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ABSTRACT

Outdoor leaders and those involved in personal outdoor adventure pursuits must be knowledgeable in the assessment, treatment, and prevention of musculoskeletal injuries in the backcountry. In the wilderness medicine setting, extended time periods of patient care, rugged terrain, severe environmental conditions, and limited resources create emergency care situations that are considerably different from standard urban emergency response. In emergencies, the trip members are the first responders and are often the rescuers. This paper focuses on the assessment, treatment, and prevention of common injuries to the musculoskeletal system. Some basic information on bones and muscles is reviewed. When assessing an injury, the care provider must look at the mechanism of injury to determine the likelihood, type, and extent of injury. Stable musculoskeletal injuries include strains, caused by overstretching or tearing of muscles or tendons, and sprains, which involve stretches or tears of the ligaments. Stable injuries are treated with rest, ice, compression, and elevation (RICE) but generally do not require splinting. Unstable musculoskeletal injuries include fractures and dislocations and are treated with hands-on stabilization, traction in line, and splinting, in addition to RICE. The diagnosis, treatment, and potential need for evacuation are detailed for various types of injury within each category. The improvisation of splints from backcountry gear and their application to fracture or dislocation are discussed. (Author/SV)

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ABSTRACT

Accidents do happen . . . ankles are sprained, shoulders are dislocated, arms are broken. Most individuals or groups do not carry mega-first aid kits with high-tech splints. It is important for outdoor leaders as well as those involved in personal outdoor adventure pursuits to be knowledgeable in the assessment, treatment, and prevention of musculoskeletal injuries in the backcountry. In the wilderness medicine setting, extended time periods of patient care, rugged terrain, severe environmental conditions, and limited resources create emergency care situations that are considerably different from the urban emergency response that is standard in most areas of the United States and other developed countries. In emergencies, the trip members are the first responders and are often the rescuers.

In the course of outdoor recreation pursuits, individuals are constantly faced with emotional and physical risks. The challenges of outdoor adventure are what drive many to participate in these activities. Experienced outdoor leaders and adventurers manage the risk, and most of the time come away without problems. At some point, however, most backcountry enthusiasts are faced with a situation that warrants medical care. Some situations are minor and others are serious, sometimes life-threatening emergencies that dictate the need for skilled emergency care (in the field) and timely evacuation to a medical facility.

Injuries to the musculoskeletal system are common in the backcountry. The focus of this article is on the assessment, treatment, and prevention of common injuries to the musculoskeletal system, such as sprains, strains, fractures, and dislocations. The construction of splints using available

resources will be discussed. Injuries to the axial skeleton (head, spine, ribs, sternum) will not be covered.

Given the nature of wilderness emergencies, first responders must be able to more thoroughly assess the nature of musculoskeletal injuries than in the urban context. Emergency responders need to be able to differentiate between sprains, strains, fractures, and dislocations. In urban prehospital care, upon assessment of musculoskeletal injury, a splint is applied to stabilize the injury and prevent further damage. Patients are then transported to a hospital. In wilderness medicine, the injury must be diagnosed more specifically so that decisions can be made as to the most appropriate field care as well as when and how to evacuate.

In order to assess musculoskeletal injuries accurately, it is necessary to understand some basic anatomy and physiology. According to Frank Hubbell, DO (1996), "The Musculoskeletal System is made up of muscles, tendons, ligaments, cartilage, and bones. Together these provide us with locomotion, protection, cosmoses, mineral storage, and hematopoiesis."

Muscles provide the body with locomotion or the ability to move. Skeletal muscles are connected to the bones by tendons. The tendons in the "connection areas" are padded by the bursae, much like climbing anchor slings are padded across rock edges. Ligaments connect the bones at joints. Cartilage provides padding on the ends of the bones. Bones store minerals, produce red blood cells, and provide the body overall structural support. The upper and lower extremities, clavicles, scapulae, and pelvis make up the appendicular skeleton.

When assessing a musculoskeletal injury, a care provider must look at the mechanism of injury (MOI) to determine the likelihood and type of injury. MOIs in the backcountry include falls, skiing into trees, avalanches, rock

falls, whitewater swims, snowmobile accidents, ATV accidents, horseback riding accidents, wild animal attacks, and gunshots. Overuse/overexercise, heavy backpacks, improper equipment, and improper technique can also cause injuries.

There are several types of common acute (sudden) injuries to the musculoskeletal system. Strains and sprains are called stable musculoskeletal injuries. Overstretching or tearing muscles or tendons results in strains.

Common strains include muscular strains of the legs and back from carrying packs that are too heavy, and tendon strains of the Achilles tendon from hiking with improper footwear and/or carrying a heavy pack. Excessive workload and improper warm-up can cause strains. Strains may be near joints or in muscle masses. The signs and symptoms of strains are pain, tenderness, and swelling. The patient will be able to use the injured area.

Muscles and tendons are fairly elastic tissues that tend to heal well with proper treatment. Treatment of strains is to RICE the injury. Rest, Ice, Compression, and Elevation of the injury site will help reduce swelling which is important to limit the extent of the injury and speed up the rate of healing.

Patients with strains can continue trips but should limit their activities. Strains are sore, but a patient can usually tell the difference between soreness and aggravating pain (brought on by use) and should not push hard enough to aggravate the injury. Ice should be applied immediately for 20–30 minutes and then applied 2–3 times per day for the first 48 hours. After that, heat should be applied several times per day to stimulate circulation, which speeds healing. Compression wraps (elastic bandages) should be used for 48 hours. Elevation of a strain should be used as much is as practical during the first 48 hours. Arms can be put in a sling and swathe. The over-the-counter medication, ibuprofen, can be used to limit swelling and pain.

The care provider should be certain that good circulation is maintained. Circulation is monitored by checking the pulse distal to the injury at the wrist (radial artery) or top of the foot (dorsalis pedis artery) or inside of the ankle (posterior tibial artery). Another method of monitoring circulation is by checking capillary refill. This is done by pressing the fingernail bed or toenail bed until the tissue underlying the nail turns white. Upon the release of pressure, the time that it should take for the tissue to return to a pink color should be about two seconds. Strains can be prevented by warming up before exercise and properly monitoring the workload undertaken during the activity.

Another type of stable injury is a sprain. Sprains are initially acute injuries that often turn into chronic (long-term) injuries. Sprains are injuries to the joints (areas where bones meet) which specifically involve stretches or tears of the ligaments. Sprains are classified by the degree of damage to the ligaments. Ligaments are relatively inelastic tissues that do not heal easily. Mild sprains involve stretched ligaments, moderate sprains involve some tearing of ligaments, and severe sprains involve complete tearing of ligaments. The most commonly sprained joint is the ankle. An ankle sprain often occurs from walking downhill with a pack on rough terrain. Ankles are sprained on the forward foot when the ankle rolls to the outside under weight or force. Ankle sprains can be prevented by using sturdy footwear and paying attention to trail conditions.

The treatment of a sprain is rest, ice, compession, and elevation (RICE). It is critical to keep swelling to a minimum. Sprains will typically need more support, gained by elastic wraps or tape, than will strains. Ibuprofen should be used to reduce swelling and pain. Sprains do not indicate evacuation, as long as the patient is able to manage the workload of the trip. If the workload aggravates the injury, the patient should be evacuated. Upon

return from the backcountry, patients with sprains should be examined by a physician to determine the best method of long-term treatment.

Fractures are cracks or breaks in bones and can occur in conjunction with sprains and dislocations. Fractures are unstable musculoskeletal injuries. Common fractures involve the forearm, wrist, fingers, toes, ankles, and lower leg. Joints can be fractured. Fractures are often the result of high-speed collisions (such as skiing into a tree) or falls which usually result in a direct force to the injured area. Boot-top fractures are common in skiing, mountaineering, and ice-climbing accidents due to the stiff boots that are used.

Signs and symptoms include pain, muscle spasms, tenderness, swelling, discoloration, deformity, crepitus (grating noise and sensation of bones rubbing together), and a snap, crack, or pop upon impact. Patients with fractures will not be able to use the affected part. Any external bleeding near the site of a fracture should be considered to be the result of an open fracture, where bones ends have protruded through the skin. Open fractures should be considered even if bones are not visible, whenever bleeding is present at the fracture site.

Open fractures should be cleaned using irrigation with treated water. External bleeding needs to be controlled. Open fractures are at a significant risk of infection, even when cleaned in the field. The standard treatment for fractures begins by stabilizing the injury site on both sides of the injury to prevent any additional movement. The rescuer should then check the circulation, sensation, and motor function (CSMs) distal to the injury. Compromised CSMs indicate damaged circulatory or nervous system function.

The care provider needs to apply traction in line to bring fractured limbs into their normal position. This is done using gentle traction (pull) to reposition the limb while continually checking in with the patient. Ask the

patient, "Is this better or worse?" Continue moving toward what feels better and go back if the pain gets worse. The process of applying traction in line takes time. Traction in line is used to reduce swelling and pain, improve CSMs, and make the limb easier to splint.

Wilderness medicine principles call for all fractures to be treated with traction in line, which differs from urban prehospital care. Although rescuers are sometimes reluctant to reduce fractures, the situation is almost always improved by bringing limbs into normal position.

Whenever the fractured limb seems to be at the optimum position, it must be immobilized using a splint. A splint is an immobilizing device and splinting is the skill of devising the splint. CSMs must be checked after the splint is applied, and must be monitored frequently. Swelling may cause splints to become too constricting and splints sometimes loosen on their own.

Femur fractures require special treatment involving the application of significant manual traction which is then transferred over to a traction splint. Femur fractures are potentially life-threatening injuries due to the potential for significant blood loss. There are usually significant muscle spasms which pull broken bone ends past each other, in effect, shortening the leg. Traction splints are used to pull bone ends apart, control bleeding, decrease pain, improve CSMs, and stabilize the injury. Patients with femur fractures are also likely candidates for spinal injury.

Rest, ice, compression, and elevation should be used with fractures. Swelling and pain can be reduced by using ibuprofen. On extended expeditions, it may be appropriate to use stronger pain medications. Antibiotics should be started on extended expeditions for a patient with an open fracture. Strong pain medications and antibiotics are prescription drugs that should be used under the supervision (or pre-trip consultation) of a physician who is

knowledgeable in wilderness medicine. All patients with fractures must be evacuated to a hospital.

Dislocations are unstable injuries to the joints that occur when bones are displaced from their position of function in the joint. Dislocations can occur in conjunction with sprains and/or fractures. The most common dislocations are to the fingers, patella (kneecap), and the shoulder. Patellas are often dislocated by dropping the knee onto hard snow during telemark ski turns or falling onto a knee while hiking, and shoulders are often dislocated by kayakers using high braces incorrectly. Dislocations can result from direct force or indirect force to the injury site. An example of indirect force injury is falling onto the feet, while bouldering, and dislocating the hip. Dislocations often result in a chronic problem due to joint damage. Kayakers who dislocate a shoulder are much more likely to have subsequent dislocations. The signs and symptoms of dislocations are pain and tenderness, deformity of the joint, swelling, an inability to use the joint, and compromised CSMs. The treatment of dislocations begins with applying hands-on stabilization and checking CSMs. Traction in line is used to reduce the dislocation. A reduction brings the joint into proper position. Dislocation reduction techniques are learned in hands-on training sessions.

Reductions may take a long time because they work on the principle of tiring the muscles around the joint. Shoulder dislocations, for example, will usually result in significant muscle spasms. Reduction techniques tire the muscles which cause them to relax and allow the joint to be repositioned. First-time dislocations will typically be much harder to reduce than subsequent dislocations due to the intense pain and spasms. Often, patients who chronically dislocate shoulders will instruct the care provider in how to best accomplish the reduction.

Reducing dislocations is a wilderness medicine principle that is not used in urban prehospital care. In the urban setting, reductions are done in the hospital emergency departments. Reducing dislocations decreases swelling and will likely improve circulation and nervous system function. Successful reductions will significantly reduce pain for the patient.

Dislocation reductions in the field do carry some risk of nerve and blood vessel damage; however, not reducing dislocations in a wilderness setting greatly increases the chance of serious damage to joint, nerves, and vessels. Upon reducing a dislocation, the care provider will need to check the CSMs and splint the extremity. RICE and ibuprofen should be used to decrease pain and swelling.

Even with successful reduction, all first-time dislocation patients will need to be evacuated to hospital care. Patients with finger or toe injuries who have good CSMs can continue trips; however, they need to be examined by a physician upon return from the backcountry. Patients with chronic dislocation problems may choose to stay on trips provided they have good CSMs and are comfortable with the decision, but they should seek the care of a physician upon return.

In review, stable musculoskeletal injuries (strains and sprains) are treated with Rest, Ice, Compression, and Elevation but generally do not require splinting. Unstable musculoskeletal injuries (fractures and dislocations) are treated with hands-on stabilization, traction in line, and splinting, in addition to RICE. Circulation, sensation, and motor function must be monitored frequently.

By immobilizing bones or joints, splints support injured areas and reduce pain, bleeding, and the risk of additional injuries. Splints immobilize

and support injured areas. Splinting is the art of making and applying the splint.

Ambulances carry splinting devices of various types. Air splints, vacuum splints, board splints, SAM Splints™, and traction splints are often used. There is a limit to the amount of gear that can or should be carried on wilderness trips; therefore, most backcountry travelers do not carry premade splints.

A principle of wilderness medicine is to improvise first aid equipment from gear that is commonly used in the backcountry. A typical backcountry first aid kit might contain a SAM Splint™, roller gauze, tape, an elastic bandage, and a couple of triangular bandages. These items are typical splinting supplies; however, most splints also utilize other materials that are available. Anything goes when making splints. The key to improvisation is creativity, so any available resources can be used.

A great exercise is to think about what items taken on a hiking, climbing, paddling, skiing, or backpacking trip could be used for a splint. It is important to practice improvising splints using this gear before an emergency occurs. Resources available in the natural world, such as sticks, can also be utilized. Some common outdoor equipment items that work well for splints are clothing, tent poles, ensolite (ground) pads, air mattresses, Crazy Creek Chairs™, paddles, life jackets, harnesses, cordage, ropes, webbing, skis, ski or trekking poles, ice axes, snowshoes, backpacks, and day packs.

Proper splinting follows a number of principles. To begin with, when in doubt, always splint. A properly applied splint can do no harm. One needs to make a FUSS over splints (Splints need to be Fat, Ugly, Stable, and Secure). They need to be well padded with all voids being filled with padding.

Joints and bones on either side of a fracture and/or dislocation need to be immobilized.

Long-bone fractures need to be immobilized in the normal position. Joint fractures should be splinted at mid-range of normal function. Femur fractures must be immobilized using a traction splint. Spinal injuries and pelvic injuries need to be immobilized using proper spinal immobilization equipment such as a cervical collar and backboard, sled, or litter. Constant monitoring of splints as well as circulation, sensation, and motor function of affected limbs is important.

Given the experiential nature of teaming to improvise splints, the best teaming process involves taking a wilderness medical course and staying current in the skills and knowledge by reading, practicing skills, taking refresher courses, and for some wilderness medicine practitioners, volunteering with a backcountry rescue team.

Since musculoskeletal injuries are common on backcountry trips, outdoor enthusiasts need to focus on the prevention of accidents and injuries and also be capable of dealing with them when they occur. Outdoor adventurers on personal trips, guided clients on extended or high-risk expeditions, and all outdoor leaders/guides require some level of wilderness medical training. Despite the improvement in communications technology and outdoor equipment, skills, knowledge, experience, and good judgment are still the critical elements for safe and fun outdoor adventures.

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