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## The Magic of Stem Cells

By Lee Diehl, MD

A recent article in the January 2017 issue of the *Journal of the American Medical Association,* stated "Every organ in the body is made of cells that originated as stem cells, which are then differentiated (changed) into different forms." It is magical that the body has a line of cells capable of turning into all the other important tissues and structures that make us what we are and allow us to live our lives. In theory, it is possible to use the appropriate stem cells to "restore" or "remake" any organ or tissue in the body. We learn more and more about stem cells every day, what types there are, where we can get them, and how we can encourage them to develop in the direction we want.

### What is a stem cell?

Our entire body is made up of cells or the products of cells. Stem cells, the initial building blocks, are described as "pluripotent," meaning they can become more than one type of cell as they continue to develop. Using blood as an example, blood forming stem cells can differentiate into all three of the main cellular components in blood: white blood cells which fight disease, red blood cells which carry oxygen, and megakaryocytes that form platelets for blood clotting. The more cell types that a stem cell can differentiate into, the more "potent" it is considered to be. Stem cells from the earliest stages of development, such as from an embryo or placental tissue, have this maximum "potency." Stems cells that are isolated from adult bone marrow or adipose tissue (fat), have already partially matured along their path and are more limited in what they can do. Current research has also focused on how to "rejuvenate" these older stem cells which are more readily available, and make them more "potent."

A few examples of current or potential stem cell therapies include:

- Restoring vision in retinal disease of the eye
- Bone marrow transplantation for cancer or other blood disorders
- Restoring nerve cell function after spinal cord injury
- Reforming joint surface cartilage after knee injury

To use stem cells as an effective treatment in sports medicine, the cells must recognize where they are and know what they need to do. They then need to change into the types of cells needed to form new cartilage, make new bone, or "re-organize" damaged tendon. We hope that stem cells will do all of this without causing any adverse or unexpected consequences. There are theoretical and actual risks that we won't be able to control where and how the cells work, or that uncontrolled growth or differentiation will actually cause certain types of cancer.

While we have learned a lot about stem cells, we need to know a whole lot more to be able to use them safely. They represent a unique way to use natural tools to repair or restore tissue harmed by injury or disease. The challenge going forward is to develop and use scientific evidence to understand and guide their application to avoid harm and provide maximum benefit.

# Freezing Your Injuries with Cryotherapy—Good or Bad?

By Grant Jones, MD

**There has been a lot of recent interest in whole body cryotherapy (WBC) in the sports world. WBC or "cold treatment" involves exposing the body to temperatures as low as negative 160 to 200 degrees Fahrenheit for two to four minutes. The athlete is placed in a chamber from the neck down and is exposed to cool, dry vapors. In the past, whole body cryotherapy has been used to treat medical conditions such as multiple sclerosis, rheumatoid arthritis, osteoarthritis, chronic low back pain, and mood disorders with varying degrees of success. More recently, athletes such as basketball stars Kobe Bryant and LeBron James and boxing champion Floyd Mayweather have popularized its use to decrease pain and inflammation and facilitate body recovery after intense exercise and improve neuromuscular performance.**

According to the U.S. Cryotherapy company website, the "cold shock" drops the skin temperature and sends distress signals to the brain. The brain responds by releasing a "cold shock" protein (norepinephrine) which is a powerful anti-inflammatory protein and endorphins which block pain reception signals. The signals also result in pooling of blood from the extremities to the core. During the blood pooling, the core oxygenates the blood and enriches it with nutrients. With re-warming, the blood goes back to the extremities oxygenated and enriched with nutrients, allowing for muscle recovery.

## Is cryotherapy effective?

One study demonstrated that WBC applied before exercise can reduce inflammatory proteins in the blood stream. Another investigation showed improved neuromuscular performance in terms of position sense and reaction time. In a paper on well-trained athletes, WBC resulted in improved acute recovery of running performance during high intensity exercise. Finally, studies on elite synchronized swimmers and high ranking professional tennis players showed that WBC limited "overreaching" after training which can result in reduced sleep quantity, increased fatigue, and impaired exercise ability.

On the other hand, other studies have demonstrated no benefit on exercise recovery. One study on professional academy soccer players showed no benefit of WBC on performance or perceptual responses post-exercise and another demonstrated no effect on vertical jump after high-intensity exercise. Furthermore, in a recent systematic review paper of the medical literature on WBC, the authors found that there was insufficient evidence to determine whether WBC reduces self-reported muscle soreness or improves subjective recovery after exercise in physically active young adult males and no evidence that it helps in females or elite athletes.

## Is it safe?

One investigation on healthy volunteers demonstrated that the extreme temperatures do, in fact, have a significant effect on one's cardiovascular system, affecting the body's ability to control heart rate and blood pressure in the standing and resting positions. Furthermore, in 2015, there is a case of a spa worker in Las Vegas who died in a cryotherapy chamber after entering it unsupervised. The systematic review paper discussed above showed that there is a lack of medical evidence on the adverse events that can occur with exposure. So, we do not know definitively what the potential negative effects on the body are.

Overall, cryotherapy may be helpful in recovery after intense exercise, but the jury is still out. Also, due to the potential effect of the extreme temperatures on the cardiovascular system, individuals should consult with their physicians before undergoing cryotherapy, particularly if they have a history of heart problems.

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# Patella Instability: When should surgery be considered?

By Seth L. Sherman MD

**Patella dislocation is the second most common cause of traumatic knee injury behind an anterior cruciate ligament (ACL) tear.** The patella or "kneecap" may dislocate (i.e., pop out of place) during sports participation. This may be the result of a contact/collision or a non-contact injury while cutting or pivoting. Sometimes, the patella comes partially out of its groove, termed a subluxation. Other times, the patella fully dislocates and either goes back into place spontaneously or it may require a physician on the field or in the emergency room putting it back in place. The initial treatment of patella instability is to follow the RICE protocol (Rest, Ice, Compression, Elevation) and to consider a brief period of crutches, bracing, and anti-inflammatory medication. The decision to operate following a patella instability event is often complex. Below are some pearls to help you determine when a consultation with a surgeon may be recommended.

First of all, the vast majority of visits to the doctor for patellofemoral issues are for pain and NOT for instability (i.e., dislocation, subluxation). There is no role for surgical stabilization for patellofemoral pain syndrome. Rehabilitation is the recommended treatment. For patients with a subluxation event or even multiple minor events, a trial of non-surgical treatment is also highly recommended. This should include a comprehensive "core to floor" rehabilitation plan. Temporary use of a patella stabilization brace or sleeve may be helpful. Activity modification is followed by clearance for return to sport once range of motion, strength, and functional movements are optimized to help prevent recurrent injury. Surgical stabilization is only considered after failure of conservative treatment.

The majority of first time patella dislocation events may also be treated non-surgically, with the recurrent dislocation rate ranging from 17–44%. In patients with otherwise normal bone alignment, higher energy is required for dislocation (i.e., football collision). These patients may present with large knee swelling suspicious for fracture or cartilage injury. An MRI is recommended for this type of injury, as early surgery may be needed to manage the fracture or cartilage injury. If there is no major cartilage or bony injury, non-surgical treatment of the first time contact dislocation has a good success rate. After a second dislocation event, surgery is recommended to improve function and to decrease the risk of recurrence.

Non-contact dislocation (i.e., cutting or pivoting) hints towards underlying bone and soft tissue abnormalities that may predispose to further dislocation events. Several risk factors for recurrent dislocation have been identified, including younger age, open growth plates, sports injury, and anatomic abnormalities (i.e., flat kneecap groove, high patella). Surgery is indicated for recurrent dislocation to stabilize the knee and to prevent worsening soft tissue or cartilage injury. In this subset of patients, surgery may also be considered after the first dislocation.

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# Return to Play after ACL Reconstruction

By Arun Ramappa, MD


**About AOSSM and *In Motion***

As a world leader in sports medicine education, the American Orthopaedic Society for Sports Medicine (AOSSM), we have designed the publication to highlight relevant information for multiple age groups from exercise and rehabilitation to nutrition and psychology.

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Injury to the anterior cruciate ligament (ACL) is one of the most common knee injuries sustained by athletes.[1] Hearing news of this injury is often overwhelming for athletes as they know they will have to put their recreational or competitive careers on hold to allow for surgical intervention and rehabilitation. This news is even more frustrating when they are told that their earliest return to sport is months away.

Historically, restoration of an ACL injury was slow and often career ending. Many athletes who injured their ACL would continue to play and further damage their knees until the injuries were beyond repair. In addition, early efforts involving casting methods and repair of the torn ligament provided poor patient outcomes, and were not very successful.[2] Today's gold standard of ACL reconstruction, essentially a replacement of the ligament, has allowed for improved patient outcomes that permit return to sport faster than ever before. But are we pushing the limits of recovery?

As we have improved surgical techniques and rehabilitation programs, the time for return to sport has shortened. Some patients, such as professional athletes, have been returning 6 to 8 months post-surgery, though there is considerable variability. These quick recoveries are often highly publicized and therefore have a great impact on the public's beliefs about recovery.

Recent research has shown that the knee does not fully recover from this injury until two years post-surgery, especially in younger athletes. After two years, basic biological and functional measures including graft maturation and neuromuscular control are resolved and reestablished.[3] If patients return too quickly, complications, such as a second ACL injury, are more likely to occur. Research has identified that second ACL injuries are six times more likely within two years after surgery, in the adolescent population and five times more likely within the female

adolescent population.[1] This evidence points to a key fact for proper ACL recovery: rehabilitation takes time, especially in younger patients.

It is important to note that return to play recommendations are in evolution based on this newer research and they will differ from case to case depending on the patient and their efforts towards recovery. During ACL recovery, enrollment in a rehabilitation program is essential and patients will work with therapists and physicians to construct an individualized program.[4]

The take home point is that a specific time point after surgery, such as 6 or 8 months, should not be used to determine return to play. Rather, it is essential for patients to establish their appropriate recovery plan with guidance from their physicians and therapists to ensure full recovery.

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