Questioning the use of ICE Given Inflammation is a Perfectly Healthy Response Following Acute Musculoskeletal Injuries

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When my children bumped their head I used to reflexively put ice on their bumps for 2-3 minutes just to numb the pain a little and to make myself feel like I was being a useful and caring parent. For many years when I encountered an acute ankle sprain on the field, I would again instinctively and immediately place an ice pack on the sprained ankle for 20 minutes to numb the pain and improve recovery by minimizing inflammation ...at least thatôs what I was taught and assumed to be correct.

There is certainly anecdotal and clinical evidence that ice has a temporary pain reducing and localized numbing effect (Hubbard et al 2004); therefore if ice is applied to simply numb an area post injury, then I guess itôs alright. However what about the claims that ice helps reduce inflammation? What about the claim that ice helps the healing process post acute injury?

Even though there are some animal studies supporting the hypothesis that icing may have an effect on various inflammatory events at a cellular level (Bleakley et al 2010), that still does not support the belief that many have that icing is actually beneficial in humans in real clinical settings. In fact clinical trials on the efficacy of RICE (Rest, Ice, Compression, Elevation) have supported the use of compression but have found no value in icing (other than the temporary numbing effect already mentioned) (Hubbard et al 2004).
In this short but likely controversial article I will be sharing with you the crazy idea that ice is not only ineffective, but may even be counterproductive to proper natural healing following acute soft tissue injuries.

I have always been puzzled by the proposal that when an injury occurs, we must immediately act to reduce and eliminate inflammation. I just have one question to ask: why? Can anyone answer why the normal inflammatory response post acute trauma is not good for healing? For me it is similar to proposing that the blood coagulation mechanism that occurs after an acute cut is pathological and must be reduced. Why?

Our mammalian ancestors spent hundreds of millions years evolving and specifically humans have spent about 7 million years in the making. Survival of a species relies on effective physiological repairing of an injury when it inevitably occurs. Do we truly believe that the bodyôs natural inflammatory response that has evolved over millions of years is somehow wrong? If it is not wrong, then why do we try so hard to prevent, minimize and reduce inflammation? When did inflammation after an acute injury become a harmful toxic agent that must be eliminated at all costs?

Our ancestors did not have access to and did not dream about putting ice on an injured tissue. In fact, the majority of the population on earth still does not accept icing in managing injuries. In

Chinese and Ayurvedic Indian medicine, icing is believed to be counterproductive; perhaps they have it right and western medicine has it wrong.

Going back to basic physiology, we are all aware of the three phases of healing following an acute injury- inflammatory, proliferation and remodeling. Describing the detailed physiology behind each phase is way beyond the scope of my knowledge and this article.

Inflammation is an inevitable and an essential biological response following acute soft tissue injuries. It is a protective attempt by the body to remove the damaging stimuli and to begin the healing process.

Acute inflammation results in vasodilation and increased permeability at the arteriole and capillary levels which are brought on by the actions of various inflammatory mediators. This allows more blood to arrive, and with it leukocytes and macrophages (white blood cells) to ñclean upò the injured site.

The build up of fluid, swelling or edema at the site should be considered a positive reaction as it increases sensitivity to pain *(to prevent us from further injuring the tissue)*, restricts movement *(to prevent us from further injuring the tissue)* and allows the inflammatory process to progress *(to help us repair the injured tissue).*

My only concern is that if we artificially ñfiddle aroundò with the initial inflammatory phase of healing, are we not potentially influencing the final remodeling phase? It turns out that we may be negatively effecting tissue remodeling through our obsession to get rid of inflammation with icing and the use of non-steroidal anti-inflammatory drugs (NSAIDs).

Does the body really need help in reducing inflammation? The lymphatic system naturally and slowly removes all the waste products and excess fluid buildup caused by the inflammatory process. While the circulatory system relies on the heart for continuous transport of blood through its vessels, the lymphatic system does not have a ñheartò and therefore primarily relies on movement, skeletal muscular contraction and breathing for lymphatic drainage; this may be assisted by elevation and compression. Icing has been shown to reduce skeletal muscle contraction (Bleakely et al 2012) which may temporarily reduce optimum lymphatic drainage at the injury site.

It has even been hypothesized that icing an injury may ironically restrict lymphatic flow and promote fluid build-up (Starrett K: Mobilitywod video link 2012).

When ice is applied to a soft tissue for a prolonged period, the lymphatic vessels in the region increase their permeability resulting in large amounts of fluid exiting the lymphatics into the injured area, thereby increasing the amount of local swelling (Meeusen & Lievens 1986).

In this experimental study (Takagi et al 2011), the muscle belly of the extensor digitorum longus of anaesthetized rats was crushed for 30 seconds using forceps, to which a weight (500g) was attached. Immediately after the injury the rats were randomly divided into two groups, the no icing group and icing group where they lightly placed fine crushed ice in a tiny polyethylene bag on their injured hind leg for 20 minutes.

At 12 h and 1, 2, 3, 4, 5, 6, 7, 14 and 28 days after the injury, their injured muscles were microscopically and physiologically analyzed. I have summarized and have very much simplified the results of this study in the following chart.

Influence of Icing on Muscle Regeneration After Crush Injury to Skeletal Muscles in Rats		
Time after injury	**No Icing Group**	**Icing Group**
12 hours	Macrophages were found within the necrotic muscle fibers (Macrophage migration to an injured site to phagocytose the necrotic muscle fibers is essential for "clean-up")	**Less** macrophages were found within the necrotic muscle fibers
Day 3	Regenerating muscle cells present	**Reduced** regenerating muscle cells
Day 4	Normal sized muscle cells produced	**Smaller** sized regenerating muscle cells
Day 14	Normal maturation of the regenerating muscle fibers	Maturation of the regenerating muscle fibers was visibly **reduced**
Day 28	Cross-sectional area of the regenerating muscle was 65% greater than the icing group Collagen fibers were seen only among the bundles of muscle fibers as it is seen in healthy muscles	Regenerating muscle fibers was **significantly less** in the icing group ($P < 0.01$) **Abnormal collagen formation** where collagen fibers surrounded each muscle fiber
Takagi, R, et al. Influence of Icing on Muscle Regeneration After Crush Injury to Skeletal Muscles in Rats. J of App Phys. February 1, 2011 vol. 110 no. 2 382-388 http://jap.physiology.org/content/110/2/382		

The final summary sentence from the above-mentioned study published in *The Journal of Applied Physiology* is,

"Judging from these findings, it might be better to avoid icing, although it has been widely used in sports medicine."

As health care providers we must ask ourselves if the temporary (20-30 minutes) pain reduction and numbness is worth the potential hindrance to the proper maturation and collagen formation.

You may be asking yourself; surely this is just one study, what about all the other studies supporting the use of ice? I will reply with, ñwhat other studies?ò

The Cochrane review on low back pain (French et al 2006) concludes that to date there is some evidence supporting the use of heat but no evidence on the use of cryotherapy.

An analysis of 11 trials involving 868 patients (van den Bekerom et al 2012) concludes that there is insufficient evidence from randomized controlled trials to determine the relative effectiveness of RICE therapy for acute ankle sprains.

The most recent systematic review (Bleakley et al 2012) based on 35 clinical trials suggests that athletes may in fact be at a performance disadvantage if they return to their athletic activity immediately after 20 minutes of icing.

Another systematic review (Bleakley et al 2004) based on 22 clinical trials concluded that the effect of cryotherapy on acute injuries such as muscle strains and contusions has not yet been shown. Here is a direct quote from the paper,

"There was little evidence to suggest that the addition of ice to compression had any significant effect". (Bleakley et al 2004)

Icing of sore muscles after a hard athletic workout is commonly thought to help recovery and promote earlier return to activity. This experimental study in fact demonstrated the opposite to occur (Tseng et al 2013). After performing 6 sets of heavy eccentric triceps workout, half the athletes were randomly allocated to receive either 15 minutes of cooling ice pack or a sham pack. After 2 and 3 days the icing group had significantly greater creatine kinase and myoglobin (signs of muscle overload) and the athletes subjectively reported of having more triceps fatigue than the sham ice group.

Here is a quote from the above-mentioned paper published in the *Journal of Strength & Conditioning Research*,

"These data suggest that topical cooling, a commonly used clinical intervention, seems to not improve but rather delay recovery from eccentric exercise-induced muscle damage". (Tseng et al 2013)

Are you kidding me? We've been putting ice on thousands of professional and amateur athletes, and on thousands of kids in school playgrounds. You mean to tell me after all these decades we don't yet have a single study to support the use of ice with respect to enhancing tissue healing and hastening recovery? Could it be that the use of ice has been way overrated? We have all been somehow duped to believe that ice is so effective that it did not even require scientific scrutiny and supportive evidence.

So what about icing for patients post-op? A meta-analysis of seven clinical trials on cryotherapy post ACL surgery concluded that icing added no additional benefit with respect to reducing swelling or improving ROM; however **icing did significantly lower post-op pain** and potentially reduced the use of pain meds (Raynor et al 2005).

The Cochrane database and another meta-analysis of eleven clinical trials concluded that cryotherapy post total knee arthroplasty (TKA) resulted **in small improvements in ROM but provided no benefits on pain**, analgesia use, swelling or functional outcomes (Adie et al 2010, 2012).

Sorry to upset anyone, again ...I'm just a messenger.

There are always patients who find the cooling and compression post-op very soothing which may help them sleep better after major knee surgery. Perhaps even with the lack of evidence, pos-op patients may benefit simply from the numbing benefits of cold compression tools.

Based on the evidences presented in this paper, a paradigm shift is proposed for the automatic, instantaneous and frequent use of ice post acute soft tissue injuries.

The follow-up to this paper will review the evidences for the use of NSAIDs post acute soft tissue injuries. However it will **also present the not so often discussed potential adverse effects of NSAIDs on tissue healing and possible injury reoccurrences.**

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