FROSTBITE

A firsthand account

By Rod Willard

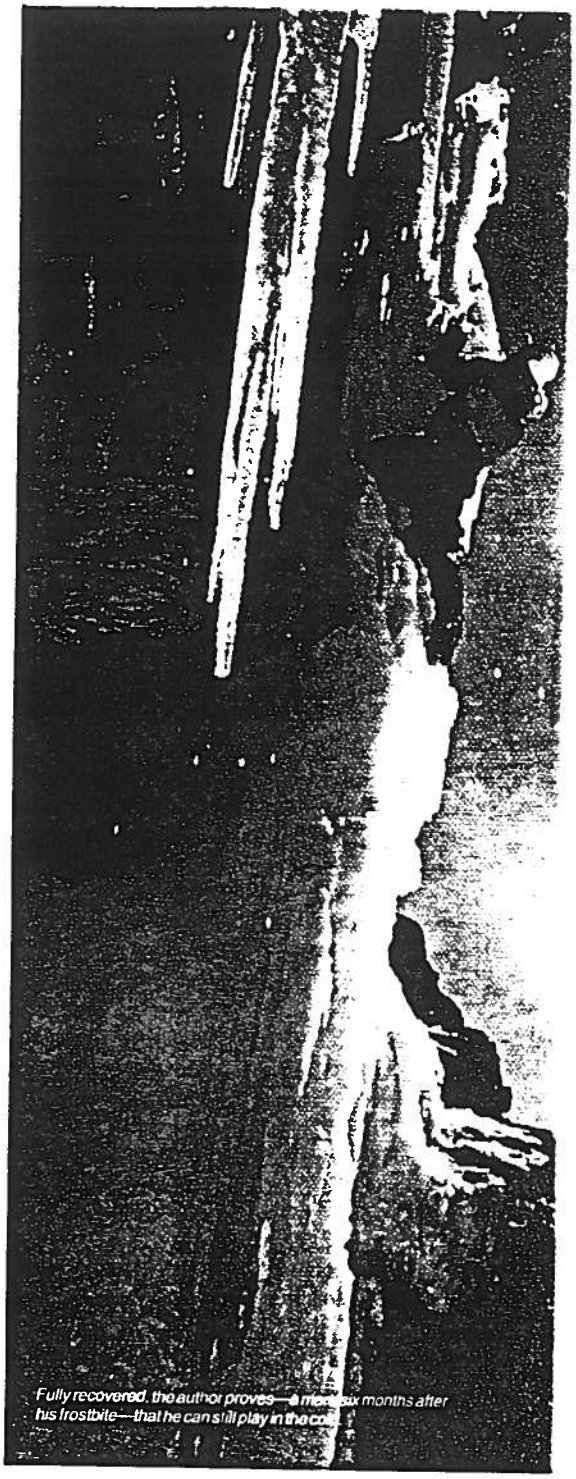
After twenty three hours on our feet, we collapsed into the tent, elation creeping through our exhaustion. We had completed a difficult route on Ama Dablam and returned safely despite the stove failing *and* an intense storm. As I removed my gloves to examine my partner's anesthetized feet, I could only stare in total disbelief. "Bloody Hell, your fingers look terrible!" uttered somebody. My fingers were deep blue, cold, and numb. Insidious and potentially crippling, frostbite is best prevented, but when it occurs, rapid rewarming and progressive long term therapy can minimize the damage.

Frostbite occurs when the bodies mechanisms for maintaining warmth fail. We have two defenses against the cold: physical changes and mental decisions. When initially exposed to cold the body reacts by sending extra warm blood to the area. But as the cold exposure continues, the core of the body begins to cool and the brain diverts warm blood away from peripheral areas such as arms, legs, and ears.

Prevention: Minimizing the risk

The brain is our best defense against the cold. You can reduce exposure to injury by making good decisions.

- Nutrition and hydration play a large part in the body's ability to deal with cold. Staying ahead on hydration (clear urine is the goal here) and eating plenty of good food will keep internal fires stoked.
- Be sure to have plenty of dry insulation that fits correctly. Too loose allows air leaks and makes excess space to be heated. Too tight restricts blood flow.
- Blood flow can also be restricted by mechanical pressure such as gripping a ski pole too tightly.
- Alcohol and nicotine should also be avoided. Alcohol dilates your blood vessels, increasing the rate at which you lose heat. Nicotine constricts your blood vessels and will cause premature cooling of your extremities. Furthermore, alcohol, altitude, low blood sugar, etc. can affect the decisions you make to protect yourself from the cold. The majority of frostbite cases in America today do not happen to winter outdoor funhogs, but to homeless folks who have poor hydration, lousy nutrition, insufficient insulation, and may use alcohol and nicotine.
- The last risk factor is prior cold injury, each time an area is frostnipped or frostbitten the circulation to that area is reduced.



Fully recovered, the author proves—a mere six months after his frostbite—that he can still play in the cold.

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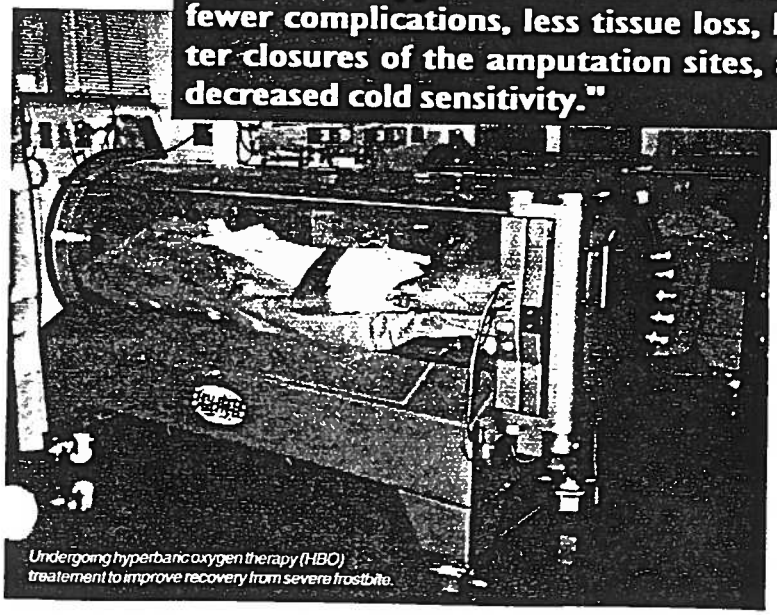


Undergoing hyperbaric oxygen therapy (HBO) treatement to improve recovery from severe frostbite.

Frostbite mechanics

So what happens when the body and brain fail to stay warm? In a typical outdoor setting, freezing happens slowly and occurs in the fluid *between* the cells, rather than *inside* the cells. This causes fluid to be drawn out of the cells, dehydrating them and eventually causing cellular death. The blood that is able to reach the area via the constricted capillaries is thick and cold, and tends to clot, completely blocking the capillaries. The damage caused by frostbite continues even after the area has thawed. As blood flow is resumed into the frozen tissue, the vessels begin to leak, causing swelling in the tissue and concentrating the blood. This sludging effect further decreases blood flow and clotting may occur during the post–thaw phase as well. During this phase, tissue is very susceptible to further trauma. If it refreezes, tissue loss is certain. Even simple use of the area, such as walking or using your hands, can increase damage.

Detection

Let's say your spring skiing trip turns nasty as a cold storm blows up. Your wet gloves soon freeze on the outside and the feeling in your fingers evaporates. Once back to shelter, you must evaluate the possible damage. After some fumbling, removal of your gloves reveals your fingertips as white to yellowish in color, cold to the touch, with diminished or even absent sensation and they are stiff to bend, but feel soft when touched. At this point the injury is superficial and the only long term damage would be increased chance of another cold injury.

Deep tissue frostbite will be white/yellow to deep blue in color, totally without sensation, hard to the touch, and very difficult to move *if* it is possible at all. Anytime you suspect that you have received a cold injury, superficial or deep, treat it as serious frostbite.

Treatment

The primary treatment is rapid rewarming of the affected area. But there are some things you should consider first. Anyone who has frostbite should also be assumed to be hypothermic. Treat this and any other life threatening problems first. The affected area should not be used, as it is very fragile and rewarming should not be done if there is risk of refreeze. If you are in a remote situation requiring exposure of the frozen part, it is better to leave it frozen. Once it has thawed, using the affected area, whether intentional or accidental, will only increase long term damage. If you can make it to a medical facility in less than 2 hours, go to the hospital to be rewarmed.

When it is appropriate to rewarm the area, it should be done by immersing it in water that is 104°–108° F, hot tub temperature. Test the water with a healthy finger. It should not be so hot that you cannot leave a finger in the water for several minutes. Remember that the affected part will have altered feeling and is very susceptible to being burned. A double pan system is recommended to help prevent further injury during rewarming, or thaw the affected area in a pan that is not on the stove and is kept warm by adding water to it. Do not get the water too hot or allow the frozen part to contact the base of the pan on a stove. The rewarming process should take 20 to 30 minutes. This can be some of the most excruciating pain one can ever experience. Be supportive, and if appropriate, medicate the patient. If you cannot rewarm the part in a water bath, a second choice is to place it against your body, preferably an armpit or groin. This technique is much less effective at reducing the extent of the injury.

Once the rewarming is complete, the area should be pink to red, and warm to the touch. If not, try additional time in the water bath. Deep frostbite damage may not improve in color and will remain cool to the touch. Gently dry the area. *Never massage or rub frostbite*. Bandage the damaged part in soft, dry dressings, separating fingers and toes without constricting circulation. It is now time to make tracks for a medical facility.

This may take hours or days, but start the process immediately. If you are more than a few hours from medical help you will need to continue treating the frostbite.

The first few hours can be critical, and aggressive treatment can make a big difference in the patient's outcome. The pain will continue, so use medications as appropriate, but don't knock out somebody who needs to be able to walk out to help. The area will swell and blisters may develop, so periodically check the dressing to be sure that they don't become too tight.

Clear blisters that extend to the tip of the affected area are a good sign. Blood filled blisters, or none at all, are signs of a poor long-term outcome. Do not break the blisters because they provide protection for the tissue underneath. Begin the patient on Naproxen (Aleve), 440mg twice a day, to combat the effects of sludging blood and clotting. If you are in the backcountry or out of the country begin an antibiotic to prevent infection. A good choice is Cephalexin, 500mg twice a day. Be sure the patient has had a tetanus immunization in the last 5 years. Treat any blisters with topical aloe vera gel. Be sure to use a brand (example: Fruit Of The Earth) that does not contain alcohol or glycol, because when they evaporate, they cool the areas causing intense pain. Do not allow the patient to consume any caffeine as it will further restrict the bloodflow to the damaged area. These therapies will suffice while evacuating to a medical facility. Serious frostbite needs to be treated by a knowledgeable physician with appropriate facilities (HBO therapy) as soon as possible. Get home as quickly as possible.

Recovery

Once you have become a victim of frostbite and the first few hours have elapsed, there has been very little written about what happens next. I would like to share some lessons I have learned through experience that may save some precious tissue.

First, find a physician who has experience with frostbite. The average physician has no idea what to do with this rare injury. I often found myself educating the medical personal who treated me, about the pathology of my injury and how to treat it. In today's arena of communication, any local physician can consult with an expert in cold injury. Dr. Peter Hackett is one of the best, and helped facilitate my treatment and recovery. If you need assistance in finding a local physician who has experience with frostbite, or your doctor would like to discuss your treatment with an expert, he can be reached at 970-242-4358.

Next, it is important to begin hyperbaric oxygen therapy (HBO) as soon as possible. During an HBO treatment, you enter a chamber and the pressure inside is increased to two atmospheres with pure oxygen. This saturates your entire body with oxygen, even areas that have very compromised blood supply. These two-hour "dives" are done daily; I received 40 treatments.

The use of HBO is contested by some cold injury experts. Their opinions are primarily based on studies that are not applicable to typical frostbite injury.

When comparing my recovery to that of others who did not receive HBO therapy, I had a faster recovery, fewer complications, less tissue loss, better closures of the amputation sites, and decreased cold sensitivity. For example, on the six-month anniversary of my injury, I led the first ascent of "Frostbite Falls" WI4+. It has taken other frostbite victims years to get back out in the winter realm that we all love.

Physical therapy is an important component of a rapid recovery. Twice a week I saw a therapist as well as exercising several times a day at home. The goal is to maintain flexibility and strength as well as to increase circulation in the damaged areas. Warm water whirlpools were a great way to warm up before each exercise session. They can be done at home with a large bucket/barrel and a "jacuzzi" unit designed to hang over the edge of a bathtub. If surgery is required, therapy will also be needed to desensitize the new closure.

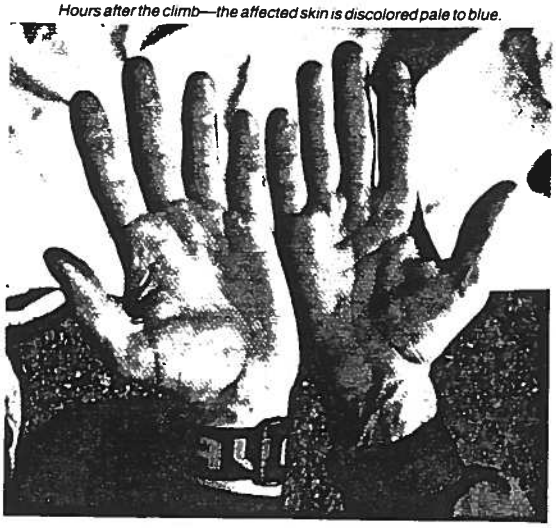
Patience plays a huge part of frostbite recovery. The body's ability to heal is incredible, so take plenty of time before making any decisions about surgery. It will take weeks to months before a clear demarcation line between good tissue and the dead eschar is shown. This rush can be self induced, brought on by a physician/insurance company, or may be forced upon you by infection. Infections can be prevented very effectively with HBO therapy.

Once an obvious line of demarcation has developed, there are several options for closures. Be sure to discuss these options with your surgeon. I chose to lose a tiny bit of length in order to use the natural finger skin to close the tip, rather than a skin flap or a graft. This technique gives the best sensitivity and the toughest skin over the new fingertips.

After surgery, there are still weeks of therapy and then years of becoming used to "the new you," both physically and mentally. Throughout this time I was lucky enough to have an excellent group of doctors and therapists, plus the love and support of my girlfriend and family.

Prevention is best, but sometimes even the most gallant fight still loses to the cold. When this happens, you must continue fighting and try to save every bit of your body that you can.

Hours after the climb—the affected skin is discolored pale to blue.



Days after being frostbitten—the dead tissue is turning black.

Six months later, the dead tissue has been removed—and a few fingers are shorter, but still working.

If you need more information on frostbite, current treatment and getting through recovery, feel free to contact me:
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