Massage Therapy Effects on Sport and Exercise Performance

Subjects: Anatomy & Morphology

Contributor: Miloš Dakić, Lazar Toskić, Vladimir Ilić, Saša Đurić, Milivoj Dopsaj, Jožef Šimenko

A massage is a tool that is frequently used in sports and exercise in general for recovery and increased performance. Massages, in general, do not affect motor abilities, except flexibility. However, several studies demonstrated that positive muscle force and strength changed 48 h after the massage was given. Concerning neurophysiological parameters, the massage did not change blood lactate clearance, muscle blood flow, muscle temperature, or activation. However, many studies indicate pain reduction and delayed onset muscle soreness, which are probably correlated with the reduction of the level of creatine kinase enzyme and psychological mechanisms. In addition, the massage treatment led to a decrease in depression, stress, anxiety, and the perception of fatigue and an increase in mood, relaxation, and the perception of recovery.

Keywords: recovery ; motor abilities ; neurophysiology ; psychology

1. Introduction

Today's regime of competitive sport is very intensive and often causes athletes to become fatigued. If the organism has not recovered enough between strenuous activities, it could eventually lead to overtraining or an injury. It is also necessary for recovery to be as fast and efficient as possible because, in real field situations, during breaks, an athlete has a couple of hours or sometimes only a few minutes to prepare for the next game/match. The difference between winning and losing is often the capability to optimally maintain muscle work despite fatigue. A sports massage represents a tool that is frequently used in sports for that purpose, to recover and prepare an athlete for the following match [1][2][3]. However, it has been highlighted that sports massage is time-consuming and expensive [3]. Therefore, the best and most efficient practices should be explored, which are also supported by evidence.

A massage is generally defined as the mechanical manipulation of soft tissues using rhythmically applied moves and pressures with the purpose of enhancing health and well-being [1][2]. Besides manual massages, many other forms of massages are applied in sports. These are the vibro-massage, hydro-massage, acupressure massage, rolling massage (using myofascial release techniques), and massages with a foam roller (FR), which is the most used instrument in the sport and fitness industry today [4]. The literature frequently reports that massage therapy positively affects physiological, neurological, psychological, and biomechanical mechanisms [5]. Still, there have been many adverse results when researchers tried to test those hypotheses, as shown in the following sections of the manuscript. Despite this, the massage is the most often used medical treatment in sports competitions. For example, Galloway and Watt [2] and Ernst [6] observed athletes in Great Britain between 1987 and 1998 and showed that massage therapies had 45% more involvement than all other medical treatments did at big sports events. Additionally, the sports massage has been reported to generate a multi-million-GBP industry of professional therapists and massage accessories [3].

2. The Effect of Massage Therapy on Motor Abilities

In most studies, massages did not affect muscle force [7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23], but a few studies showed that massages led to a significant improvement in muscle force [24][25][26][27][28][29][30]. They also revealed that performing a massage before doing muscle strength or speed tests in most conditions did not alter the results in the post-tests [10][16][17][19][22][28][31][32][33][34][35][36][37][38][39][40][41][42][43][44][45]. However, the results of several studies showed improvements in muscle force and strength, especially 48 h after the fatigue protocols [13][27][28][37][46][47].

The findings of Hiruma et al. (2014) and Kargarfard et al. (2016) revealed the positive effects of massages on muscle force 48 h after the fatigue protocol [27][28], and McGregor et al. (2018) also obtained positive results of massages on maximal voluntary contraction (MVC), but only 30 min after the treatment. There were no significant improvements when muscle force was immediately measured or 15 min after foam rolling (FR). This was the first study that reported an

improvement in MVC following FR alone, suggesting that FR could reduce the impact of fatigue during this submaximal task. The authors concluded that FR allowed the muscle to be activated more efficiently and should be conducted at least 30 min before the activity [48]. Farr et al. (2002) also presented different muscle force results in relation to time after the fatigue protocol. They compared the influence of therapeutic massages on the subjects' force after a 40 min downhill treadmill walk loaded with 10% of their body mass. The massage was conducted on one limb 2 h post-walk, and muscle force was measured twice before and 1, 24, 72, and 120 h after the walk. The results indicated that the massage negatively affected muscle force only 1 h, but not 24, 72, and 120 h after the walk [49]. Only one study demonstrated that massage therapy negatively affected muscle force development. The findings of that study revealed that a single bout of foam rolling led to neuromuscular exhaustion regarding the maximal force production of knee extensors [31].

When muscle strength was observed, two types of methods were used: strength assessed with a dynamometer [31][32][33][34][35][36][49][50][51][52] and assessed via jumping [10][13][16][17][19][22][25][27][28][33][34][35][37][38][39][40][41][46][49][53][54][55][56]. Most studies indicated that a massage does not affect muscle strength [10][16][17][19][22][28][31][32][33][34][35][36][37][38][39][40][41]. Additionally, most benefits were found 48 h after the massage therapy [13][27][28][37][46], while four studies showed an immediate positive effect of the massage on muscle strength [25][50][53][54]. In the first one, the subjects were given an FR massage and performed a dynamic warm-up exercise [25]. In the second one, the subjects used vibration rolling (VR), non-vibration rolling (NVR), and static stretching as part of their warm-up. Vibration rolling significantly increased the quadriceps' muscle strength [50]. The third study revealed that both VR and NVR allows the athletes to have increased jump heights [53], and the last one showed that adding VR to dynamic stretching would also result in greater power in the lower limbs [54]. The findings of these studies suggested that using FR as a part of a warm-up should lead to an overall improvement in muscle strength. The opposite results were obtained regarding the strength of the quadriceps and hamstrings muscles when different speeds were used, as measured with an isokinetic dynamometer [34][49][51][52]. In a study by Hunter et al. (2006), massages appeared to reduce strength during concentric isokinetic contractions of the knee extensions at 60°/s, with there being no changes when they were performed at 120, 180, and 240°/s velocities. This reduction was caused by a change in muscle architecture, which affected the length–tension relationship and not due to altered neuromuscular recruitment (44). On the other hand, Arroyo-Morales et al. (2011) showed that the strength of knee extensions was significantly lower when they were performed at higher velocities (180 and 240°/s) and that a massage did not influence them at lower velocities (60 and 120°/s). In this study, a pre-event massage negatively affected muscle performance at higher velocities, possibly because of the increased parasympathetic nervous system activity and decreased afferent input, leading to less motor unit activation. However, the strength of knee flexions stayed unchanged after a massage at all observed velocities [51]. The results of Su et al. (2017) also revealed that a massage could not contribute to knee flexion peak torque improvements. However, that was not the case for the quadriceps muscles.

Concerning endurance, a twenty-minute massage did not improve the cycle ergometer endurance times (total or lap times) during a 161 km race. The race was finished in 4 days, and the same distance had to be completed daily [57]. In a similar endurance study, the subjects did not obtain better results in a 5 km bicycle race when they were given a massage rather than active or passive rest. However, combining massage and active recovery led to better results at the same distance [58]. Junker and Stöggl (2019) also demonstrated that FR did not increase nor decrease core strength endurance within an eight-week training period [41]. The next four studies showed improvements in a leg extension task, where the subjects performed the maximum number of leg extensions against half maximum load [59], in an eggbeater kick performance endurance task (water polo) [60], in a 200 m swimming task m [61], and in a hand grip endurance task involving healthy young men [29].

The most obvious effects of the massage were the effects on flexibility, as most studies indicated a positive correlation between massage and flexibility, significantly increasing the range of motion. Therefore, it is concluded that a massage can be used as an alternative method for the enhancement of flexibility [12][13][16][17][20][21][22][25][26][27][32][36][39][41][52][53][54][56][60][62][63][64][65][66][67][68][69][70][71][72][73][74]. A few studies showed significant and non-significant enhancements in range of motion (ROM) [19][50][75][76]. Aune et al. (2018) showed that FR only led to acute and not chronic improvements of dorsiflexion ROM [19]. Additionally, improvements in hip abduction were found only after FR for the gluteal muscle group and not for the iliotibial band [76]. When vibration and non-vibration rolling were compared, VR affected both knee extension and flexion, and NVR only affected knee extension [50]. The foam rolling of the anterior thigh improved hip extension ROM and did not affect knee flexion ROM [75]. Only six studies showed non-significant enhancements of ROM [8][38][48][77][78][79]. The FR technique was used in all of these studies, and the massage time was no longer than two minutes. The effects of the massage on flexibility 6, 24, and 48 h [8] and 24 h [38] post-exercise were also without significance.

3. The Effects of Massage Therapy on Neurophysiological Mechanisms

Most studies examining the neurophysiological mechanisms of the human organism and its relationship with massage therapy concerned muscle fatigue or soreness. Fatigue activates recovery mechanisms that protect the organism. The accumulation of lactate acid is one of the most important mechanisms, which leads to the appearance of fatigue. Therefore, its removal is believed to be crucial for recovery [80][81]. Regarding the neurophysiological mechanisms, a massage cannot remove lactate acid, but it can reduce creatine kinase enzyme and, in that way, contribute to reducing pain or delayed onset muscle soreness.

Bale and James (1991) confirmed that a massage has a positive effect on lactate removal (LR) [82]. There was just one more study in which a massage was more effective than passive recovery was in removing blood lactate (10 min massage after 200 m of front crawl swimming with maximal effort) [61]. Nevertheless, one study showed that a massage negatively affected LR [83]. In this study, subjects performed 2 min of strenuous isometric handgrip exercise at 40% MVC to elevate the level of forearm muscle lactic acid after they received a manual massage for 10 min. This was the first study that examined venous lactate acid, allowing researchers to investigate a massage's influence on its removal from exercised muscle. In a series of future studies, other authors did not obtain similar results [11][58][79][84][85][86][87][88][89][90][91][92].

Concerning massages' effects on muscle temperature, Hinds et al. (2004), as well as Mori et al. (2004) and Boguszewski et al. (2014), revealed that a massage has only a surface (skin) influence [93][94][95]. However, Hinds et al. (2004) also measured the temperature of m. vastus lateralis at depths of 3, 2 and 1 cm using a needle thermocouple under local anesthesia. The results of this study did not support the hypothesis that a post-exercise massage elevates limb blood flow [95]. On the other hand, Drust et al. (2003) showed that, besides skin temperature, a massage increased the temperature at 1.5 cm and 2.5 cm and did not have an influence at a depth of 3.5 cm [96]. The experiments showed that blood flow and muscle temperature did not help remove lactate acid.

One of the most common fatigue mechanisms is DOMS. It was believed that lactate acid is the main cause of DOMS. However, Cheung et al. (2003) have proven that the increased lactate acid concentration after exercise returns to rest values one hour after strenuous exercise [97]. Therefore, it can be concluded that higher values of lactate acid cannot cause DOMS, which is formed from 24 to 48 h after intense physical activity. A detailed investigation of DOMS and intense physical activity revealed the development of muscle fibers damage, which led to the direct releasement of the enzyme creatine kinase (cK) [28][98][99][100][101]. Only one study did not show the positive influence of massages on the reduction of the cK level [102]. In this experiment, the massage therapist conducted vigorous massages, increasing the amount of cK. It eventually led to a subject feeling of reduced DOMS. This enzyme is one of the main indicators of damaged muscles, activating pain receptors and elevating their perception. In conclusion, there are positive trends between massage application and the reduction of DOMS, which are backed up by the results of numerous studies: [8][18][30][35][38][47][49][69][103][104][105][106][107].

Regarding muscle activity, it has been assumed that a massage could influence the level of muscle activation. Because of this, researchers tried to investigate those claims. Surface electromyography is a technique used for capturing and measuring electrical activity and muscle action potential. It is commonly applied to specify force production and analyze muscle fatigue. Two methods are used to assess the differences among EMG signals. First, the root means square (RMS) value of the myoelectric signal is a commonly utilized method that reflects the level of the physiological activities in the motor unit during contraction [108]. Most of the studies showed that a massage could not alter the electromyographic characteristics of muscles [26][34][92][109][110][111]. On the other hand, a few studies demonstrated the double-natured effects of massages on the EMG properties of muscles [21][112][113]. In the study of Madoni et al. (2018), the subjects performed maximal knee extension and flexion at three different velocities. No significant changes were found for eccentric hamstring EMG, while the concentric muscle activation of the biceps femoris decreased from pre- to post-test after the foam rolling of the dominant side hamstrings [21]. Aboodarda et al. (2017) investigated the alterations of corticospinal excitability following the rolling massage of the quadriceps muscles. The RMS EMG recorded from VL and VM at 50% of MVC did not demonstrate any difference between the two conditions, but it indicated a significantly lower value for electromyographic activity recorded from VL at 10% MVC. The results revealed that rolling massages aggravate the central excitability of muscles (specifically VL), but only at low-level contractions where the minimum central drive is required to recruit the low threshold spinal motoneurons and motor units [114].

4. The Effects of Massage Therapy on Psychological Mechanisms

Studies that link massage and psychological mechanisms are scarce. In the athletic and recreational sport population, most of the studies confirmed a positive correlation between a massage and the improvement of different psychological states. Massages reduce stress [115][116], anxiety [115][117][118][119], depression [115], and fatigue perception [89][90][93][107][112][113][120] and increase mood [51][117][118], relaxation [117] and recovery from fatigue [88][112][116]. However, only one study found no influence of massages on mood state [121]. In that study, 16 subjects completed a questionnaire to establish their baseline mood, and then performed a 30 s Wingate anaerobic cycling test. After the test, they received a 30 min massage or had 30 min of passive rest, and then repeated the same procedure.

5. Conclusions

The massage generally does not cause negative or positive effects on motor performance after its application, except flexibility, and there are some indications of its positive effects 48 h after intensive activities. Concerning the neurophysiological parameters, a massage did not affect blood lactate clearance, muscle blood flow, muscle temperature, or activation. However, many studies indicate pain reduction and delayed onset muscle soreness, which are probably correlated with the reduction of the level of creatine kinase enzyme and psychological mechanisms. Nevertheless, massage therapy is often used in modern elite sports and exercise, probably because of its effects on different psychological states, such as decreases in depression, stress, anxiety, and fatigue perception and increases in mood, relaxation, and the perception of recovery.

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