In the United States, approximately 30 million children and 45 million adults are involved in sports. Roughly 3.5 million children and 5.5 million adults suffer from sports-related injuries. The most common types of sport-related injuries in children and adults are sprains (mostly ankle), muscle strains, bone or growth plate injuries (in children), repetitive motion injuries, and heat-related illness (1).

Although death from a sports injury is rare, the leading cause of death from a sports-related injury is a brain injury. Approximately 2 out of 5 traumatic brain injuries among children are associated with participation in sports and recreational activities. In the United States a total of ~300,000 hospital admissions (2) for sports concussion injuries are recorded, and the number is expected to increase.

Although concussions and brain injuries are life altering injuries, non-brain injuries, such as cartilage, tendon, ligament and bone injuries can hamper mobility and the ability to make a living. For high performing amateur, junior and professional athletes sport injuries can side-line careers and activities. Recovery from injuries can take months with traditional therapies. In cases were surgery is required, a slow and steady physical rehabilitation regime is always recommended, but not always followed by patients eager to return to pre-injury activity levels. Re-injuries are common because the original injury take so long to heal.

In order to increase the odds of a successful recovery from injury, the sport medicine and hyperbaric community have been employing hyperbaric oxygen therapy to help accelerate healing and reduce the time to recovery. In many cases of sport injury, surgery is often required. Given that healing after surgery is the longest part of the procedure, treatments that can speed up the healing process are of great interest to patients and doctors. The advantages of HBOT are the known benefits in reducing swelling (3-7), decreasing inflammation (8-10), improving collagen deposition in the skin (11-15), increasing the growth of new blood vessels (16), increasing the number of stem cells
in circulation associated with skin repair \((17-19)\) and limiting the damage of reperfusion injury \((20)\). HBOT is a safe and fast acting therapy, with few risks and side effects to patients. By stimulating the body to heal, time to recovery can be substantially reduced.

**HBOT: Pre- and Post-surgery treatment**

Athletic injuries occur more regularly than most people would like and must be treated. HBOT treatment prior to surgery can improve surgical outcomes and decrease recovery time \((3, 4)\), especially after cardiac surgery \((21, 22)\). In animal models of anterior cruciate ligament (ACL) reconstruction, HBOT can improve outcomes \((23)\) and the positive effects of HBOT has been observed in clinical case studies for over two decades. Pre-treatment can prepare the wound site by reducing inflammation, increasing anti-apoptosis protein expression in cells \((24-30)\) and reducing swelling/edema \((31-35)\). These benefits are carried forward after surgery and by repeated treatment with HBOT. In cases were the surgery compromises or partially blocks the blood supply of the surgical site, HBOT can decrease the amount of reperfusion injury and spare compromised tissue.

These benefits are significant in tissues that have a relative poor blood supply, even in the best of athletes. Tissues like cartilage, ligaments and tendons are not well supported by a robust vascular bed, thus limiting recovery rates. HBOT can stimulate angiogenesis and provide a sufficient amount of oxygen to support the cartilage, ligament or tendon as they heal. Bone repair and bone grafting are greatly enhanced using HBOT \((36-38)\), thus enhancing a rapid repair of the fracture or bone stress.

**Treatment Recommendations**

As a general guideline to treat an injury, we recommend that patients with recent injuries (less than 12 hours old) start treatment with a single 2.8 ATA, 1.5 hour treatment and then use 2.4 ATA for 1.5 hours, once-a-day. Patient with older injuries should be treated at 2.4 ATA for 1.5 hours, once-a-day:

1) For planned surgery, we would recommend no less than one pre-op treatment and most likely 2 to 3 treatments pre-op; followed by no less than 3 post-op treatments, with 5 as the ideal post-op.

2) For injuries, we recommend that treatment begin as close to the time of injury as possible. We should treat 5-7 times, ideally. This will help control the swelling and inflammation at the site of injury and accelerate healing.

3) It is critical that injured patients follow the protocol that is prescribed to them. Like any treatment, the effectiveness is dependent on how well the patient follows the prescribed regime.

As more research is done in the field of hyperbaric medicine, we may begin to identify specific mechanisms that affect healing via hyperbaric oxygen. The genetic make-up of individuals appears to affect how the body reacts to HBOT treatment. In mouse studies, the loss of endothelial nitrous oxide synthase (eNOS), an enzyme that produces nitrous
oxide (NO) affected the release of stem cells from the bone marrow after HBOT treatment (17, 39, 40). Thus, understanding the genes and proteins required to induce the healing effects of HBOT will allow us to identify those individuals that may receive the greatest benefit from this therapy.

By coupling the advances in sports medicine, physical therapy and hyperbaric medicine, we will help accelerate the time to recovery, complement surgical procedures and enhance the outcomes of physical therapy. As many professional sport teams have discovered, HBOT is a real tool to enhance their performance and reduce down-time from injuries.

References: