The Truth About Icing & Recovery

Something shocking is underway across sports medicine circles. The habitual practice of icing and using the RICE protocol to accelerate healing and promote recovery is being questioned as ineffective or potentially damaging.

Introduction

We were skeptics at first too. After all, how could something so universally accepted and practiced be so wrong? We looked at the origins of icing and RICE, reviewed the principles of inflammation and recovery, and most importantly learned from the vast amount of published studies on the topic. Not to say that icing (cryotherapy) doesn't have a purpose, but after reviewing the research it became apparent that icing damaged tissue from injury or exercise does nothing to improve recovery and likely slows and delays the healing process. So now the question is, where do we go from here?

A Paradigm Shift in Sports Medicine

Many are familiar with Dr. Gabe Mirkin's simple advice for treating acute sports injuries, RICE (Rest, Ice, Compression, and Elevation). In fact, most individuals have been told to "put ice on it" in some capacity or another for as long as they can remember. Now, almost forty years after its original publication, Dr. Mirkin has caught the sports medicine world by storm with his 2014 retraction. "Almost forty years ago, I coined the term RICE as the treatment for acute sports injuries. Subsequent research shows that rest and ice can actually delay recovery. Mild movements help tissue to heal and the application of cold suppresses the immune responses that start and hasten recovery."[1]

The rapid spread of ice being used in therapy centers may be attributed to the fact that it is easy to use, readily available, inexpensive, and can be applied by anyone. Now, athletes, trainers, and clinicians are simply realizing that delaying the inflammatory (healing) process and reducing blood flow is not effective for accelerating recovery. We know far more about the role of inflammatory cells in healing now than we did in 1978. The use of ice appears to be more habitual than based on scientific evidence.

When to Grab the Ice

Of course, icing isn't all bad. There is a time and a place when ice can and should be used.

- Ice can provide temporary pain relief

  Putting some ice on your child's bump or bruise for a few minutes likely won't harm healing and will give them some needed comfort. But, using it for extended periods of time or repeatedly on an injured/damaged area will (e.g., a runner using ice on their knees after every run, or on and off applications for hours).

- Ice can be used to regulate core body temperature

  If overexertion, or something else, causes an unsafe rise in body temperature, ice may be an appropriate and quick way to help bring down core body temperature.

- Ice can be used to purposefully delay inflammation (healing) and reduce blood flow

  A common example can be seen when boxers apply cold metal compresses around the eyes to delay the inflammatory process and make it through the end of a fight.

Whether you should choose to apply ice or not depends on what you want to accomplish. If the goal is to recover or heal quickly, then you may want to stay away from the ice. However, if your goal is to temporarily mask pain signals or do anything else listed above, then grab the ice.

How the Body Heals

To get at the root of the debate over icing's role in healing and recovery from overexertion, injury, or surgery, we have to understand the body's natural responses to tissue damage. There are essentially three phases in the healing process: inflammation, repair, and remodeling.[2]

Inflammation: the cellular and vascular response to injury. This phase begins with hemostasis (shutting blood flow off to damaged tissue). Then, surrounding vessels dilate so that the supplies necessary for repair can be transported into the area.

Repair: replacement of necrotic or damaged tissue by new cells and matrix. Fibroplasia, the formation of collagen, and angiogenesis, the formation of new blood vessels, are the two processes that occur during this phase to rebuild the area.[3]

Remodel: reshaping and reorganizing of repaired tissue. A portion of the initial collagen that was sent to the damaged area is replaced by new collagen with greater tensile strength. The tensile strength of the tissue improves due to formation of intra and extra molecular cross linkages between the collagen fibers.[4]

To summarize, the process of healing begins with the release of inflammatory mediators and ends when remodeling of the repair tissue reaches a homeostatic state.[5]

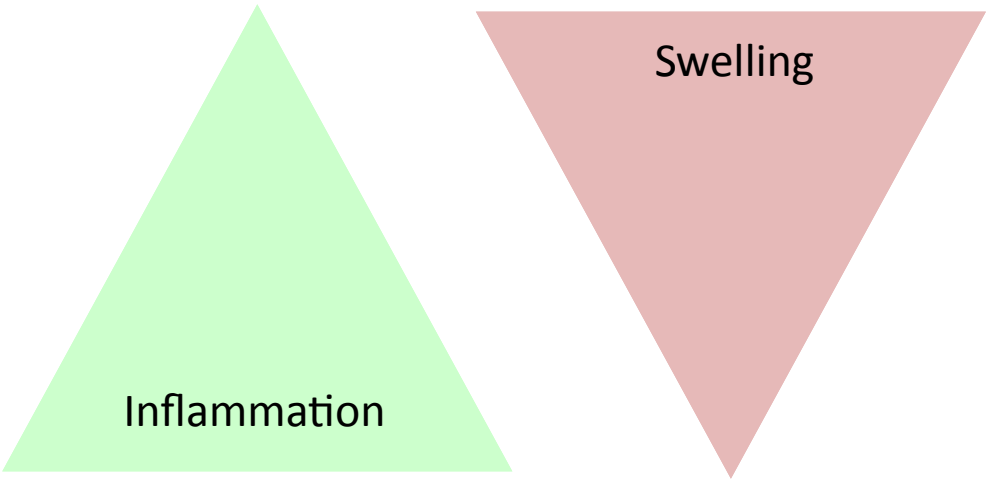
The Reality of Inflammation

The biggest proponents for cryotherapy (icing) tend to justify its use in reducing inflammation. But inflammation is crucial to the body's natural healing process and ultimately leads to the repair of damaged tissue. This has left many questioning why we would want to slow down or interfere with the very complex process by which our body is able to naturally respond to damage. The inflammatory process is so crucial in fact that the American Academy of Orthopaedic Surgeons has stated "Inflammation can occur without healing, but healing cannot occur without inflammation."[6]

A common misconception about this complex biological process is that inflammation and swelling are synonymous. They are not.

Inflammation: As described, this is the body's necessary initial response to tissue damage. Inflammation sends all of the necessary supplies to the damaged area that are needed for repair and remodeling.

Swelling: the excess fluid and waste that remains in the area after inflammation takes place. Swelling is generally due to inadequate lymphatic drainage of the leftover supplies that were delivered to the area during the inflammatory process, and the waste produced during the damage. When the body can't get rid of the congestion at a fast enough rate, it builds up, resulting in swelling.



Our bodies need inflammation to occur. Without the necessary nutrients going to the damaged area, we would never heal. However, our bodies do not need swelling. So, our focus should not be on preventing inflammation, but rather speeding up the removal of the excess waste.

What the Research and Experts Have to Say

The widespread use of icing as treatment for injuries and overexertion could have developed for a number of reasons, including the ease of access to a cheap, viable remedy, as well as immediate numbing relief. However, the popularity of icing is surprising, especially considering the lack of scientific evidence to support its efficacy. After over forty years of widespread use, there has been no irrefutable published evidence that the use of ice improves the recovery process. In fact, many studies have concluded the exact opposite. In 2012, the British Journal of Sports Medicine published a review of 22 earlier studies on cryotherapy and concluded that "ice is commonly used after acute muscle strains, but there are no clinical studies of its effectiveness."[7] The Journal of Emergency Medicine also concluded that "there is insufficient evidence to suggest that cryotherapy (icing) improves clinical outcomes."[8] A May 2013 study in the Journal of Strength and Conditioning Research reported that "topical cooling, a commonly used clinical intervention appears to not improve but rather delay recovery from eccentric exercise-induced muscle damage."[9]

Quote	Title	Publication
We provide evidence that this cooling procedure failed to improve long-term recovery of muscle performance.	Effects of Air-Pulsed Cryotherapy on Neuromuscular Recovery Subsequent to Exercise-Induced Muscle Damage	The American Journal of Sports Medicine
There was evidence from six studies that cooling adversely affected speed, power, and agility-based running tasks…"	Should Athletes Return to Sport After Applying Ice? A Systemic Review of the Effect of Local Cooling on Functional Performance	Sports Medicine
Topical cooling, a commonly used clinical intervention, appears to not improve but rather delay recovery from eccentric exercise-induced muscle damage.	Topical Cooling (Icing) Delays Recovery From Eccentric Exercise-Induces Muscle Damage	Journal of Strength and Conditioning Research
It needs to be stressed that there is not a single randomized, clinical trial to validate the effectiveness of the RICE-principle in the treatment of soft tissue injury	Regeneration of Injured Skeletal Muscle After the Injury	Muscles Ligaments Tendons Journal
The protocol of ice-water immersion used in this study was ineffectual in minimizing markers of DOMS in untrained individuals. This study challenges the wide use of this intervention as a recovery strategy by athletes.	Ice-Water Immersion and Delayed Onset Muscle Soreness- A Randomized Controlled Trial	British Journal of Sports Medicine
The key findings were that cold water immersion (1) substantially attenuated long-term gains in muscle mass and strength, and (2) delayed and/or suppressed the activity of satellite cells and kinases in the mTOR pathway during recovery from strength exercise.	Post-Exercise Cold Water Immersion Attenuates Acute Anabolic Signaling and and Long-term Adaptations in Muscle to Strength Training	Journal of Physiology

Slowing down your body's metabolic process is counterintuitive to accelerating recovery, and the prolonged application of ice can have some pretty negative effects. "When ice is applied to a body part for a prolonged period, nearby lymphatic vessels begin to dramatically increase their permeability. As lymphatic permeability is enhanced, large amounts of fluid begin to pour from the lymphatics 'in the wrong direction' (into the injured area), increasing the amount of local swelling and pressure, and potentially contributing to greater pain."[10] A recent study released even states that "regular post-exercise cold application to muscles might attenuate muscular and vascular adaptations to resistance training."[11] In other words, your body's natural recovery response at a normal rate is far more effective than the slowed down effects associated with icing.

Do No Harm

For the purpose of healing and recovery, it appears ice does more harm than good. In fact, if ice were a regulated over-the-counter medical product, it would likely never get cleared for use by the FDA. Why? In order to garner approval for such use, manufacturers are required to pass tests for safety and effectiveness. Ice would fail the effectiveness test, as there are no peer-reviewed studies to prove it really does work.

Research studies have also revealed the potentially harmful side effects icing can cause for athletes. "Often, ice is used as a short-term treatment to help injured athletes get back in the game. The cooling may help decrease pain, but it also interferes with the athlete's strength, speed, endurance, and coordination."[12] Another group of researchers found similar results; they showed that icing was effective in numbing muscle soreness, but observed—for up to 15 minutes after ice treatment—significantly reduced muscle strength, power, and fine motor coordination. Because ice reduces nerve conductivity velocity, icing slows nerve impulses and directly changes the function of the muscles and tendons. Athletes were not able to jump as high, sprint as fast, or throw as well immediately following 20 minutes of ice treatment.[13] In another recent study, athletes were told to exercise so intensely that they developed severe muscle damage that caused extensive muscle soreness. Although cooling delayed swelling, it did not hasten recovery from this muscle damage.[14] So it would seem ice does nothing to increase the rate at which the body heals. It postpones inflammation from occurring, but once the ice is removed, the body goes back to sending the inflammation to the area. Ice simply delays the natural process for some time.

"Cooling may help decrease pain, but it also interferes with the athlete's strength, speed, endurance, and coordination"

Whole Body Cryotherapy

The latest trend related to ice is Whole-Body Cryotherapy (WBC). Those who sell and use WBC machines claim that WBC can improve blood circulation, relieve pain, speed recovery, reduce muscle soreness, and help medical conditions such as osteoarthritis. While this treatment has been endorsed by celebrities, professional athletes, and wellness centers alike, the effectiveness has yet to be proven. According to an article on the FDA's website:

> This so-called treatment hasn't been proven to do any of these things…Consumers may incorrectly believe that the FDA has cleared or approved WBC devices as safe and effective to treat medical conditions. That is not the case. In fact, not a single WBC device has been cleared or approved by the agency in support of these claims…While the healing benefits of cryotherapy remain unconfirmed the potential risks are readily apparent. Potential hazards with WBC include: asphyxiation, frostbite, burns, and eye injury….The FDA is also concerned that patients who opt for WBC treatment—especially in place of treatment options with established safety and effectiveness—may experience a lack of improvement or a worsening of their medical conditions.[15]

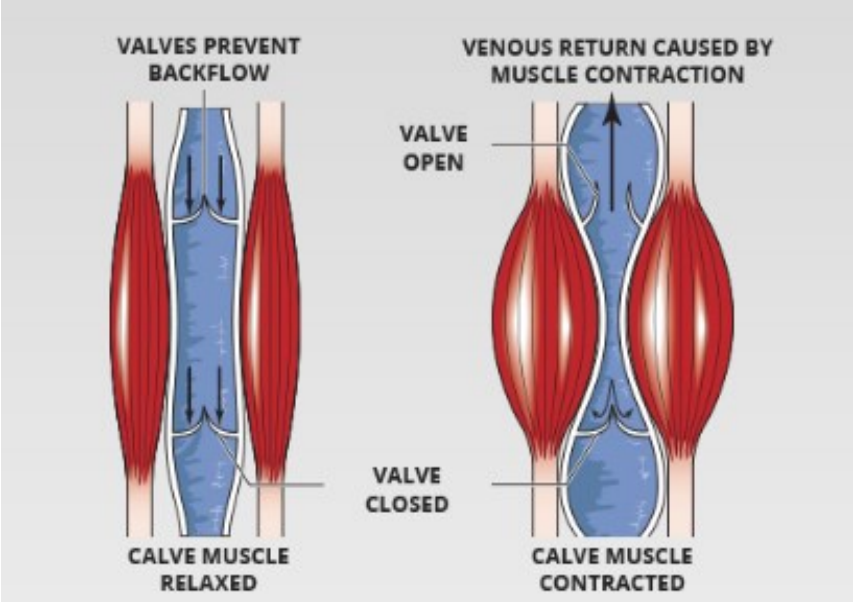
It seems that WBC is another fad that is under-studied and over-glorified.

Solving the Puzzle

So what is the alternative to icing and rest? The answer is active recovery. There are four main factors that regulate muscle recovery in adequately hydrated, nourished, and rested individuals: (1) the bringing in of nourishment and other supplies; (2) the removal of waste; (3) the production and release of myokines; and (4) the remodeling of the repaired tissue. Only active recovery can accomplish all of these goals, as muscle activation is the fundamental facilitator of the four processes noted above.

According to an article in the Journal of the American Academy of Orthopaedic Surgeons, the loading of tissues is one of the most important concepts in orthopaedics in this century. Loading (mechanical stress on tissues causes by muscle activation and contraction) accelerates healing of bone, fibrous tissue, and skeletal muscle. Although there are many approaches to facilitate tissue healing, none offer beneficial effects comparable to those produced by loading of healing tissues.[16]

Muscle activation is critical in the removal of waste. The lymphatic system is a passive system comprised of 180,000-300,000 miles of one way vessels, which have valves designed to prevent the fluid from moving in the wrong direction. These valves create a series of tiny chambers. The fluid in the vessels moves from chamber to chamber when they are compressed by the surrounding muscles. Lymphatic fluid does not move automatically, like blood; which is activated through the contraction of the heart, it is only activated through the mechanical movement of muscles.[17] So if swelling is the accumulation of fluid due to lack of lymphatic drainage, then activating the lymphatic system is the solution to reducing swelling.



Muscle activation is also critical to increasing the delivery of nourishment to tissue damaged from exercise or injury. When muscles are adequately activated, they send a message to the smooth muscles that surround the blood vessels to relax. Once relaxed, the blood vessels dilate (widen) and circulation increases.

Muscle activation is the key facilitator for all stages of the recovery process.

It's also muscle activation that provides the needed mechanical stress (loading) to facilitate the production and release of myokines; which drives the tissue regeneration process. Repaired muscle tissue cannot optimally remodel without mechanical stress. Failure to optimally remodel the repaired muscle tissue leads directly to dysfunctional movement and poor biomechanics. Active recovery provides the necessary mechanical stress to facilitate this process.

Alternatively, rest is often recommended along with icing, as too much stress on the injured area may aggravate the tissue, causing additional damage. By being still, you won't cause any further damage, but you also won't do anything to optimize the recovery process.

For enhanced recovery, the goal is to find practical active recovery and loading methods that will not aggravate the tissue or cause any additional damage. Ideally, you should try to activate the muscles surrounding the damaged tissue in order to achieve the largest amount of pain-free, low-stress, and non-fatiguing muscle activation. Muscle contraction in the affected area will generate a lymphatic flush and increase circulation, bringing nourishment in and waste out of the area. Mild, controlled movements are also essential to the repair and remodel process.

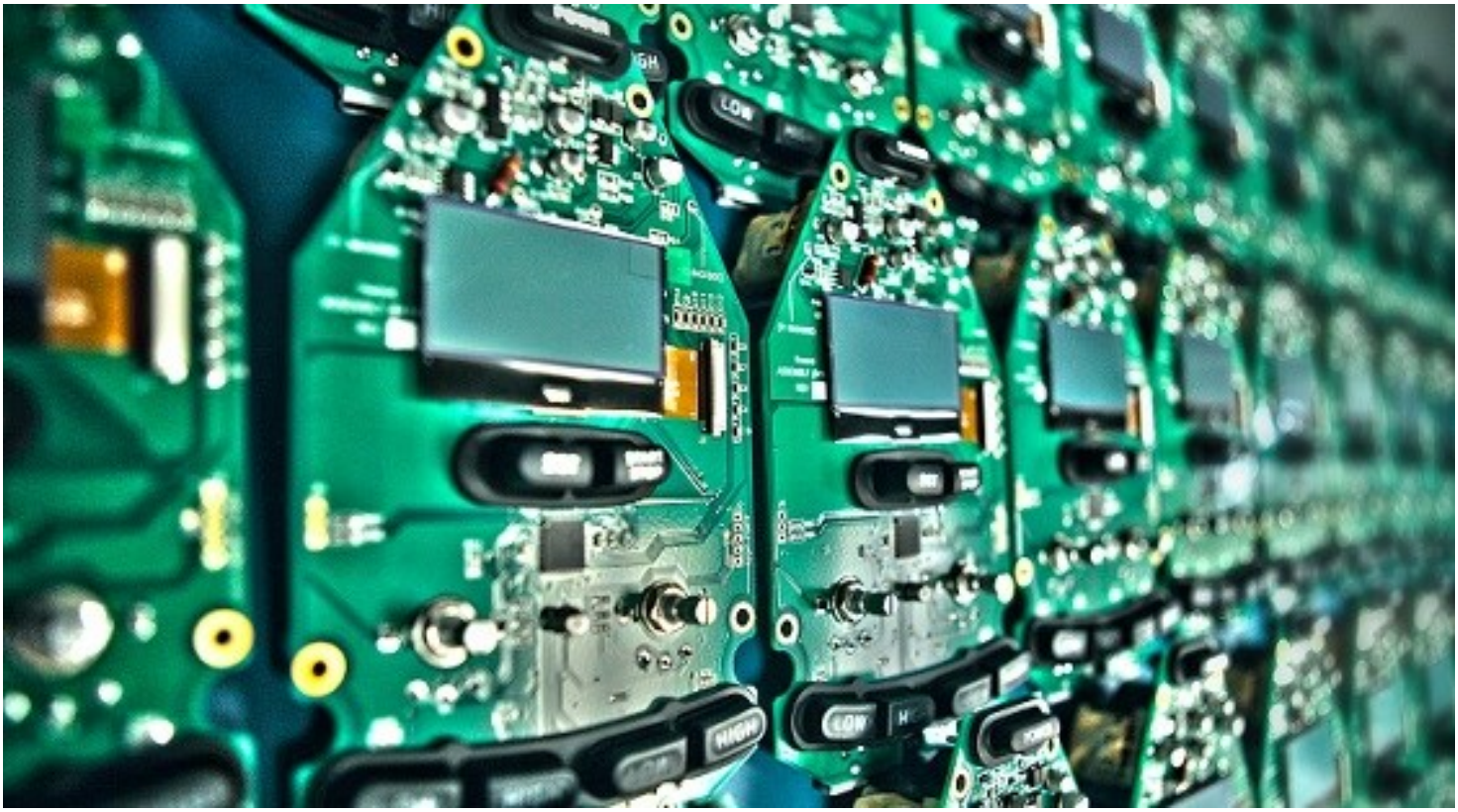
The Future of Recovery

The biggest obstacle in the way of reducing the widespread use of icing is the need for reeducation. It is difficult to alter how the masses see such a universally accepted ritual. This will take research and a lot of time to alter what is believed to be true. Author, speaker, CrossFit coach and physical therapist, Dr. Kelly Starrett DPT has said in regards to learning the truth about icing,

> "I have had to resolve quite a bit of personal and professional cognitive dissonance… Does this mean I'm wrong? Have I limited the healing of my patients? …if you know it's wrong, and your clinical experience is refuting what you thought you knew; shouldn't you also inform your friends and colleagues?"[18]

The amount of clinicians, athletes, trainers, and other professionals joining in on the movement away from ice and RICE has slowly allowed it to gain more traction. Today, the percentage of trainers for professional sports teams who are recommending icing is dwindling. Legendary pitching coach Dick Mills even wrote an article about "The Scientific Reason Why Baseball Pitchers Should Never Ice Their Arms."[19]

So while icing still has value in numbing pain and providing a temporary delay to swelling, all indicators point to it being ineffective for healing and recovery. Here's the bottom line: if you want to speed recovery, skip the ice and focus on controlled, low-stress, non-fatiguing muscle activation.



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