Rice Therapy: Rest, Ice, Compression, Elevation under criticism

For many athletes a doctor’s recommendation of the RICE protocol for healing their sports related soft tissue issue injury was seen as the gold standard of care. However, this treatment is now under criticism from a surprising source, the doctor who created the RICE treatment guidelines, Gabe Mirkin, MD.

In a recent article on his own website, Dr. Mirkin admits that both ice and rest (key components of RICE) may delay healing. This insight comes 36 years after Dr. Mirkin authored the *The Sportsmedicine Book* (1978), where he coined the acronym RICE for the 4 elements which became the standard of care in treating soft tissue injuries—Rest, Ice, Compression and Elevation. Coaches, physicians, physical therapists and the lay public have recommended and followed the “RICE” guidelines for decades, but as Mirkin states, “it now appears that both ice and complete rest may delay healing, instead of helping.”

Icing Injuries

Topical cooling with a cold pack or ice is frequently used therapeutically to reduce acute pain and inflammation of injured tissues. Topical cooling has also been used in an effort to boost recovery after athletic exercise. But does ice help recovery?

Researchers tested whether applications of ice were helpful in recovery after strength training—a type of eccentric exercise where muscle damage is induced as a result of the exercise. Eccentric training is defined as active contraction of a muscle occurring simultaneously with lengthening of the muscle. When the tissue is cooled through icing, peripheral blood perfusion can be reduced, in other words the blood vessels constrict and shut off the blood flow that brings in healing cells. After the ice is removed, the blood perfusion may then return, but the blood vessels may not open for many hours after the ice application. This research team found that this hemodynamic fluctuation can cause the tissue to die due to lack of blood flow. It can also lead to temporary or permanent nerve damage and disability in the individual or athlete. Therefore, ice application does not boost recovery after exercise and can instead cause tissue and nerve damage.

Topical ice applications can cause muscle damage, fatigue, and delayed recovery in elite athletes

A study was done in 2013 involving eleven 20 year old male baseball players to examine the effects of topical cooling on recovery after eccentric exercise. Muscle damage markers and hemodynamic changes were checked. Topical cooling caused a significant increase in muscle damage markers (CK-MB and myoglobin) during recovery from eccentric exercise over the controls at 48 and 72 hours, as well as increased fatigue at 72 hours. “This data suggests that topical cooling, a commonly used clinical intervention
appears to not improve but rather delay recovery from eccentric exercise-induced muscle damage.” Mirkin himself referenced a June 2013 study in *The American Journal of Sports Medicine* showing cooling did not hasten recovery from exercise induced muscle damage.

**What about inflammation? Should it be reduced with ice?**

Inflammation is necessary because it plays an important role in the healing and recovery of muscle cells and soft tissue regeneration. Tissue that is damaged through trauma or vigorous exercise requires inflammation. When muscles and other tissues are damaged, your body sends inflammatory cells to the damaged tissue to promote healing. Inflammatory cells rush to injured tissue to start the healing. “During the early period of inflammation, damaged muscle cells are eliminated by phagocytosis of macrophages.” The macrophages release a hormone called insulin-like growth factor (IGF-1) into the damaged tissues, which helps muscles and other injured parts to heal. Mirkin states, “Applying ice to reduce swelling actually delays healing by preventing the body from releasing IGF-1.”1 Muscle cell regeneration takes place by recruiting stem cells from surrounding tissues. This early response can last for a week along with the elevated circulating levels of CK-MB and myoglobin during the regeneration phase. Thus any change in these rates, as occurs with ice application, would be expected to affect the timing of muscle regeneration. Tseng et al conclude, “The result of greater increases in exercise-induced CK-MB and myoglobin levels between 48 and 72 h post-exercise and peak shift in inflammatory cytokine IL-12p70 may reflect a change in the time course of cell turnover and muscle regeneration by topical cooling. As it stands, our results provide evidence that topical cooling does not enhance and appears to delay the return to normal of muscle damage markers and subjective fatigue feeling after eccentric exercise. The surge in tissue oxygenation after removal of the cooling application may be part of the mechanisms involved in the delayed recovery. Collectively, these results indicate that intervention with topical cooling disrupts the normal adaptive responses to exercise.”3

**Ice applications can negatively affect athletic performance**

Another study done in 2009 looked into the effect of cold-pack application on hormones and inflammatory mediators on young elite handball players. Various anabolic hormones, catabolic hormones and anti-inflammatory cytokines were reviewed. The twelve male players performed $4 \times 250$ m treadmill run, at 80% of each individual’s maximal speed, followed by a rest period with and without local cold-pack application. Pre, immediately post, and 60-min post-exercise blood samples were drawn. The results? Local ice therapy immediately following sprint-interval training was associated with greater decreases in both pro- and anti-inflammatory cytokines and anabolic hormones supporting some clinical evidence for possible negative effects on athletic performance. Although these methods were developed to enhance the recovery of elite athletes after intense training or
competition, utilizing cryotherapy such as cold packs and ice to treat sports associated injuries or as a method for recovery following training and competition may instead cause a level of traumatic muscle injury.

**Ice Also Reduces Strength, Speed, Endurance and Coordination**

Another study Mirkin cited was in Sports Med, Nov 28, 2011 which stated, “Ice is often used as short-term treatment to help injured athletes get back into a game. The cooling may help to decrease pain, but it interferes with the athlete’s strength, speed, endurance and coordination.” Mirkin goes on…”In this review, a search of the medical literature found 35 studies on the effects of cooling. Most of the studies used cooling for more than 20 minutes, and most reported that immediately after cooling, there was a decrease in strength, speed, power and agility-based running. A short re-warming period returned the strength, speed and coordination. The authors recommend that if cooling is done at all to limit swelling, it should be done for less than five minutes, followed by progressive warming prior to returning to play.”

This wasn’t the first study demonstrating that just 5 minutes of icing could be problematic. Ho et had already published articles in 1990 on the negative effects of ice, where they showed that as little as five minutes of icing a knee could decrease both blood flow to the soft tissues and skeletal metabolism. “This effect is time-dependent and can be enhanced three to four fold by increasing the ice application time to 25 minutes.”

**Ice hinders healing by decreasing blood flow**

Healing is hindered by a decrease in blood flow and metabolism to the area. Icing increases the chance of incomplete healing by decreasing blood flow to the injured muscles, ligaments and tendons. This increases the chance of re-injury or the development of chronic pain. **Did you ever wonder why almost all athletic trainers and therapists ice a limb for 20 minutes?** Why not 15 or 30, but always 20? It does not matter if you are in France, Idaho, or Germany, they all ice for 20 minutes. In 1980, at the American Orthopedic Society meeting for Sports Medicine in Big Sky, Montana, and then again in 1981, physicians from the Louisiana State University School of Medicine reported on five athletes who obtained nerve palsies (nerve injuries usually to the peroneal nerve that moves the foot up) from too much ice around the knee. The conclusion of the article was, “Applying ice for more than 30 minutes, and preferably for not more than 20 minutes, should be strictly avoided.” They reported that one of the athletes still had nerve palsy at nine months. Here is our answer to the 20 minute question. You are iced for 20 minutes because the athletic trainer or therapist does not want to give you nerve palsy! The next time the trainer comes toward you with an ice pack, tell him, “Thanks, but no thanks. I want my injury to heal.”
We have already established that R.I.C.E. has been the conventional method of pain management and treatment of sports injuries for years, even decades. Even though the author of RICE has recanted its use, and research proves it can be injurious, you will most likely continue to see it utilized from the emergency room to the sports trainer. This is a good example of how something false can hold sway on even those who are considered professionals.

**Anti-inflammatories also delay healing**

Mirkin states, “Anything that reduces inflammation or the immune response will also delay healing. This includes cortisone, NSAIDS, immune suppressants, and cold packs/ice.”1 We agree with this statement. Anti-inflammatory medications have been proven to be harmful. However, most people will continue to receive instructions to take anti-inflammatory medications after an injury or for musculoskeletal pain. “Non-steroidal anti-inflammatory drugs (NSAIDs) inhibit cyclooxygenase (COX) activity and are widely used as anti-arthritis, post-surgical analgesics, and for the relief of acute musculoskeletal pain. Recent studies suggest that non-specific NSAIDs, which inhibit both COX-1 and COX-2 isoforms, delay bone healing. NSAIDS such as ketorolac and parecoxib delay fracture healing, but the daily administration of ketorolac, a non-selective COX inhibitor had a greater effect on this process.” NSAIDS are commonly recommended because injuries such as ligament sprains are sometimes accompanied by quite a bit of inflammation and swelling, called edema. The premise is that the inflammation or swelling and edema are harmful to the tissue. Again, we have already established that inflammation is necessary for healing of the tissue. NSAIDS are used because they relieve pain; however they are also stopping the healing mechanisms of the body. Any technique or medication that stops the normal inflammatory process that helps heal the body must have a long-term detrimental effect on the body.

**Compartment syndrome**

Muscles, unlike ligaments and tendons, are encapsulated within a tight, compartmental, special tissue called fascia. These fascial sheaths only have a limited amount of space and in high-energy trauma, as can occur in sports, this limited space can be encroached upon by a hematoma (blood clot in the muscle) or be externally compressed by a hematoma in another compartment (or broken bone, etc.). This increased tissue pressure within the fascial sheath that contains the muscle causes a decrease in the blood circulation (malperfusion), causing further tissue damage. This further tissue damage causes an increase in the edema, which increases the pressure in the space even more, causing even less oxygen to get to the injured tissues (hypoxia), which causes the pH in the tissue to be decreased (acidosis) and a vicious cycle is set up. This continued increase in a specific muscle facial sheath is called compartment syndrome. Compartment syndrome, if not immediately taken care of, quickly progresses to permanent muscle, nerve, or circulation
damage. RICE treatment can be effective at eliminating edema, so it could, theoretically, prevent a compartment syndrome situation from occurring. Compartment syndrome only occurs in muscles (and only those with a lot of damage) and never occurs in ligaments. What happened in the 1970s, unfortunately for the athletes of the world, is that sports medicine doctors and trainers started treating every injury as if it was going to turn into compartment syndrome.

**Ice applications and ligaments**

We have discussed how the fluctuation in blood supply from applications of ice can affect muscle recovery. Now let’s consider what it might do to ligaments. The main difference between muscles and ligaments is that muscles are massively strong structures with a tremendous blood supply, both outside and inside the muscle (this is why steak is red). Ligaments, on the other hand, are small tissues that have a poor blood supply both inside and outside of the ligament (why they appear white). Muscles, because of their good circulation, can heal more quickly, whereas ligaments, due to their poor blood supply, often heal incompletely. If muscles which have good circulation have healing issues due to the ice application causing a fluctuation in blood supply, it is understandable that it would be even more difficult for ligaments to recover or heal after ice applications. Ligament injuries are the cause of most chronic sports injuries and pain. The cells that make up ligaments, tendons, and organs are extremely temperature-sensitive. The metabolic rate at which these cells function is directly proportional to the temperature in their environment. For each 10 degree Celsius change in the temperature, there is a more than two-fold increase in the cell metabolism. In other words, in order to increase cell metabolic rate by more than 100 percent, the temperature of the tissue must increase by 10 degrees. Conversely, cooling tissue will decrease that cell’s metabolism. It is obvious that ligaments require improved circulation to the area in order to heal after an injury, since the blood supply to ligaments is normally so poor. Yet ice is arguably the most widely used therapeutic agent in medicine today, which most definitely decreases circulation. Ice has been shown to be one of the most efficient forms of cryotherapy, and is often the first line of treatment for traumatic injuries.

**RICE treatment is totally inappropriate for healing ligaments.**

Exercise alone does not notably increase the blood supply to ligaments. This is probably because the ligament is not important in the fight-or-flight response. It is not involved in the defense of the body if attacked. Exercise does not have the profound stimulatory effect on ligaments that it has on muscles. Ligaments are made up primarily of type I collagen. This particular type of collagen is very resistant to stretching (has a high tensile strength). Collagen is a type of protein and is therefore made up of amino acids, building blocks of protein. What most people do not know is that the collagen in ligaments is thought to remain relatively metabolically inert, with a half-life on the order of 300 to
500 days. This means that the metabolism of collagen is very, very slow. It is a good thing this is true, because blood supply to ligaments is so poor. This is another reason ligaments heal so slowly and are so prone to injury. Anything that decreases the metabolic rate or blood supply to the ligaments will further promote the decline of the ligaments, and profoundly delay their healing.

**Immobilization and rest delay soft tissue healing**

Immobilization, also known as stress deprivation, is extremely detrimental to the joints and ligaments. Both intra-articular and extra-articular (inside and outside, respectively) ligaments and periarticular (joint soft tissue) connective tissue are brutalized by immobility. Gross inspection of the ligaments after stress deprivation shows them to be less glistening and more “woody” on palpation. Under a microscope the collagen of the ligament is very random. Chemically, the ligaments lose water and glycosaminoglycans (which help maintain structure) so there is a net loss of mass in the ligaments. There is also more degradation of the collagen with stress deprivation. These changes translate to a much weaker structure. In one study, knee ligaments immobilized for even a few weeks showed that the ultimate load, linear stiffness, and energy-absorbing capacity of a bone-medial collateral ligament-bone preparation is reduced to about one third of normal. In addition to weakening of the ligaments themselves, immobilization decreases the strength of the fibro-osseous junction where the ligament attaches to the bone. If rest and immobilization hinder ligament and tendon healing, then studies should show that early mobilization helps soft tissue healing. This is exactly what has been shown. Bekerom et al reviewed 11 trials involving 868 ankle sprain patients. The results revealed those who included early mobilization compared to those following the standard RICE treatment reported a shorter sick leave with faster return to sport participation, less days missed from work with less visits to a clinic for follow-up, and improved range of motion with better functional scores.

**References**


