JOURNAL OF CONTEMPORARY CHIROPRACTIC

THE EFFICACY OF ICING FOR INJURIES AND RECOVERY – A CLINICAL COMMENTARY

Aaron Horschig, DPT[1], Kevin Sonthana, DPT[2], Brogan Williams, PhD[3], Matthew Horgan, BChiro[4], Kelly Starrett, DPT[5]

ABSTRACT

The use of ice to treat injuries and aid in recovery has become very common. This strongly-held belief that "ice is best" is prevalent not only in the general public but also in health care. Two major questions are critically analyzed in this paper, using a variety of expert and evidence-based perspectives: does using ice help with healing and reduce inflammation? Does it suppress the inflammatory process that impedes healing and postpone the body's natural healing plan? Research was sourced from Google Scholar, the Google search engine, PubMed, ResearchGate, ScienceDirect, and Academia. Further education around this topic in the medical community is needed to better help guide sports science and rehabilitation. *(J Contemporary Chiropr 2024;7:96-101)*

Key Indexing Terms: Injury, Ice Therapy, Rehabilitation

INTRODUCTION

The application of ice has been extremely popular over recent decades as a treatment for injury and a method of recovery. (1) This strong assumption that "ice is best" is not only observed throughout the general population but has rippled throughout the healthcare community. Sprained your ankle? Ice it. Pulled a muscle? Ice it. Sore after a workout? Ice it. (2) This may be a problem, as healthcare professionals worldwide have been promoting the use of ice based on limited data, inconclusive research outcomes, and a popular yet outdated acronym. (3,4) Dr. Gabe Mirkin first coined the term "RICE" in 1978, a snappy 4-letter acronym that quickly gathered momentum and popularity throughout the 80s and 90s, and which stands for rest, ice, compression, and elevation. (5) However, Dr. Mirkin has since revisited his claims, explicitly stating that ice may delay healing rather than help it. (6) Is RICE the best way to support recovery? When we look at the physiology of injury, we see conflicting views on how ice may interact with healing outcomes. Our paper looks at current, relevant, and high-quality evidence to help guide us to a better understanding.

[1] Squat University
[2] Private Practice
[3] Association of MSK Sports Physiologists
[4] New Zealand College of Chiropractic
[5] The University of California, Berkeley

DISCUSSION

The research for this commentary was sourced from Google Scholar, the Google search engine, PubMed, ResearchGate, ScienceDirect, and Academia. 43 sources were discovered and used, including research reviews, randomized controlled trials, experimental research, medical textbooks, and other relevant articles. Throughout this paper, we explore various professional and evidence-based viewpoints and critically analyze 2 key questions: does ice reduce inflammation and aid in the healing process? Does it delay the body's innate responses and blunt the inflammatory process, thereby impeding healing?

Why Ice?

Published articles dating back to the early 1940s explain that doctors would commonly use ice to help decrease infection rates, block pain, and reduce the rate of death on the operating table during amputation surgeries. (7) Ice slows cellular metabolism, allowing surgeons to keep as much muscle tissue alive as possible. While ice was initially intended to preserve severed limbs and decrease complications in the operating room, it would eventually be used for all injuries. When one examines the positive attributes of ice, we quickly see evidence showing that it is great for dulling and relieving pain. (8) Although this may be valid if your objective is only pain management following an acute injury, what about healing outcomes? As mentioned above, the belief behind icing injuries gathered momentum in the 1970s with the term "R.I.C.E", which many adopted into their belief system as it merged into Western medicine culture throughout the '80s and later. (5,9) Around this time, many thought using ice was helpful to negate the body's neutrophils' adverse effects on tissue regeneration to avoid the possibility of secondary damage to the surrounding tissues around the injury and avoid secondary hypoxic cell damage. (10) There is a general belief that ice helps alleviate pain, reduces inflammation, and restricts swelling. This is why some surgeons insist their patients use ice for months after surgery.

There is no doubt that ice relieves pain momentarily. According to existing scientific research, the main advantage of using cryotherapy is a transient decrease in pain. (2) However, the mere fact that the pain has subsided does not indicate that the injury has healed. More harm could potentially occur than healing. Additionally, some of those studies suggested that using ice in addition to other treatments like heat, massage, muscle contraction, and exercise could enhance the results of recovery. (2) It is essential to note that it is hard to distinguish which modality made that positive change. (2)

Why Not?

Over the last few decades, some have continued to perpetuate the narrative that inflammation and swelling are harmful and should be stopped or reduced as soon as possible. However, inflammation and swelling are normal responses to injury. When evaluating the drawbacks of ice, we find multiple studies link icing to heightened ischemia, decreased blood flow, and increased vasoconstriction. (11,12) Ice has the potential to stop, reduce, and even control inflammation, but a valid question is, should it be stopped or reduced? Are we confident that interfering with an innate mechanism that has evolved over millions of years will help with healing outcomes? Although drawing extremes may run the risk of resorting to a logical fallacy, it should at least be mentioned that, in a physiological sense, the long-term repercussions of prolonged ice on soft tissue are already known. It can lead to tissue death, necrosis, or frostbite. (13) You may wonder what qualifies as "prolonged." Well, that term has no fixed definition or meaning. There is a lack of research regarding the ideal or specific duration of ice on an injury. (14) No matter the injury, the patient's size, the injury's location, or the patient's history, we get another arbitrary, varied, nonspecific response, "Apply it on the skin for 10 or 20 minutes." Based on what metric? Long enough to interrupt the filtration of neutrophils and macrophages but not long enough to cause tissue damage or cell death? (10,15) Some cite the Lewis-Hunting response as a basis for ice application duration protocols. However, the Lewis Hunting reaction (which is an alternating process of vasoconstriction followed by vasodilation) is decades old (first described in 1930) and based on approximations and generalities. (16) In fact, Daanen stated that cold-induced vasodilation (CIVD) in the extremities "generally" occurs "5-10 minutes" following cold exposure. (16) Furthermore, Cheung reported, "Despite being described almost a century ago, the mechanisms of CIVD are still disputed; research in this area has remained largely descriptive in nature." (17) Finally, MacAuley conducted a systematic review published in the Clinical Journal of Sports Medicine, which looked at 45 sports medicine texts, concluding there is little guidance across the board regarding duration when using ice. He found the little guidance given was varied and stressed the need for an evidence-based consensus around icing times. (14)

Dr. Gabe Mirkin came out in 2013 in the forward to the 2nd edition of the groundbreaking book "Iced! The Illusionary Treatment Option" by Gary Reinl and withdrew his original statement. Admittedly, he wrote, "Subsequent research shows that ice can delay recovery. Mild movement helps tissue to heal faster, and the application of cold suppresses the immune responses that start and hasten recovery. Icing does help suppress pain, but athletes are usually far more interested in returning as quickly as possible to the playing field. So, today, RICE is not the preferred treatment for an acute athletic injury". (16) Since Dr. Mirkin strongly amended the "ice" piece of his acronym "RICE", many suspect that we may have gotten it wrong. (6) A 2014 study with 11 men showed that ice did not

improve healing outcomes but rather delayed recovery following eccentric exercise-induced muscle damage, causing a rebound in muscle hemoglobin concentration compared with controls. (12) Van den Bekerom *et al*. presented no evidence or any positive effect when examining the treatment of ice on sprained ankles (17), with also concluding no major outcomes for icing injuries. (1) Furthermore, Khoshnevis *et al* found that cryotherapy creates a deep state of reduced blood flow, possibly leading to tissue death. (11) There are also 4 animal studies from 2008 and 2011 that show excessive icing or topical cooling to be very damaging to soft tissue, and a study in 2010 showed that it is less efficient than physical therapy. (18- 20) What's more, a study in 2004 concluded there is little evidence across the board showing ice to have ANY effect on healing outcomes. (21,22)

The Inflammatory Process

Following an injury, our innate immune system fires off a series of orders to protect the tissue from further damage and initiate healing, identified as redness, heat, pain, swelling, and reduced function. (23) Damaged tissue then prompts the release of chemical signals, causing blood vessel dilation, leaky capillaries, and the attraction of neutrophils and, eventually, macrophages. (24) From here, phagocytosis occurs, which involves the removal of damaged and/or dead cells, increasing blood flow, providing oxygen and nutrients, and clotting proteins, resulting in "healing." (25) These physiological processes can essentially be put into three significant healing phases: inflammation, proliferation, and remodeling. (26) These phases occur in order, resulting in repaired healthy tissue. (27) As mentioned above, the secondary injury was a key reason as to the why behind ice and is often attributed to the adverse effects caused by inflammation, such as the enzymatic, hypoxic, and ischemic complications that can occur from the dead cells and debris, bleeding, hemorrhaging, change in phospholipids, and oncosis. (28) However, all these functions are a vital part of repair and regeneration, with a large amount of research now concluding that inflammation is an essential part of optimal healing and a physiological response that occurs appropriately for the given injury and healing required. (29) If ice was so effective at treating secondary injury and improving healing outcomes, why does the evidence suggest otherwise?

What About Swelling?

If you ask a healthcare practitioner why they use ice for swelling, they'll likely tell you it's because "excessive" swelling can lead to increased pain, decreased range of motion, and a longer recovery time. This is true. If swelling is allowed to stay in a joint, it can have adverse effects. However, swelling itself isn't a good or bad thing. It's simply the end response of the inflammatory cycle. It's what is done about it that makes all the difference. Following injury, the surrounding blood vessels dilate as part of the inflammatory response, and the tiny capillaries surrounding the damaged tissue "open up" to allow white blood cells to arrive. This rush of white blood cells out of the capillaries also pulls additional fluid into the surrounding tissue (which is simply swelling). (23,24)

Swelling, however, is there for a reason. It contains the waste byproduct of the initial damaged tissue. (30) Unfortunately, the additional fluid containing waste can't leave the same way it came in (through the circulatory system). It has to be evacuated through the lymphatic system. Your body has a few different pathways to move fluid from place to place. (29) Your circulatory system (composed of arteries and veins) pumps blood cells and fluid to and from your heart all day. This continuous transport system works day and night when you're resting and moving around.

The lymphatic system is a tube-like system that runs throughout the entire body, except it doesn't have an "engine" like the heart to transport fluids. The lymphatic system is completely passive." This means the body have to make it work. When one contract their muscles, the lymphatic vessels deep inside the body are squeezed, and the fluid within forces it to move. Swelling, therefore, is merely the buildup of waste around the injured area that needs to be evacuated through the lymphatic system. It is a natural response to injury that only becomes a problem when it is allowed to accumulate. When an athlete has a sprained ankle, and their leg has ballooned two to three sizes the following day, they don't have a swelling problem...they have an evacuation problem. Ice does not facilitate the clearance of swelling through the passive lymphatic system. While resting and icing may feel good in the short term, the body is trapping debris around the injury and stunting the natural healing process from occurring. (31)

Long-Held Beliefs

Plain and simple, healing requires inflammation. It is an essential biological response following an injury. It isn't a bad thing, like you've been told your entire life. While chronic levels of inflammation can play a role in certain diseases (such as autoimmune disorders like rheumatoid arthritis or lupus), it is extremely beneficial to muscle regeneration directly after an acute muscle injury. A lack of inflammation blunts the healing process and contributes to poor muscle regeneration. (32-36) This "blunting" of the healing process occurs when you use ice. Placing ice on an injury essentially places a roadblock in front of the white blood cells trying to get to the injured area and stunts the natural inflammation process from occurring. While you think you're helping the healing process by placing a bag of ice on your body, you're delaying it from ever starting by preventing the body from doing what it needs to do. (37)

Contrary to long-held traditional beliefs, research does not support using ice for injuries other than pain management. (11,38) In fact, Reinl, an expert in the field of sports medicine, states, "Cells that are otherwise perfectly healthy do not die as a result of some divinely inspired, pre-programmed inescapable injury-driven master plan. (39) They die (mostly) unnecessarily from suffocation and disuse…if you want to stop the unnecessary killing of these otherwise perfectly healthy cells, simply follow ARITA (Active Recovery Is The Answer)." Furthermore, multiple high-quality studies conclude ice has no positive effects in regard to treating injuries and no improvement in healing outcomes. (17,22) In fact, a study by Yackzan *et al* found an increase in muscle soreness and a decrease in range of motion following the treatment of ice post-training between the 48-72 hour mark. (40) Research is now showing that icing can in fact create damage to soft tissue, thus reducing muscle recovery - not to mention research showing that ice is less effective than other therapeutic means. (18,19,21) Dr. Gabe Mirkin states, "You think you're recovering faster, but science has shown you're not." (41)

A Research Trial

A 2011 study looked into the effects of ice after a muscle injury (one group received ice for 20 minutes following the injury, the other did not). (36) The injuries were then closely monitored for the next 28 days. During the initial few hours following injury, it is common to see macrophages (aka the "cleanup crew) flood the area. The researchers found several within the damaged muscle fibres of the "no icing" group; however, those who had been given ice showed almost no signs of macrophages. At 3 days post-injury, the "no-icing" group already showed signs of regenerating muscle cells. Yet, in the icing group, these cells were nowhere to be found. At 4 days out, regenerated muscle cells were found in both groups, but those in the "no-icing" group were significantly larger than those in the icing group. At 28 days post-injury, the regenerating muscle of the "no-icing" group was 65% larger than the icing group! In addition, the researchers found significantly more scarring compared to the untreated muscles. The study's authors concluded, "Judging from these findings, it might be better to avoid icing, although it has been widely used in sports medicine." Despite "conventional wisdom" that tells us ice is a good idea, research shows that ice actually delays muscle repair after injury, and gives us direct evidence that ice can ultimately lead to increased scarring. To make matters even worse, the way in which we use ice also has the potential to decrease muscle strength and size. When most people have an injury, they wrap a bag of ice tightly around the painful joint or muscle and stop moving. We do this because we've always been told moving the injury will cause further damage. However, immobilizing your injury is likely doing more harm than good.

CONCLUSION

Based on the information presented here, we cannot support the hypothesis that "ice" is an appropriate treatment for supporting healing outcomes. Our information suggests that ice slows the cascade of physiological events, which are in fact responsible for optimal healing. We are aware that we're challenging a prominent long-held belief by many, and further education is needed around this common misconception in and throughout the medical community moving forward. We encourage those to take personal responsibility to reach their communities and change this outdated narrative surrounding "ice."

New research can and may change our conclusion on this matter. Our approach to appraising this information was to establish and follow a hierarchy of importance when choosing what information should primarily shape our conclusion. It is possible that more information will change the breadth of our understanding of the inflammatory process and how ice interacts with healing, thus changing our current conclusion. Certainly, further education around this topic is needed.

REFERENCES

1. Bizzini M. Ice and modern sports physiotherapy: still cool? Br J Sports Med. 2012;46(4):219–219. https://doi.org/10.1136/bjsports-2012-090960

2. Meeusen R, Lievens P. The use of cryotherapy in sports injuries. Sports Med. 1986;(6):398–414. https://doi.org/10.2165/00007256-198603060-00002

3. St. John. St John guide to first aid for sprains, strains and bruises. Www.Stjohn.Org.Nz. https://www.stjohn.org.nz/First-Aid/First-Aid-Library/Sprains-Strains-and-Bruises/

4. Williams R. RICE treatment: why it works so well for minor injuries. Www.Coastalorthoteam.Com; Coastal Orthopeics. 2016. https://www.coastalorthoteam.com/blog/rice-treatment-why-it-works-so-well-for-minor-injuries#:~:text=RICE%20treatment%2C%20or%20RICE%20therapy

5. Mirkin G. Sports medicine. J Am Med Assoc. 1978;254(16):2340. https://doi.org/10.1001/jama.1985.03360160172052

6. Mirkin G. Why Ice Delays Recovery | Dr. Gabe Mirkin on Health. Drmirkin.Com. 2015. https://www.drmirkin.com/fitness/why-ice-delays-recovery.html

7. Massie F. Refrigeration anesthesia for amputation. Ann Surg. 1946;123(5):937-947

8. Bleakley C. Cryotherapy for acute ankle sprains: a randomised controlled study of two different icing protocols. Br J Sports Med. 2006;40(8):700–705. https://doi.org/10.1136/bjsm.2006.025932

9. Stone J. RICE: The End of an Ice Age. 2014. https://k-active.com/wissen/wp-content/uploads/2019/10/RICE_The_End_of_an_Ice_Age.pdf

10. Singh D, Barani Lonbani Z, Woodruff M, Parker T, Steck R, Peake J. Effects of topical icing on inflammation, angiogenesis, revascularization, and myofiber regeneration in skeletal muscle following contusion injury. Front Physiol. 2017;8. https://doi.org/10.3389/fphys.2017.00093

11. Khoshnevis S, Craik N, Diller K. Cold-induced vasoconstriction may persist long after cooling ends: an evaluation of multiple cryotherapy units. Knee Surg Sports Traumatol Arthrosc. 2014;23(9):2475–2483. https://doi.org/10.1007/s00167-014-2911-y

12. Tseng C, Lee J, Tsai Y, Lee S, Kao C, Liu T, *et al*. Topical cooling (icing) delays recovery from eccentric exercise–induced muscle damage. J Strength Cond Res. 2013; 27(5):1354–1361. https://doi.org/10.1519/jsc.0b013e318267a22c

13. Murphy J, Banwell P, Roberts A, McGrouther D. Frostbite: pathogenesis and treatment. J Trauma Acute Care Surg. 2000;48(1):171. https://doi.org/10.1016/s0735-6757(01)80175-3

14. MacAuley D. Do textbooks agree on their advice on ice? Clinic J Sport Med. 2001;11(2):67–72. https://doi.org/10.1097/00042752-200104000-00001

15. Basit H, Wallen T, Dudley C. Frostbite. StatPearls [Internet]. 2020. https://www.ncbi.nlm.nih.gov/books/NBK536914/

16. Cheung S. Responses of the hands and feet to cold exposure. Temperature. 2015;2(1):105–120.

17. Daanen H. Finger cold-induced vasodilation: a review. Europ J App Physiol. 2003;89(5):411–426.

18. Reinl G. Iced! The illusionary treatment option. 2nd Edition. Gary Reinl. 2014.

19. Van den Bekerom M, Struijs P, Blankevoort L, Welling L, van Dijk C, Kerkhoffs G. What is the evidence for rest, ice, compression, and elevation therapy in the treatment of ankle sprains in adults? J Athl Train. 2012;47(4):435–443. https://doi.org/10.4085/1062-6050-47.4.14

20. Collins N. Is ice right? Does cryotherapy improve outcome for acute soft tissue injury? Emerg Med J. 2008;25(2):65–68. https://doi.org/10.1136/emj.2007.051664

21. Bleakley C, O'Connor S, Tully M *et al*. Effect of accelerated rehabilitation on function after ankle sprain: randomised controlled trial. BMJ. 2010;340:1964 –1964. https://doi.org/10.1136/bmj.c1964

22. Bleakley C, Glasgow P, Webb M. Cooling an acute muscle injury: can basic scientific theory translate into the clinical setting? Brit J Sports Med. 2011;46(4):296–298. https://doi.org/10.1136/bjsm.2011.086116

23. Roberts L, Raastad T, Markworth J *et al*. Post-exercise cold water immersion attenuates acute anabolic signaling and long-term adaptations in muscle to strength training. J Physiol. 2015;593(18):4285–4301. https://doi.org/10.1113/jp270570

24. Bleakley C, McDonough S, MacAuley D. The use of ice in the treatment of acute soft-tissue injury: a systematic review of randomized controlled trials. A J Sports Med. 2004;32(1):251–261. https://doi.org/10.1177/0363546503260757

25. Herrington C. Muir's textbook of pathology (15th ed.). Crc Press. 2014.

26. Serhan C, Ward P, Gilroy D. Fundamentals of Inflammation. Cambridge University Press. 2009. https://doi.org/10.1017/cbo9781139195737

27. Nicpon E, Keller S. Essentials of human anatomy & physiology (12th ed.). Pearson. 2018.

28. Cook S. Healing injuries the natural way : how to mend bones, muscles, tendons and more. Your Health Press Trafford. 2014.

29. Buckwalter J, Grodzinsky A, Loading of healing bone, fibrous tissue, and muscle: implications for orthopaedic practice. J Am Acad Orthop Surg. 1999;7(5):291–299. https://doi.org/10.5435/00124635-199909000-00002

30. Merrick M. Secondary injury after musculoskeletal trauma: a review and update. J Athlet Train. 2002;37(2):209–217. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC164347/

31. Tidball J. Inflammatory processes in muscle injury and repair. Am J Physiol Regul Integr Comp Physiol. 2005;288(2):R345–R353. https://doi.org/10.1152/ajpregu.00454.2004

32. Dubois B, Esculier J. Soft-tissue Injuries Simply Need PEACE and LOVE. British J Sports Med. 2019;54(2):101253. https://doi.org/10.1136/bjsports-2019-101253

33. Cleveland Clinic. Lymphatic System: Parts & Common Problems. Cleveland Clinic. 2020. https://my.clevelandclinic.org/health/articles/21199-lymphatic-system

34. Lu H, Huang D, Saederup N. Macrophages recruited via CCR2 produce insulin-like growth factor-1 to repair acute skeletal muscle injury. FASEB J. 2011;25(1):358-69.

35. Summan M, Warren G, Mercer R, Chapman R, *et al*. Macrophages and skeletal muscle regeneration: a clodronate-containing liposome depletion study. Am J Physiol Regul Integr Comp Physiol. 2006;290(6):R1488-95

36. Pelosi L, Giacinti C, Nardis C, Borsellino G. Local expression of IGF-1 accelerates muscle regeneration by rapidly modulating inflammatory cytokines and chemokines. FASEB J. 2007;21:1393–1402

37. Singh D, Lonbani Z, Woodruff M, Parker JP.. Effects of topical icing on inflammation, angiogenesis, revascularization, and myofiber regeneration in skeletal muscle following contusion injury. Front Physiol. 2017;8:93.

38. Takagi R, Fujita N, Arakawa T, Kawada S, Ishii N, Miki A. Influence of icing on muscle regeneration after crush injury to skeletal muscles in rats. J Appl Physiol. 2011;110:382–388.

39. Tiidus P. Alternative traetments for muscle injury: massage, cryotherapy, and hyperbaric oxygen. Curr Rev Musculoskelet Med. 2015;8(2):162-7

40. Leadbetter W, Buckwalter J, Gordon S. Sports-induced inflammation : clinical and basic science concepts. Acad Orthop Surg. 1990.

41. Reinl G. "Secondary Cellular Death" Is Actually Negligent Homicide. 2015. https://www.garyreinl.com/articles/Secondary-Cellular-Death-Is-Negligent-Homocide.pdf

42. Yackzan L, Adams C, Francis K. The effects of ice massage on delayed muscle soreness. A J Sports Med. 1984; 12(2):159–165. https://doi.org/10.1177/036354658401200214

43. Berra L. The cold, hard truth about icing your injuries. Men's Health. 2019. https://www.menshealth.com/fitness/a29710918/icing-sore-muscles/