

Massage Therapy Attenuates Inflammatory Signaling After Exercise-Induced Muscle Damage

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Editor's Summary **The Mechanism of Massage**

"Massage reduced signs of inflammation, and massaged muscles cells were better able to make new mitochondria—promoting faster recovery from exercise-induced muscle damage."

Massage activates mechanosensory sensors.

Massage activates the formation of additional mitochondria, "presumably accelerating healing of the muscles."

Massage reduced accumulation of inflammatory mediator nuclear factor kappa B (NFkB), and reduced the activity of immune cytokines interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF-a), "a sign of less cellular stress and inflammation."

However, "massage did not help clear lactic acid from tired muscles."

FROM ABSTRACT

Massage therapy is commonly used during physical rehabilitation of skeletal muscle to ameliorate pain and promote recovery from injury. Although there is evidence that massage may relieve pain in injured muscle, how massage affects cellular function remains unknown.

To assess the effects of massage, we administered either massage therapy or no treatment to separate quadriceps of 11 young male participants after exercise induced muscle damage. Muscle biopsies were acquired from the quadriceps (vastus lateralis) at baseline, immediately after 10 min of massage treatment, and after a 2.5-hour period of recovery.

We found that massage:

- Activated the mechanotransduction signaling pathways
- Increased mitochondrial biogenesis
- Mitigated the rise in nuclear factor kB (NFkB)

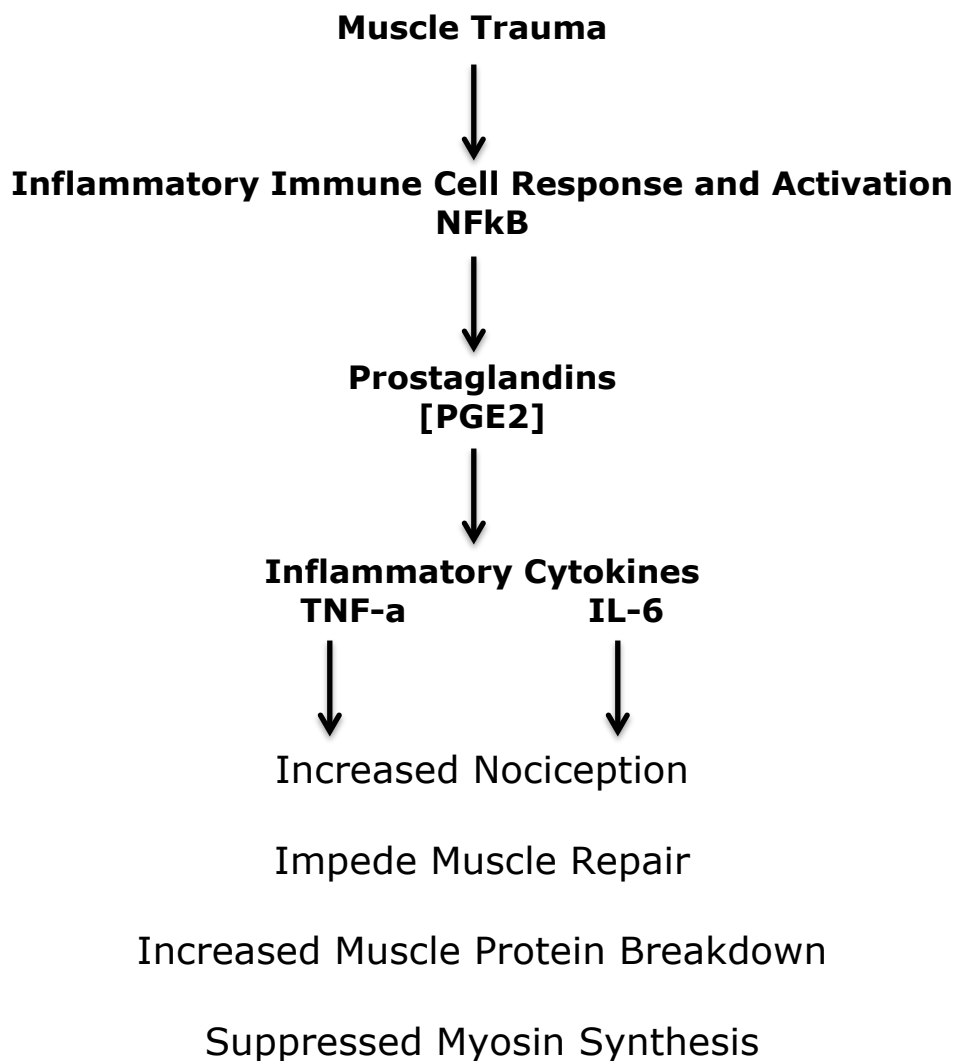
Moreover, despite having no effect on muscle metabolites (glycogen, lactate), massage attenuated the production of the inflammatory cytokines tumor necrosis factor- α (TNF- α) and interleukin-6 (IL-6), thereby mitigating cellular stress resulting from myofiber injury.

In summary, when administered to skeletal muscle that has been acutely damaged through exercise, massage therapy appears to be clinically beneficial by reducing inflammation and promoting mitochondrial biogenesis. **[Key Point]**

KEY POINTS FROM THIS STUDY:

- 1) "Complementary and alternative medicine (CAM) is increasingly used as a cost-effective adjunct to conventional medical care. Many CAM techniques, such as acupuncture, massage therapy, or chiropractic manipulations, are aimed at managing pain, relieving stress, and preventing injury."
- 2) "The increasing use of massage therapy as an adjunct to conventional care for musculoskeletal injury recovery and the growing number of physician referrals for massage represent a shift toward nondrug-based therapies for personal health."
- 3) "Given the spiraling cost of primary care and medications in the US, it is likely that more patients will seek out this therapy as well as other nontraditional medical alternatives to complement more conventional approaches to their healthcare."
- 4) "Massage therapy is a well-known form of alternative medicine that consists of physical manipulation of muscle and connective tissue at a site of injury, inflexibility, or soreness to reduce pain and promote recovery."
- 5) "Massage has been hypothesized to moderate inflammation, improve blood flow, and reduce tissue stiffness, resulting in a diminished sensation of pain."
- 6) "The potential benefits of massage could be useful to a broad spectrum of individuals including the elderly, those suffering from musculoskeletal injuries, and patients with chronic inflammatory conditions."
- 7) There are several reports that long-term massage therapy reduces chronic pain and improves range of motion in clinical trials.
- 8) "Muscle inflammation and pain are typically present when damage to the myofibrillar structure has occurred."
- 9) Muscle trauma initially results in inflammation with immune cell activation and cytokine release.
- 10) The inflammatory immune response is led by NF κ B. "Repression of NF κ B activation improves tissue repair and reduces immune cell infiltration into muscle."

- 11) A mechanical stimulus to a muscle will physically alter the cells membrane and the extracellular matrix and transmit signals via proteins known as integrins. Integrins in turn activate and propagate mechanotransduction signals that "modulate protein synthesis, glucose uptake, and immune cell recruitment."
- 12) The mechanical stretch during massage activates mechanotransduction signaling that increases muscle glucose uptake, protein synthesis and muscle growth.
- 13) "Any physiological benefits due to massage would likely be initiated through mechanical effects on skeletal muscle followed by changes to intracellular regulatory cascades."
- 14) Massage alters processes related to the cytoskeleton and to inflammation.
- 15) "After activating cellular signaling pathways through mechanotransduction, massage attenuated the rise in several other signaling pathways indicative of muscle inflammation and cell stress regulated by NFkB."
- 16) Damage to skeletal muscle activates the inflammatory NFkB pathway, which increases prostaglandin synthesis [like PGE2] and inflammatory cytokine expression [IL-6, TNF-a]. These inflammatory cytokines impede muscle repair by increasing muscle protein breakdown and suppressing myosin synthesis.
- 17) Also these inflammatory cytokines activate nociceptors, causing increased sensitivity to pain (hyperalgesia).
- 18) Cyclooxygenase inhibitors blunt most of the hyperalgesia derived from local IL-6 and TNF-a, "indicating that prostaglandins are largely responsible for the sensitization of muscle-associated nerves caused by inflammatory cytokines."
- 19) "Similarly, pain and inflammation in human patients are often treated with analgesic medications that block the local formation of prostaglandins, suggesting that massage may act in a similar fashion."
- 20) One class of analgesics, nonsteroidal anti-inflammatory drugs (NSAIDs), are some of the most commonly consumed drugs in the world. Massage may provide similar benefits without side effects. "Massage may be useful in situations where areas of low blood flow (the muscle tendon interface) restrict the access of circulating analgesics to a site of inflammation."
- 21) The "positive effects of massage are a result of an attenuated production of inflammatory cytokines, which may reduce pain by the same mechanism as conventional anti-inflammatory drugs such as NSAIDs."
- 22) "These results elucidate the biological effects of massage in skeletal muscle and provide evidence that manipulative therapies may be justifiable in medical practice."



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Massage Does The Following:

- Activates the mechanotransduction signaling pathways
 - increases muscle glucose uptake, protein synthesis and muscle growth
- Increases the biosynthesis of mitochondria; this increases the production of the ATP energy required for protein synthesis and repair of injury.
- Reduces the production of NFκB.
- Reduces the production of inflammatory prostaglandins [PGE2].
- Reduces the production of inflammatory cytokines [TNF-α, IL-6].
- Reduces pain.
- Accelerates healing, faster recovery.