MEDICINE OF OUTDOOR SPORTS

A COURSE OF STUDY ON THE MEDICINE OF SOME OUTDOOR SPORTS

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Chapter 1: Biking

Mountain Biking Injuries

When people think of mountain bike injuries, they first think of fractures and dislocations. However, those types of injuries are low on the list, accounting for just a few of the total injuries. Most fractures and dislocation occur while mountain biking happens in the upper extremity, where they can be subject to high compressive forces. Injuries involving the radius, clavicle, and wrist bones are among the most common biking fractures, while common dislocations involve the shoulder.

Type of Cycling Injury	Percentage
Wound	35%
Bruise	25%
Strain	15%
Tendinitis	7%
Fracture	4%
Dislocation	3%

Body Part Percentage			
Neck	50%	Thighs	8%
Knees	42%	Elbows	5%
Groin	35%	Head	4%
Hand	31%	Hips	4%
Shoulders	31%	Ankles	4%
Back	30%	Achilles	4%
Feet	30%		

Wounds and bruises are the most common types of injuries people tend to sustain when biking. The most common parts of the body that are injured for which bikers seek medical care are the neck, knees, buttocks/groin, and upper extremities. Head injuries are common and can be very serious. High speed, technical terrain, and proximity of other bikers in races all increase the likelihood of head injuries. Thus, bikers should ALWAYS wear a helmet. The style, shape, and size of helmets can vary. Mountain bikers should always check with the manufacturer's recommendation when determining which type of helmet is correct for their given style of riding. As well, any time a fall involves an impact to the head, the integrity of the helmet should be checked to make sure it is still suitable for continued use.

Head Injuries

Head injuries from biking can result in a concussion. Clinical findings of a concussion depend on the severity and location of the injury. Look for clear liquid leaking from the ears or nose, as this may be a sign of a skull fracture and would constitute a medical emergency. The treatment of a concussion (Traumatic Brain Injury, or **TBI**) varies with the severity.

With a mild concussion, there is no specific treatment, and patients are usually monitored for 24 hours. More severe concussions can require intensive monitoring, care, and even surgery depending on the extent of the injury. A CT scan is often used to help the care team with the assessment.

One should use extreme caution when treating a concussion in a wilderness setting. A general rule is if symptoms worsen and last longer than 15 minutes, evacuate the patient. A patient evacuation may also be required if other symptoms are present. Head injuries are often accompanied with neck and spinal cord injury. Thus, caution and proper evacuation techniques should be used when moving a patient that has suffered a head injury to ensure that no neck and spinal cord damage is caused.

Common Signs of a Concussion	
Headache	Vertigo
Slurred speech	Nausea
Vomiting	Vacant stare
Delayed speech	Delayed motor
Disorientation	Confusion
Memory deficits	Loss of consciousness
Intense emotions	Dizziness

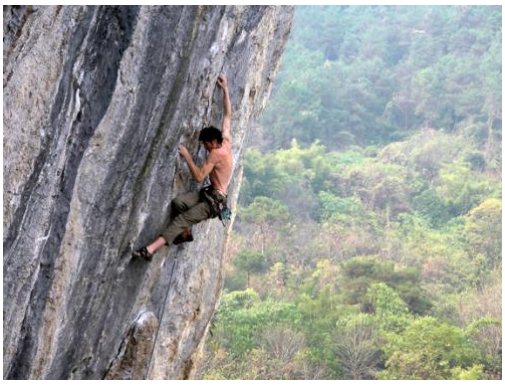
Other Biking Injuries

Not all biking injuries are the result of a hard crash. Some injuries come from small micro-injuries over an extended period. For example, **Micro-Whiplash syndrome** is the result of tail vibrations on the neck. We all recognize that the human head is heavy. Placing a helmet on it makes it heavier, and then it vibrates up and down while riding. Micro-Whiplash syndrome, along with generalized neck and back pain, can be avoided by ensuring the bike is properly fitted and adjusted for the rider. Massaging, ice, stretching, and non-sedating pain relievers can help in the management of such injuries.

Saddle associated symptoms are also common among bike riders. Proper saddle height and positioning can help avoid many of the saddle associated symptoms and injuries. If the saddle height is too low, patellar tendonitis and quadriceps tendonitis can occur, often presenting with patellar pain, swelling, and joint tenderness. Thus, correcting the saddle height can aid in the alleviation of the pain. Conversely, if the saddle is positioned too high, saddle sores and chafing are common and can present as localized skin irritation. Keeping the area clean and dry, and wearing seamless shorts can help prevent and alleviate the symptoms associated with saddle sores and chaffing. As well as correcting saddle position, standing intermittently, when completing long bike rides, can help avoid pudendal nerve injury.

Proper Bike Set Up to Reduce Medical Problems	
1. The rider should sit on the seat with their heel on the pedal. The height should then be adjusted so the leg on the pedal is straight. That is the proper seat height.	
2. When adjusting the seat angle for males, generally the level is slightly elevated in the back, and for women generally the seat angle is depressed in the back. Handlebar adjustments are usually necessary as well.	
3. The handlebar is generally positioned one to four inches below the level of the saddle, and the rider's nose should be directly over the handlebar. The proper adjustment should allow for about one third of the rider's body weight to be resting on the arms. However, the height and positioning of the handlebars can be adjusted during long rides to help with back and neck pain.	

Chapter 2: Rock Climbing



Rock climbing has been around for a very long time. Paintings dating from the second century show Chinese men rock climbing. But recently, it was discovered that climbing is older than that. New research shows that rock climbing began in Africa millions of years ago, when a primate ancestor of homo sapiens, put their hands on the hard, vertical surface of the earth and moved upwards. Our African ancestors were superb climbers who used their rock skills for hunting, safety, and ceremonial purposes. In early America, the cliff-dwelling Anasazi in the 12th century are thought to have been great climbers. In the 1880's, European rock climbing became an independent pursuit outside of mountain climbing. But it is generally thought that the sport of rock climbing began in the last nineteenth century in Europe. It is now a distinct athletic activity.

How Rock-Climbing Injuries Happen

Falling is what we think of first when we think of a rock-climbing injury. As climbers ascend their routes they often place or clip into pieces of equipment in the rock. This equipment helps catch a climber who has fallen. For every foot above the last anchor point a climber goes, they will fall two feet before the rope begins to slow them down. Climbing ropes are dynamic and can stretch up to 30% of their length to reduce the force felt by a climber. A skilled belay partner can also let slack out or jump to further soften a fall. The actual physics is very complex but can be thought of simply as the longer it takes a climber to stop falling, the less force this person will feel.

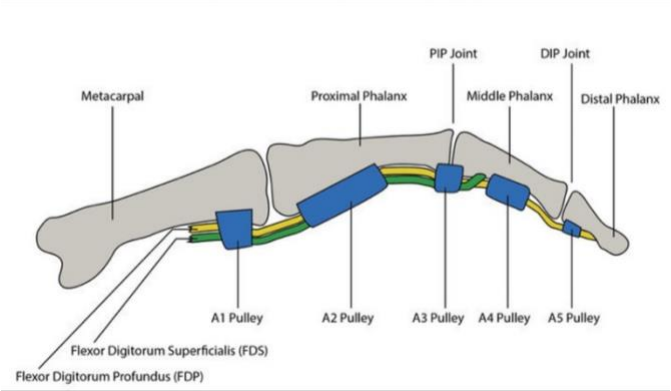
Another common injury happens when a climber passes their leg in front of the rope and then falls. The rope will grab their leg and flip them upside down causing the head or neck to impact the rock. This can cause severe spinal traumas and concussions. Helmets worn while climbing can reduce the impact from these dangerous falls.

The most dangerous moment for a climber is not while ascending but the transition to descending. At the top of a route, climbers build anchors to protect themselves. When done with a climb, climbers will remove this protection and momentarily shift from one safety system to another. Sadly, mistakes have been made at this critical moment, with climbers thinking they are secured to their second system and fall the full length of the route. This is the most common mistake that results in climbing deaths.

Belaying a climber is not as safe as it appears. For example, the belayer can be slammed into the wall by a falling climber. This happens when the belayer does not let out slack on a fall, creating a pendulum effect as the belayer is pulled into the air, ultimately swinging the belayer into the climbing wall. This is the cause of many traumatic climbing injuries including sprained and broken ankles and arms. Belayers can also be injured by falling rocks. Falling climbers have hit belayers. There are many cases where climbers have become stranded when their belayer is injured or killed by falling debris.

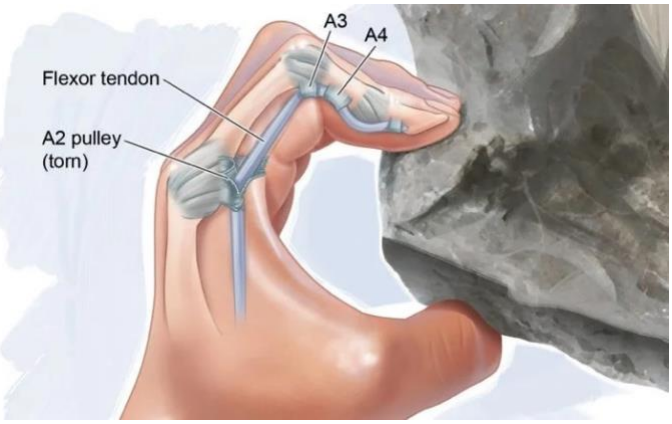
Overuse Injuries of the Hands

While many injuries in climbing are traumatic in nature, many common injuries are overuse injuries. These injuries often happen when a person climbs in a manner that overloads the tendons, joints, and muscles. If you have rock climbed for any length of time, you are familiar with many of these types of injuries.



A discussion of rock-climbing overuse injuries needs to start with the tendons of the hands. Tendons are held tightly to the bones by bands that medicine calls 'pulleys.' There are five pulleys in the fingers. They are named A1 through A5. The A1, A3, and A5 pulleys are smaller and considered minor pulleys (mostly due to size and not importance). The A2 and A4 pulleys are larger and are sometimes called the major pulleys. The pulleys do not wrap all the way around the fingers. They are attached to the front of the fingers only. The tendons which flex our fingers are held tightly to the bones. Pulleys are there to prevent what is called 'bowstringing.' The issue for rock climbers is the crazy amount of force that they experience through the finger tendons which can overload the pulleys. With enough force, the pulleys can become injured or even rupture. The pulleys often become inflamed and become painful. The A2 pulley is often cited as the most injured pulley that presents to clinicians.

The basic mechanism for flexor tendon pulley injury is a force that is applied to the pulley above what it can tolerate when a climber uses the 'crimp grip.' The best form of prevention is gentle climbing and focus on good technique. Climbers should focus on using their feet to make upward progress instead of pulling harder with the hands. And climbers should make a conscious effort to use the full crimp grip less often when possible.



Finger pulley tears are frustrating because they take time to heal. Applying ice and taking an anti-inflammatory is the first step to healing a finger pulley injury. Patients will need to take time off climbing until the fingers have healed. When easing back into climbing, stick to big jugs and other holds that avoid putting direct pressure on the injured finger(s). Taping these fingers while climbing during the healing process is an effective way to prevent worsening the injury.

Rock Climbing Shoes

Rock climbing shoes are most often made of leather uppers with rubber toe and heel caps. The rubber of climbing shoes is specially formulated to stick to rock features and improve friction. Depending on individual preference as well as climbing difficulty level, these athletes may wear

climbing shoes are several sizes smaller than street shoe size. This is because climbing shoes have variable features to improve performance on different terrain. These features include downturned toes for overhanging rock and stiff toe boxes for climbing shoes specific for crack climbing. While designed for performance, rock climbing shoes can contribute to many acute and chronic climbing-related injuries.

Suspension Trauma

Suspension trauma is a condition where climbers will become lightheaded or even pass out after the body remains motionless in a harness in a vertical or sitting position for a period. This happens when blood pools in the legs because the leg muscles sit idle and don't squeeze the blood up to the brain. It is often seen when a climber is maneuvering an overhead rock and leaves the wall and cannot make it around the cliff and hangs suspended.

The climber will begin to be lightheaded and ultimately pass out as blood pools in the legs. This can be a life-threatening situation. Symptoms typically occur after suspension for over an hour, but 20% of patients will have an onset of these symptoms within 5-10 minutes. The highest priority for field care of the suspension trauma patient is urgent evacuation to the ground.

Chapter 3: Hiking and Backpacking

Understanding Feet & Shoes for Hiking and Backpacking

Foot problems

Any discussion of hiking and backpacking medicine begins with our feet. There are 28 bones in each foot, which is nearly one-fourth of all the bones in the entire body. As well, there are 30 joints and more than 100 muscles, ligaments, and tendons. These make the feet flexible so that they can adapt to uneven surfaces, but it becomes complicated when there's an injury.

Toes

The big toe plays an essential role during hiking. The toe's function is to grip the feet to the walking surface. Although the big toe carries part of the bodyweight with each step, no weight rests on the big toe as the body stands. We stand on our heels.

Arches

The foot has three arches. They are designed to act like springs, aid in propulsion, and store energy. The arches shape is designed in a similar manner to a spring and bears the weight of the body and absorbs the shock that is produced with walking. The metabolic energy saved by the arch is due to the spring that it supplies that would otherwise be done by active muscles.

Arch Supports

Correct arch suport is an essential issue in backcountry medicine, especially with hikers and trekkers, because they typically carry an additional weight on their back. A person with a low arch, or flat feet, often stands and walks with their rotated in the wrong position. This makes the hiker susceptible to heel pain, arch pain, and plantar fasciitis.

With high arches, there is less surface area for absorbing impact. This places excessive pressure on the back part of the foot and the forefoot areas. This can make a person susceptible to foot conditions such as heel pain and plantar fasciitis. Having proper arch support becomes vital in making the backcountry trip successful. Most shoes have useless inserts, rather than arch supports. These should be removed, and arch supports placed inside. If people really need new shoes but cannot afford them, arch supports are a less expensive alternative and offer significant help.

Shoes

There is probably nothing more important for foot care than having proper shoes that fit appropriately. Shoes are activity specific. Running and walking shoes are made for straight-ahead, forward motion, while basketball and tennis shoes are made for side-to-side movements. Hiking

shoes are designed with stiff bottoms enabling the shoes to grab onto rocks. Climbing shoes are made to point and give strength to the toes. If someone does not use the right shoe for their outdoor support, then knee, hip, and back pain may result. When shoes are old and worn out, they will tilt your feet, forcing you to strike the ground in an awkward way. Even the slightest angle can hurt your feet and cause back and hip pain. On average, replace the shoes you wear daily every six months at most. For other shoes, keep an eye on the soles and replace or resole them once you notice that the support is getting low.

Proper Shoe Fit

While it may seem counter-intuitive, you don't want your shoes to be tight or press too hard on your feet. In doing so, they will increase the force on your skin, increasing the chance of a blister.

Here is how to fit your shoes:

- To check proper fit around your heel, place your index finger between your shoe and your foot. You should be able to slide your finger between them with little force. If your finger cannot fit, the shoes are too tight. If your finger has too much room, the shoes are too large.

- Stand up with the shoes on and make sure you have a half-inch (about the width of your finger) between your longest toe and the front of the shoe. Your toes need wiggle room so that you don't get blisters, calluses, or damaged toenails.

Protecting Your Feet for Wilderness Activity

'Prevention is worth a pound of cure.' This is so true with shoes. Here is what you need to know to prevent foot problems in the wilderness.

Clip Your Toenails

From a medical perspective, it is critical to clip your toenails before a hike. If they're too long, your boots or shoes will push into the nails. The nail(s) will be traumatized, and blood will form under them. The nails will then lift from their beds. This is painful and might quickly end the hike or trek.

One or Two Socks

There is no definitive data to show that wearing two socks is better than wearing just one sock while hiking or trekking. It comes down to personal preference. What is clear is having the appropriate sock to protect your feet. If you choose to have two socks, the first sock should be a thin, skin-tight, moisture-wicking synthetic sock. Its purpose is to reduce friction by fitting tightly onto your foot and reducing moisture by wicking it away from your foot to your second (outer) sock. The purpose of the second (outer) sock is to reduce friction by serving as a cushion between your foot and the boot and to reduce moisture by absorbing it from the first sock.

Wear the Right Socks

Hiking socks are rarely made from a single fabric, but rather from a blend that creates the right balance of comfort, warmth, durability, and fast drying. These are the most common materials you'll find in hiking socks:

- **Wool:** Wool is the most popular hiking sock material and is recommend above all others. Most wool socks use blends of wool and synthetic materials for better durability and faster drying.
- **Polyester:** Polyester is a synthetic material that insulates, wicks moisture, and dries quickly.
- **Nylon:** This is another synthetic option that is occasionally used as the primary material. It adds durability and can help improve drying times.
- **Silk**: A natural insulator, silk is comfortable and lightweight, but not as durable as other options. It's occasionally used in sock liners for reliable moisture wicking.
- **Spandex:** Many hiking socks include a small percentage of spandex. This elastic material helps socks hold their shape and keep bunching and wrinkling to a minimum.

Avoid 100% cotton socks at all costs. It absorbs and collects sweat but dries very slowly. This means that when they get wet, they stay wet.

Blister Care and Hot Spots

A blister is a pocket of fluid between the upper layers of skin, but still under the epidermis. Blisters commonly develop on the feet when performing activities such as hiking and backpacking. Blisters can be filled with serum, plasma, blood, or pus, depending on how and where they form. Blisters are formed by friction. Friction is formed by the force the shoe pushes on the foot and how slippery the skin and the shoe/sock interact.

Successful preventive strategies are aimed at making the shoe and foot more slippery and reducing the force that shoe puts on the foot. Having proper material in one's socks and having shoes that fit well are the ways to prevent blisters.

Blisters usually form a 'hot spot' (sore spot) first. If one of these does form, place a dual-layer pad over that area. **Blist-o-ban** is one such material. These pads address the two causes of blisters, the slipperiness, and the force of the shoe on the foot. The dual layer will allow the bandage to glide smoothly in all directions, deflecting friction away from the skin. The key to preventing blisters is to reduce 'hot spots' by properly breaking in boots and reducing moisture by wearing wool socks.

You can treat a blister that has already formed by cutting a hole in moleskin or duct tape and placing the ring around the blister. This reduces the pressure placed on the blister. This should help reduce the pain too. It is not recommended to open or drain blisters that are small (<2cm or <0.75 in).

When should a blister be opened? The answer is not clear. In general, if the blister is 2 cm in diameter or larger, then it is likely to rupture spontaneously and may be amenable to initial treatment by intentionally rupturing it. However, there is no best answer to this issue. In those cases where it is large enough, or it has already ruptured, wash the area, and puncture the base of the blister with a sterile needle or sterilized safety pin. Trim the external flap of skin from the blister, apply an antibiotic ointment, and cover the blister with a

sterile dressing. This can be protected with moleskin or mole foam.

Understanding Clothing and Heat

Clothing

Clothing might seem like an afterthought when one is headed hiking of backpacking. Still, it's the first and most important layer of protection between you and the elements. No level of skill or planning can make up for ill-chosen clothing if the weather takes a turn for the worse. It's essential to understand the fundamentals of layering to make sure you can stay safe in any conditions.

Heat from Our Bodies

To understand the use of clothing, it is first essential to understand heat. Our bodies are hot. The normal human body temperature is averaged at around 98.6°F (37°C). Since the air around us is usually much cooler, heat is always leaving our bodies. So, all we can do is control the heat flow as it leaves our bodies. Clothing is designed to control how much, and how quickly, heat can leave the body.

How Body Heat is Given Off

Heat moves from hot to cold in three ways:

1. **Radiation** is how most heat leaves the body.
2. **Conduction** occurs when the body is in contact with any object that is cooler than the body. Heat loss by conduction can be a significant when the body is wet.
3. **Convection** occurs when the heat is transferred away with wind. Heat loss by convection can be significant with exposure to cold wind.

When it is cold, we bundle up to keep heat in, and when it is hot, we take clothes off to allow more heat to leave our bodies. One of the best conductors of heat is ***water***. One of the poorest conductors of heat is ***air***. For example, in the summer, when we want to conduct heat out of our bodies, we go swimming. If we want to keep heat in our bodies, we will surround ourselves with air. Fibers and fabrics, such as wool, are excellent insulators because they have a lot of air in them. Since water is a good conductor of heat, the inside layers of clothing are designed to move or 'wick', water away from the skin.

Layering

Heat transfer out of the body is best controlled with clothing worn in layers. Body heat is trapped in the dead air space in the middle layer creating insulation, while perspiration is wicked away from the skin and through to the outer layer to prevent conductive losses. Wind and rain cannot penetrate the outer layer, therefore limiting convective heat loss. Not all clothing is designed to insulate.

Base layer

This is the layer of clothing directly against your skin, and its purpose is to wick sweat away to keep you dry. This includes socks, underwear, and an initial pant/shirt base layer if in colder conditions.

Middle layer
The middle layer is for insulating. This layer functions to retain body heat by creating 'dead air.' This can be clothing such as shirts and pants, thus an extension of the wicking layer.

The Outer layer
The outer layer, or shell, is a water- or wind-resistant barrier between you and the elements, keeping the wind from blowing across someone and causing convection loss of heat.

If you don't plan on wearing these three layers throughout your trek, it would be prudent to at least pack these types of layers to have just in case. If conditions change, you can always peel off layers to cool down or add layers if the weather takes a colder turn. Some clothing will help move heat away from the body. For example, in hot environments, loose-fitting clothing should be worn to move heat away from the body, as this facilitates ventilation.

Types of Fabric

What types of fabric are more appropriate to wick water from the skin, insulate from heat, or even facilitate heat loss? This topic has been discussed by recreationists of all experience levels. It can take some experimentation to figure out what works best for you. Here are some basic guidelines to consider when choosing the fabric that best fits your activity and goals:

Wool

Wool is a very popular choice and with good reason. Wools 3D wavy crimp-type fibers trap air easily. Eighty percent of the material is air. It's an excellent insulator and will keep body heat contained in cold weather. Wool also absorbs a lot of water. For example, merino wool can hold 30% of its weight in water absorption before the wearer can even feel it on their skin. Even with the water that it has absorbed, the wool maintains insulation, which is a huge plus for this material. Wool is also wind resistant. These properties make it an ideal fabric choice for most activities. Many people use wools as their base layer. Once maligned for being itchy, ultra-fine merino wool is itch-free, naturally breathable, moisture-wicking, fairly fast-drying, and not prone to odors.

Fleece

Polyester and Nylon are synthetics, such as fleece, that offer quick-drying capabilities at a more affordable cost. These fabrics are quite durable and make great slacks and shirts. Synthetic fibers have 3D patterns that imitate wool. Synthetics are warm when wet, but do not absorb moisture. They dry quickly, are as warm as wool, and are only half the weight of wool. One problem is that synthetics have poor wind resistance. They can also develop an odor worse than

wool. Overall, however, synthetics are a fantastic and affordable option that many choose as their base layers.

Down

"Down" is the under plumage that is found beneath the feathers of ducks, geese, and other waterfowl. It is natural insulation. Goose down insulation itself does not consist of feathers. Goose down frequently contains terms like "600+ fill goose down" or "900+ fill goose down" lines. These numbers indicate how much goose down is added to the coat or sleeping bag, for example. This is known as the "fill rating." The higher the number, the more goose down insulation is added into the coat or sleeping bag, and the warmer it should be.

Down is very soft, provides excellent insulation, and is very lightweight. It must be packed in compartments for this reason. It is excellent to use for sleeping bags and coats as it packs well, and it conforms to the user. The problem with down is that it will clump when it is wet and lose its ability to create dead air space, thus losing its insulative ability.

Silk

Silk is a soft, luxurious fabric that is quite thin and light, making it a great choice for moderate, cool-weather conditions. The downside is that it doesn't wick moisture away from the skin as well as wool or synthetics, so it isn't a good option for warmer days or activities with a great deal of exertion. Another consideration of silk is that, like synthetics, it can be prone to odor. The softness of silk also results in it being a less durable fabric, and its vulnerability to abrasion and sunlight results in a shorter lifespan than the other fabrics discussed.

Cotton

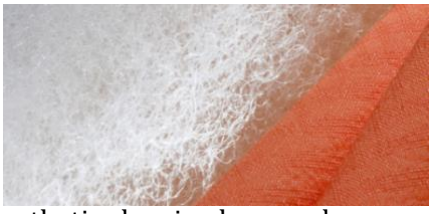
Cotton is never a good choice for outdoor activities, even when layering. There's a reason that experienced recreationists use the phrase "cotton kills." Cotton does not effectively wick moisture away from your skin, it doesn't dry quickly, and it is a very poor insulator. While wool will keep you warm when you're wet, cotton will keep you cold when you're wet. Even cotton socks should be avoided, as wet and cold feet are a recipe for disaster. So, in reality, cotton does not kill, but hypothermia does. It's easier to get hypothermia when you wear cotton, not because it doesn't insulate you as well as other materials, but because it just doesn't insulate you as well when it is wet. Cotton is a comfortable and cheap option for lounging around at the campsite but should be avoided for active pursuits.

Synthetic Fibers

Synthetic fabrics are human-made and produced entirely from chemicals to create fabrics like polyester, rayon, acrylic, and many others.

Over the years, synthetic fibers have increasingly grown in popularity. They are resistant to insects and fungus and have little to no ability to absorb moisture. Synthetics can easily create dead space. And because they are usually cheaper to produce, they are cheaper to buy.

A serious drawback of synthetic fibers is that they will melt. Since they have little to no ability to absorb water, they will always insulate, even when wet. This makes synthetic clothing ideal in wet environments like river trips. However, synthetic clothes are heavy and do not pack well, so they are not suggested for hiking.



Microchannels can be created in the fibers to create **Quallofil** and **PolarGuard**. Quallofil is made by Du Pont and is used both in sleeping bags and in many insulated jackets. The problem with Quallofil is that it is a bit on the heavy and bulky side. PolarGuard, and all its various derivatives, is considered the "premiere" synthetic insulation and is used in most high-quality synthetic sleeping bags and clothing. New iterations have made the material significantly less bulky, while at the same time improving the insulating abilities by around 10%.

Super thin fibers are a small synthetic fiber. They are very tiny, so manufacturers can put more of these in clothing. That means dead air space and more insulation. Since they are small, they are also light and pack well. They stay dry and keep their warmth when wet. There are not too many negatives with this material. Primaloft and Thinsulate are examples.

Tying it all Together

Now that you've learned about the basics of layering, fabric types, and sun protection, it's time to bring it all together. We've discussed the three main layers (sweat-wicking, insulating, shell) and three optimal fabrics (wool, synthetic, silk), but how do you combine those?

The Base layer (wicking). This layer needs to be one of the high-performance fabrics, such as wool, synthetic, or silk. Its purpose is to wick sweat away to keep you dry. Many consider this to be the most important layer of all, as this is the layer that keeps you cool and comfortable when you're working up a sweat. The weight of this base layer can also change depending on the season and activity. Examples of wicking layers are Capilene, Lifa, and Dryline

The Middle layer (insulating). The middle layer functions to retain body heat. This is the layer that will keep you warm and is typically the thickest or heaviest-weight material of the three. Wool and down are popular choices for mid-layers, but you can also choose fleece or synthetics with high-loft options such as Polar-guard, Micro-loft, and Primaloft. For wet weather, it would be wise to choose those synthetic pile or fleece options, as down can get soggy and lose its insulating capabilities in very wet conditions. Synthetics are also breathable and easier to ventilate and wash. A good rule of thumb for the mid-layer in colder weather would be to plan on wearing a synthetic as your go-to and to always pack an extra down jacket. Down "puffies" are easily compressible and lightweight, so they add substantial function at a low weight.

The Outer layer (shell). The outer layer is a water- or wind-resistant barrier between you and the elements. Being the first line of defense against the elements, this layer needs to be able to repel rain and snow while simultaneously being breathable. You don't want your perspiration to build up inside your layers; that would defeat the purpose altogether. In very wet conditions, go for something completely waterproof, with features like sealed seams, zipper guards, and cinch-able

hoods. Things like armpit zips and mesh pockets can help you ventilate even while working up a sweat in wet conditions. In drier conditions, you can consider using a lighter shell that is just windproof. These typically aren't very waterproof but are highly breathable, and pack down small enough to fit into a pack.

Now that you know the essentials of dressing for the outdoors, you can simply mix and match your layers to prepare appropriately for any conditions. Remember that what you wear is what is keeping you safe against whatever mother nature throws at you. There is no bad weather, only bad clothing.

Chapter 4: Skiing and Snowboarding

Improper Equipment Maintenance

The overall occurrence of skiing related injuries has decreased by 50 percent since the 1970's. This is in large part due to the improvement of the equipment with safety release bindings and hard-shell boots that allow for better control.

However, while the number of lower limb fractures has decreased, the number of soft tissue injuries has drastically increased. This trend is most likely associated with the newer equipment being used. Even though the equipment has continued to improve, the need for constant maintenance of equipment is always required. Nearly half of all downhill skiing accidents are the result of improper equipment maintenance. About 70 percent of the lower leg fractures and knee injuries that have occurred while skiing is a result of improper binding release. Thus, it is crucial that the settings on the bindings be adjusted to the skier.

Soft Tissue Knee Injuries

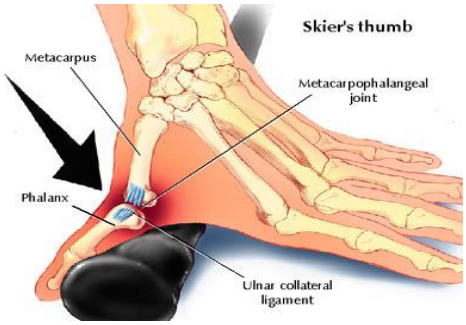
Soft tissue knee injuries are the most common within the sport. Beginner skiers are especially suspectable **to medial collateral ligament (MCL)** injuries because most beginner to low-intermediate skiers are taught to use the "snowplow," or "wedge" technique. If they turn too sharply, or one ski catches, the MCL is subject to high stresses. If a knee injury is suspected, the patient's knee should be immobilized with a splint, and the patient taken off the hill.

The most injured structure of the knee is the **anterior cruciate ligament (ACL)**. The ACL's role is to prevent backward motion of the femur on the tibia, as well as hyperextension at the knee. An injury to the ACL is often the result of a movement such as cutting or twisting that place too much stress on the ligament. Many skiers who suffer from an ACL injury report hearing an audible "pop" or "snap" just prior to the knee giving out. Placing snow and immobilizing the knee is important until medical care is available.

Although soft tissue knee injuries encompass most lower extremity injuries, fractures still occur. Many fractures typically occur at the top of the boot because the hard shell of the boot provides support wherever the boot covers. Such an injury has coined the term "boot top" fracture. This injury needs to go to the hospital. The boot should be kept on until medical care is obtained.

Upper Extremity Injuries

The skier's thumb injury is the most common upper extremity injury and typically occurs on hardpacked snow. It happens when the skier falls on their ski pole, which acts as a lever between thumb and index finger. It can also occur when the thumb catches some snow during a fall. Symptoms are tenderness in the area with deep throbbing pain. The treatment is to splint the hand in a functional position and seek medical help.



Re-cap of Common Ski Related Injuries	
Head Injury	At worst, head injuries can cause a bleed in the brain. Most other injuries will be less severe and may require suturing. Generally, head injuries are severe, could become worse, and will need proper management off of the slope.
Medial Collateral Ligament Tear	Found on the inside of the knee, its ultimate purpose is to prevent the knee from bending fully inwards. While skiing or snowboarding, an MCL tear may occur because of the impact caused by the force of one leg falling on another. As a result of this injury, skiers will likely experience severe pain, as well as bruising and swelling. While standing with this injury is possible, it will be painful.
Anterior Cruciate Ligament Injury	This is one of the most common sports injuries. The ACL is subject to injury in any sport that involves rapid maneuvering. Skiing and snowboarding both involve sudden turns that could potentially cause an ACL tear. Located in the center of the knee, the ACL controls how far the femur can move in relation to the tibia. ACL injuries occur when people pivot while standing, hyperextend, or stop suddenly. Often, people suffering from an ACL injury will hear a popping sound.
Shoulder Injury	Depending on the way a skier and/or snowboarder falls, a shoulder injury may be common as well. Because the shoulder connects the arms to the torso, there are plenty of body structures that may be affected. The ligaments, muscles, and tendons may be affected by the fall as well, and as a result, become weakened. Shoulder injuries require individualized treatment.
Wrist Fracture	This is a common injury for skiers. During a fall, it's instinctual to attempt to catch your balance by reaching out a hand for support. If you are suffering from a wrist injury while skiing, then it's imperative to stop skiing.
Skier's Thumb	The thumb is an especially vulnerable joint. Thumb ligament injuries are the second most common skiing injuries, surpassed only by MCL injuries in the knee. Skier's Thumb is an acute injury that often happens when falling with your hand in the ski pole strap. Your thumb can get caught and pulled away from the hand, which can cause a ligament tear. This can result in difficulty with grasping.

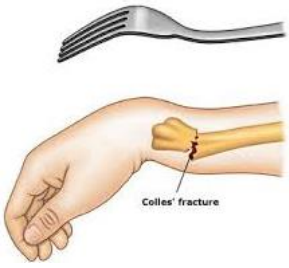
Boot Top Fracture	One of the worst ski injuries that can occur to the lower extremity is the boot top fracture. These fractures occur as the tibia and/or fibula fracture above the top of the boot. They almost always require surgical intervention as the tibia has the highest rate of non-union among all bones in the body.

Just like mountain biking, skiing also should be done with a helmet. However, helmets of any sort only offer protection to a certain extent. The Consumer Product Safety Commission suggests helmets offer little protection beyond 12 mph. Unfortunately, the use of helmets can give patrons of sports a false sense of security, leading to reckless behaviors. When assisting a patient who has fallen, one should always be suspicious of a head injury and vigilant for the common signs of concussions, as discussed previously.

Snowboarding

Snowboarding is another high-velocity sport where injures are common. Since the equipment and technique required for snowboarding are different from skiing, so too are the commonly seen injuries.

A toe side fall on a snowboard happens when the snowboarder falls face forward toward the ground. These types of falls can be violent and come unexpectedly to the snowboarder. Because of the suddenness, there often is a delayed response in being able to reach out their hands to brace the fall. This can lead to clavicular fractures, shoulder separations, and/or facial and head injuries.



However, in the circumstance where the snowboarder does have time to reach their arms out to brace for the fall, the violent nature of a toe side fall can result in a severe wrist or humeral fractures. The most common wrist fracture seen among snowboards is the “dinner fork” fracture.

Wrist guards have become more prevalent in the protection against wrist injuries seen in snowboarding. However, while the wrist guards are effective at preventing wrist injuries, the equipment may result in the transfer of forces to more proximal joints and bones, leading to forearm fractures, posterior elbow dislocations, or shoulder injuries.

The other common type of fall associated with snowboarding is a heel side fall. This occurs when the snowboarder falls back towards the ground. Because the snowboarder is falling backward, they are usually unable to use their arms to brace the fall. Consequently, this leads to buttock contusions, spinal compressions, and head injuries.

Chapter 5: Water Sports

Drowning Occurrences in the Young

Nearly 80% of people who die from drowning are male. Drug and alcohol are involved in half of adolescent and adult deaths associated with water recreation. Trauma from water recreation is secondary to dives, falls, and horseplay. And failure to wear a personal floatation device (PFD), while boating, results in a staggering 88% of drowning deaths.

Drowning – The Lungs

The lungs the organ system that is primarily involved in drowning pathophysiology. During the drowning process, the victims become panicked, which causes an increase in respiratory rate. At some point, victims are thrust underwater and have to hold their breath. Victims inhale water into their lungs, causing pulmonary damage. They become very hypoxemic, which will then cause secondary organ damage. The heart becomes ischemic, and neurological injury can result.

Arrhythmias – Irregular Heartbeats

Heart arrhythmias, or irregular heartbeats, are a common problem after drowning but are not usually caused by electrolyte disturbances such as high calcium, high magnesium, or high sodium, as the volume of aspirated water is rarely enough to disturb plasma electrolytes. The arrhythmias are typically secondary to severe hypoxemia that causes an ischemia in the cardiac conduction system.

Hypoxia

Hypoxia (lack of oxygen) causes injury and inflammation in the brain that can lead to cerebral edema and increased intracranial pressure. This process can occur after a relatively short period of hypoxia, which is why oxygenation is so important in the management of submersion injury. After resuscitating patients, it is important to monitor them for further neurologic deterioration, as reperfusion injury can occur.

Drowning itself is quick and silent, although it may be preceded by distress, which is more visible. Generally, in the early stages of drowning, very little water enters the lungs. A small amount of water entering the trachea can cause a muscle spasm that seals the airway and prevents the passage of both air and water until unconsciousness occurs. This means a person drowning is unable to shout or call for help or seek attention, as they cannot get enough air. The instinctive drowning response is the final set of autonomic reactions in the 20 to 60 seconds before sinking underwater. To the untrained eye, it can look like calm, safe behavior. Persons trained in rescue learn to recognize drowning people by watching for these movements.

Rescue

A drowning person may grab the rescuer, submerging the rescuer in the process. Thus, it is advised that the rescuer approach with a buoyant object, or from behind, twisting the victim's arm on their back to restrict movement. If the rescuer does get pushed underwater, they should dive downwards to escape the victim.

The priority is then to transport the victim to the water's edge in preparation for removal from the water. The victim is turned onto their back with a secure grip used to tow from behind. If the person is cooperative, they may be towed in a similar fashion held at the armpits. If the person is unconscious, they may be pulled in a similar way held at the chin and cheeks, ensuring that the mouth and nose are well above the water.

Since drowning is mainly an oxygenation problem, rescue breaths should be started immediately. Even before chest compression. The sooner you can get air into the lungs, the better. The European Resuscitation Council recommends that five (5) rescue breaths be initiated instead of two (2) breaths when starting CPR. Most patients with respiratory arrest will respond after the first few rescue breaths.

Prevention

Prevention is more important than any action one can take after a submersion incident has occurred. Alcohol should be avoided when participating in or supervising water activities. Everyone on a boat should always wear approved personal flotation devices that will support the person's head above water, even if the person becomes unconscious. Camp far enough away from water so that people, especially children, do not accidentally wander into the water.