (2 minutes) on the exercise bike at arbitrary pedalling rhythm. In the first session, the maximum power of quadriceps femoris muscle was measured in the subjects using knee extension machine. In the second (rest) and third (massage) sessions, quadriceps femoris muscle strength was measured after preliminary warm-up and before the application of fatigue protocol. Then, the participants performed concentric contraction exercise at their 50 percent maximal strength to their exhaustion within 90 degrees of ROM (i.e. from 90 percent of flexion to full extension). Subsequently, before a 6-minute passive rest or massage[17],quadriceps femoris muscle strength was measured at 90 degrees of knee angle in the participants using isometric force measurement

device (YM-300, made in Japan). During contractions, verbal incentives and visual feedback were used to encourage the individuals to use their maximum muscular power [18, 19]. During the concentric contractions performed to the exhaustion limit, the subjects were asked to apply their power across the definite range of motion while they were encouraged by continual verbal incentives. At the end of fatigue protocol, the participants either received 6 minutes of massage (according to table 1) or they took passive rest for the same amount of time.

The data were analyzed using paired sample t test. All the data analyses were done using SPSS software. P <0/05 was considered as significant.

Intervention

Many coaches, athletes and sports therapists have applied Swedish type massage [14, 20, 21]. In the present study, Swedish massage techniques were applied in the massage protocol. This massage includes five manipulations: effleurage, friction, petrissage, vibration and tapotment. The massage was applied on the anterior lower limbs (thighs) for 6 minutes.

Statistical analysis

The data are presented as mean ± standard deviation (SD) and were analyzed using SPSS software (version 14). paired-samples t-test was run to analyze the data, and compare passive rest and massage sessions.

Results

The results showed that there was a significant difference between massage and passive rest conditions regarding fatigue reduction (P=0.002). However, the difference was not significant before the intervention (P=0.812). Table 2 illustrates data regarding fatigue reduction.

The results of paired-samples t-test showed that massage was more effective in recovery of muscular strength as compared to passive rest (P=0.000), and that there was a significant difference between the effects of massage intervention and passive rest in this regard. However, the difference was not significant before the intervention (P=0.150). Table 3 illustrates the results of statistical analysis of muscular strength recovery.

Table 1: Anterior lower limb (thigh) massages protocol

Massage Technique	Rate	Time (duration) In seconds
Effleurage	30-40 strokes/min	30
Friction (circular) performed with the thumb (left hand, right hand, two hands together)	60-70 circles/min	35
Friction (circular) performed with the other four fingers (left hand, right hand, two hands together)	60-70 circles/min	35
Friction (circular) performed with the palm (left hand, right hand, two hands together)	60-70 circles/min	35
Deep friction	40-50 circles/min	20
Comb friction	30-40 strokes/min	30
Octave friction (medial, intermediate, lateral)	60-70 circles/min	30
Petrissage (circular kneading with palm)	60-70 strokes/min	25
Cutting petrissage with two hand (medial thigh)	60-70 strokes/min	20
Tapotment – hacking	240-260 contacts/min	30
Vibration	60-70 shakes/min	10
Effleurage	40-50 strokes/min	30

Table 2: Comparison of fatigue in different stages of evaluation, between massage and passive rest sessions

Variable (unit)	Stage of evaluation	Mean ± SD	P
Fatigue(mm)	Before massage – before rest	88.20±11.02---89.30±9.36	0.812
	After massage—after rest	18.2800±13.50--41.20±14.38	0.002*

Table 3: Comparison of knee extensors muscular strength in different stages of evaluation between massage and passive rest sessions

Variable (unit)	Stage of evaluation	Mean ± SD		P
Muscular strength (Nm)	Before massage – before rest	68.20±11.44	59.80±22.10	0.150
	After massage—after rest	95.10±9.99	70.40±14.84	0.000

Discussion and Conclusion

Over the past years, massage has gained much application in sports [11]. The present study, compared the fatigue and muscular strength of quadriceps after massage intervention and passive rest. Results showed a significant difference between the two. After the application of fatigue protocol, a significant decrease was observed in the participants' functional performance and power, which indicated the incidence of fatigue due to the protocol. After 6 minutes of massage, fatigue and muscular strength was significantly restored in the participants following exhaustive concentric contractions. Therefore, massage may result in a more effective recovery following exhaustive concentric contractions (fatigue) as compared to passive rest. Balke et al (1989) studied 7 healthy participants and reported that massage may restore muscular strength following exhaustive exercise[17].

Rinder and Sutherland (1995) investigated the effect of massage on the performance of quadriceps muscles in 20 healthy participants following exhaustive exercise. They reported that massage improved the number of knee extension repetitions as well as performance, as compared to rest [22].

The present findings correspond to the findings of Balke et al (1989), Jordan and Joseph (1990) and Rinder and Sutherland (1995), confirming the positive effects of massage on the restoration of muscular strength. Hemmings et al (2000) studied 8 amateur boxers for two sessions. The boxers performed five 2-minute rounds of boxing followed by either 20 minutes of massage or passive rest. Then, they repeated boxing training the same number of rounds. The researchers reported that massage had no effect, neither on the participants' performance nor on the power reduction across boxing rounds. However, massage significantly improved the perceived recovery in the participants[10].

The present findings do not correspond to the findings of ShojaAldin et al (2009), Hemmings et al (2000), Dawson et al (2004) and Robertson et al (2004). This may be related to differences in research methodologies, whereby they drew on the repetition of athletic performance. Besides, the duration of massage intervention was not the same in the two studies. Moreover, massage has been more effective in restoring strength following a fatigue-inducing protocol and exhaustive concentric contractions, as compared to passive rest.. A few mechanisms may be involved in relaxing responses to massage, which include increase in plasma endorphin, decrease in irritability, decrease in stress hormone levels and/or variations in parasympathetic activity [1, 14]. Research has shown that motivation and lack of perceived fatigue may affect the athletes' capacity and improve their performance because both physical and mental fatigue influence athletic performance [14]. Central nervous system is the center of fatigue. When the central nervous system, which controls and coordinates all physical activities, is recovered, the individuals may have more concentration on their activities, which eventually improves their functional capacity.

Athletes believe that massage may positively affect their performance and decrease recovery time following muscular fatigue, which improves the athletic performance in subsequent competitions. Sport therapists and physiotherapists broadly use massage therapy with athletes. The results of the present study showed that there was a significant difference between the effects of massage and passive rest, on fatigue reduction and strength restoration, following exhaustive contractions. In other words, massage was more effective than rest, in restoring muscular strength following exhaustive concentric contractions. Also, massage was more

effective in removing perceived fatigue as compared to passive rest. Therefore, with regards to the biomechanical (increase in the ROM, decrease in tissue adhesions), physiological (increase in blood flow in tissues, increase in parasympathetic nervous activities, decrease in the secretion of stress hormones), and psychological and neurological effects of massage, it is recommended that massage be used to remove fatigue and restore muscular strength during rest intervals in strength and exhaustive sports as well as exercise. A comparison between the present and previous findings shows that further research is necessary to illuminate the exact effects of massage on restoration of muscular strength, improvement of performance and reduction of fatigue.

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