Volume 23, Number 4, pages 65–69

Post-Training Massage: A Review for Strength and Power Athletes

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Keywords: massage; strength and power training; athletes; delayed onset muscle soreness; neuromuscular fatigue.

Summary

The high volume and high intensity associated with training of strength and power athletes often leads to short- and long-term fatigue. Current research shows manual massage has little, if any, beneficial effects. Types of massage evaluated are manual massage, including effleurage, pettrisage, tapotement, and underwater water-jet massage (UWWJM). Dependent variables evaluated include strength and power performance variables, muscle damage, and delayed onset muscle soreness (DOMS). Studies evaluating the effects of manual massage have been fraught with methodological errors. Failure to standardize treatment protocol, including type, duration, and time course of massage, has limited the value of research to this point. Eccentric exercise protocols have been used to induce DOMS; however, this is not reflective of how strength and power athletes train. Although positive effects of UWWJM have been reported, future study is required to determine the reliability and validity of the results. Future efforts to study massage should focus on evaluating performance variables and muscle damage rather than DOMS, using realistic training programs over a longer time span.

Introduction

A great deal of controversy exists regarding the use of massage to enhance recovery from heavy resistance training (HRT). The lay literature contains a large number of articles prescribing the use of massage as a treatment protocol for athletes. The current use of high-intensity and high-volume training by athletes necessitates the use of means to enhance recovery. These means include coaching, medical/biological, and psychological. Among the medical/biological means to enhance recovery is the use of postexercise massage.

Various forms of massage have been proposed as treatments for athletes. The literature includes references to effleurage (13, 15–17, 20), pettrisage (13, 15, 16, 20), tapotement (9, 13, 15), ice massage, and underwater water-jet massage (UWWJM) (18). Effleurage massage refers to deep stroking in the direction of venous flow. Pettrisage involves kneading the muscle tissue in a distal to proximal direction. Tapotement refers to the use of gentle blows to the surface of the muscle. Ice massage is a form of cryotherapy and will not be discussed in this review due to the different reason of application. Typically, ice massage is applied following stress or injury to reduce local tissue temperature, inflammation, and swelling, rather than to promote recovery from bouts of training. UWWJM involves high-pressure water streams in a pool.

Athletes often use HRT to improve performance. Within resistance training, there are different classifications of training methods. One way to categorize HRT methods is into strength and power training. Strength training utilizes high load and low velocity during exercises to increase force production. Power training utilizes low/moderate load and high velocity during exercises to increase power production.

The detrimental effects of resistance training can be divided into two categories: delayed onset muscle soreness (DOMS) (1, 4, 7, 8, 10, 14, 19) and acute neuromuscular changes (1, 2, 6–8, 12, 14). DOMS is commonly associated with eccentric activity (1, 2, 6–8, 12–17, 19, 20). These changes are seen with both concentric and eccentric activity (1, 4, 7, 8, 14).

Neuromuscular Cost of Resistance Training

Acute neuromuscular changes associated with resistance training include altered electromyogram (EMG) activity (1, 6, 12), decreased maximum voluntary isometric contraction (6–8, 12, 14), and decreased torque and rate of torque development (7, 8, 12). These changes can also vary depending on whether eccentric or concentric contractions are used (1). Regardless of the mechanisms, the acute outcome of resistance training is fatigue.

One possible mechanism for fatigue may be low frequency fatigue (LFF) (1). LFF occurs following resistance training and has a greater effect with eccentric contractions. LFF is seen as the low-level electrical activation of resting muscle following exercise. It is postulated that LFF occurs due to impaired calcium transmission following damage to muscle. This damage is related to ischemia and not DOMS as evidenced by non-union between EMG and subjective pain rating scales (1). LFF often occurs with resistance training, as fast-twitch muscle fibers appear to be more susceptible than slow-twitch fibers (1).

Different physiological processes may be involved with strength and power training (2, 12), resulting in fatigue. Recovery from fatigue as a result of low force/high velocity activity appears to occur on a hyperbolic curve, containing fast and slow recovery slopes (2). Fast recovery from fatigue occurs around 60 seconds and slow recovery requires up to 6 minutes. Power, peak torque, and work drop to 45–55% of pre-exercise values (12).

Multiple high intensity/low velocity loads appear to reduce maximum force to 75% of their initial values (6). Recovery occurs in a linear fashion, returning to baseline at 48 hours.

Delayed Onset Muscle Soreness

DOMS commonly occurs during novel exercises and in untrained individuals, particularly when they consist of a high force eccentric component (5, 10). The sensation of soreness peaks at 24–48 hours postexercise and lasts from 72 hours to 10 days (1, 4, 5, 7, 8, 10, 14, 19). DOMS attenuates after 2–4 weeks of training, depending on the training status of the individual (10).

One theory for the relationship between DOMS and eccentric exercise is that the amount of tension per active sarcomere is greater as a result of lower electrical activation during eccentric contractions than during concentric contractions (1). The greater tension per active sarcomere may result in mechanical fiber disruption and changes in sarcolemma permeability. Eccentric exercise is also associated with edema causing increased osmotic pressure (4, 8). This is believed to have the same consequences on the contractile and cytoskeletal components.

DOMS is associated with an increase of serum carbonic anhydrase-III (S-CAIII), serum myoglobin (S-Mb), and serum creatine kinase (S-CK) (5, 10, 11, 16, 18, 19). S-CAIII is associated with disruption of slow-twitch fibers, S-Mb with disruption of fast-twitch fibers, and S-CK with disruption of the sarcolemma (5, 19).

In a study comparing power-trained individuals to endurance-trained individuals, similar increases in S-CAIII, S-Mb, and S-CK were seen in both groups immediately postexercise and 2 hours postexercise (10). Exercise consisted of 200 drop jumps and 200 sledge jumps (upper body drop jump on an inverted sled). The power-trained group performed more work (598 ± 177 J versus 425 ± 425 J) and generated more power (3,668 ± 597 W versus 2,187 ± 173 W) during each jump. Therefore, the power-trained group sustained the same amount of muscle damage while performing a greater amount of work, suggesting an inhibition to damage in trained individuals. In a study comparing trained individuals to untrained individuals, trained individuals were found to have a higher perception of DOMS, but no concomitant increase in S-CK occurred (10). There were no differences between groups regarding peak torque. This suggests that DOMS is independent of muscle damage.

■ Physiological Mechanisms of Massage

Intramuscular pressure increases due to edema that may result in DOMS (4, 7). Massage is believed to increase muscle blood flow (MBF), which theoretically should decrease intramuscular pressure (3, 15, 17). Therefore, postexercise massage should obviate DOMS. The idea that increasing MBF postexercise will prevent DOMS has been tested using multiple modalities. Three studies have shown that increasing MBF attenuates DOMS. These studies used ultrasound (8), high-speed voluntary contractions (7), and light concentric exercise (14) to increase MBF. One study, using microcurrent electrical stimulation versus massage versus ergometry, found contrary evidence that MBF was not increased (20). All studies using massage as a means to increase MBF, with and without an HRT stimulus, have found massage ineffective (3, 15, 17).

The direct effects of massage on perception of DOMS have been studied extensively. One study found that massage treatment reduced perception of DOMS (16). Massage given 2 hours postexercise decreased peak soreness; however, the soreness sensation was present for the same duration (120 hours) as in the control group. Another study showed that UWWJM prevented soreness compared to a control group (18). A third study showed similar results; however, cycle ergometry and passive stretching preceded the exercise bout and their influence could not be separated from the postexercise massage (13). All other studies have shown contrary evidence and suggest that there is no effect of postexercise massage on perception of DOMS.

Further study on various markers of muscle damage has been carried out. No studies have demonstrated that using any form of massage prevents or reduces muscle damage. One study concluded that S-CK was lower in a massage treatment group compared to an untreated group (16). Review of the data, however, shows large variability in the S-CK of the massage group, reducing the effect size and magnitude of the differences. In addition, the same study concluded that neutrophil count tended to decrease in the control group and increase in the treatment group. The control group, however, had a substantially higher pre-exercise neutrophil count and, at 24 hours postexercise, still had a higher neutrophil count than the treatment group. The variability in these figures suggests that the effects of massage, if they existed, were lower than speculated in the authors' conclusion. This is in agreement with other studies that show that massage treatment does not reduce plasma lactate, S-CK, and S-Mb, and S-CAIII compared to no treatment. S-CK has been reported as being higher in the massage treatment group (11), which suggests that massage might cause discomfort and muscle contractions, resulting in increased mechanical damage (9).

S-Mb and S-CK have also been reported as being higher in a UWWJM treatment group compared to a no treatment group (18). However, this may not be caused by the treatment itself, as pilot work using the treatment without a training stimulus did not result in elevated S-Mb and S-CK. It was speculated that UWWJM had beneficial effects on either or both DOMS and fatigue, allowing the subjects to train harder and therefore cause greater mechanical disruption. In this study, certain performance measures were shown to benefit from UWWJM. In the no treatment group, ground contact time during successive rebound jumps significantly increased and jumping power significantly decreased, while no change was seen in the treatment group. Measures of isometric strength, ground contact time during drop jump, successive rebound jump height, and drop jump height did not change in either group.

Other studies have not shown enhanced performance measures as a result of massage. Peak torque at isometric, slow, and fast velocities did not benefit from 10 minutes of massage treatment (17). Another study showed that warm-up, stretching, and massage did not result in improved recovery of isotonic force at 24 and 48 hours postexercise (13).

■ Limitations of Massage Studies

A number of limitations exist in the literature regarding massage. Most of the studies reviewed used eccentric exercise models to study the effects of massage (9, 11, 13, 16, 17, 20). Although this model guarantees muscle soreness and allows the effects of treatment to be studied, it is not realistic in the training of athletes, where exercises consist of at least 50% concentric contractions. The extreme level of DOMS generated through the eccentric exercise model is not indicative of the DOMS seen in athletes. Whether or not massage is effective at lower levels of DOMS is not known and requires future study.

Eccentric exercise models also result in a longer period of DOMS and muscle damage than athletes are accustomed to. DOMS persists from 72 hours to 10 days (1, 4, 5, 7, 8, 10, 14, 16, 19), and markers of muscle damage are seen 48–120 hours postexercise (5, 10, 16, 19). As many athletes train daily, even if massage was shown to be effective using this model, the benefits would not be seen in time for future training sessions. Typically, fatigue diminishes within 48 hours (2, 6, 12).

With the exception of the UWWJM study (18), all massage treatment studies used active but untrained individuals (9, 11, 13, 16, 17, 20). As research has shown, there is a difference between S-CK, S-Mb, and S-CAIII response to exercise for resistance-trained individuals compared to untrained (10, 19). DOMS and muscle damage occur simultaneously in untrained individuals; however, muscle damage may not be present for resistance-trained individuals. The effects of massage on DOMS and muscle damage are not the same and require independent study.

Also with the exception of the UWWJM study (18), the effects of massage were studied only on a single exercise bout (9, 11, 13, 16, 17, 20). The effects of massage on multiple bouts of exercise in a short time period need to be studied to apply the results to the training of athletes.

Conclusion

Current study of the effects of postexercise massage seem to reject the notion that manual massage is beneficial in reducing postexercise soreness, muscle damage, and recovery from fatigue. Studies on the effects of postexercise massage are limited in value as to their application to athletes. The experimental models used do not replicate typical training scenarios, nor do they account for the differences in trained and untrained subjects. UWWJM may be effective in enhancing recovery from training; however, the mechanism of action may be different from those proposed for manual massage. Further study is required on UWWJM to determine if it is indeed effective in improving athletic performance. ▲

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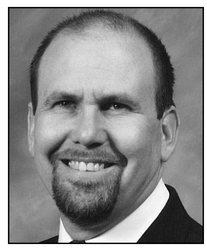

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