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Platelet-Rich Plasma Therapy: A PROMISING OPTION

Platelet-rich plasma (PRP) therapy has been around in some form since the mid-1990s. Lately, it has received considerable attention in the news and in medical journals for its potential for treating chronic tendonitis (inflammation of the tissue connecting muscle to bone) and acute sports injuries. PRP therapy is a nonsurgical treatment for bones, cartilage, muscles, tendons, and ligaments (tissue connecting one bone to another) shown to slow, halt, or possibly even heal progressive damage. It also has the potential to reduce pain and improve joint function. PRP therapy works by making use of the natural healing properties of the platelets found in blood plasma.

What is PRP?

Plasma and platelets are 2 of the 4 components of blood; the other 2 include red and white blood cells (**Fig.1**). Plasma is the pale yellow liquid component of the blood. It consists of 95% water and makes up 55% of the total blood volume. Plasma transports blood cells along with platelets and other molecules such as hormones and antibodies throughout the body. Platelets, or thrombocytes, are colorless, microscopic disc-shaped cell fragments with no nucleus that are made in the bone marrow or spongy center of bones. While known primarily for their role in clotting blood, platelets also transport smaller proteins called growth factors that can stimulate the body's own healing response. For example, when soft tissue is injured, the body's first reaction is to deliver platelets to the area where

Fig. 1. Blood components in a vessel and a blood sample before and after spinning in a centrifuge

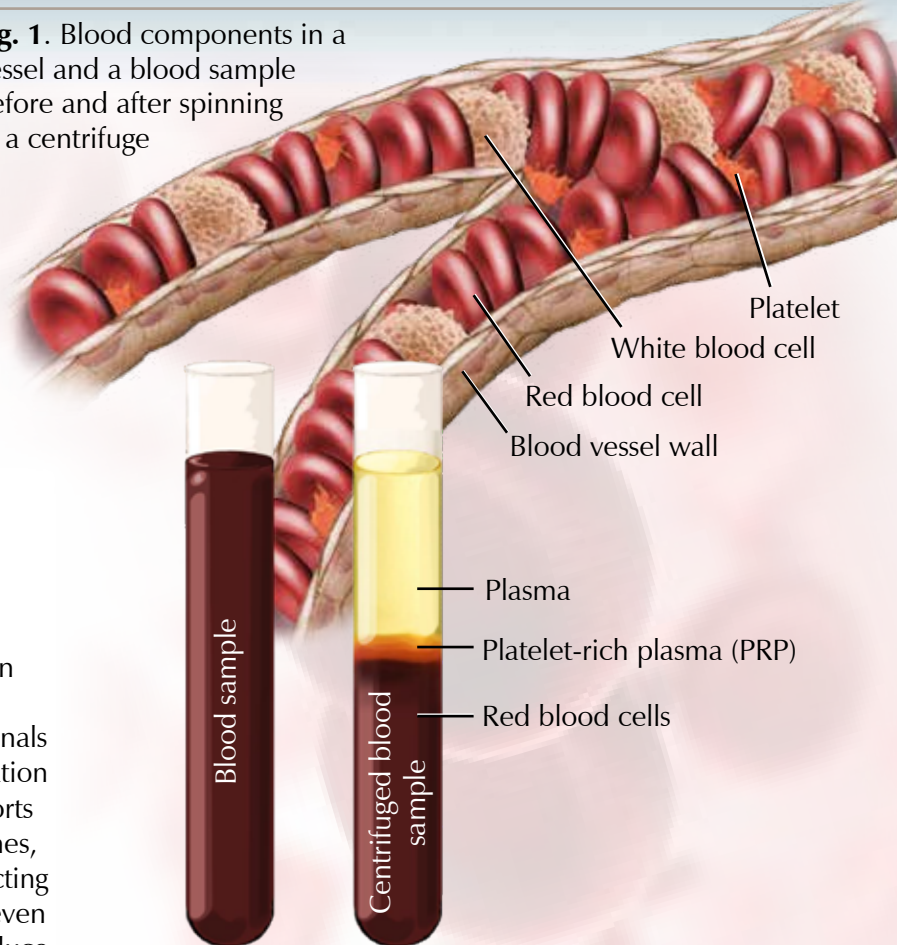
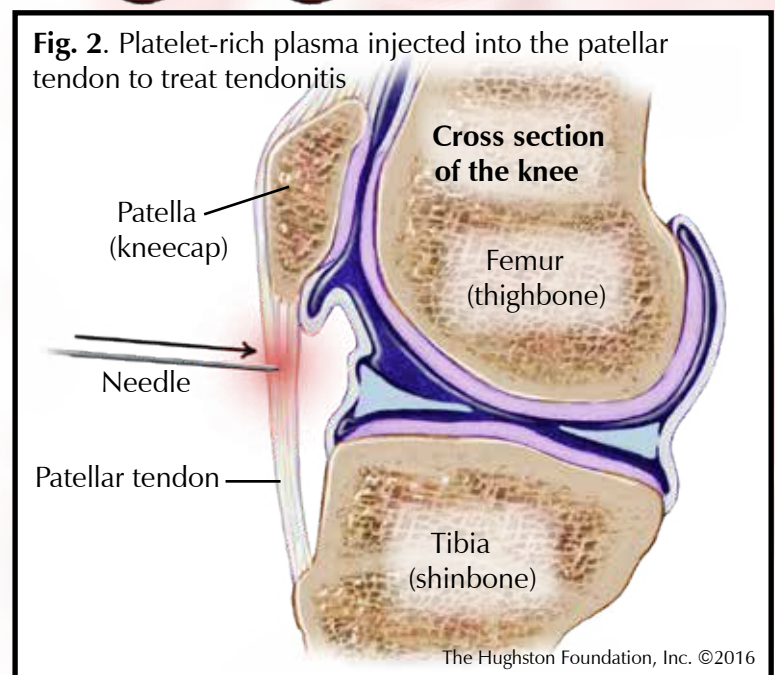


Fig. 2. Platelet-rich plasma injected into the patellar tendon to treat tendonitis



they prevent bleeding, initiate tissue repair, and can attract the assistance of stem cells (cells capable of reproducing and differentiating).

To produce plasma that is rich in platelets, a sample of blood is drawn and spun in a machine (centrifuge) at an extremely high speed to separate the platelets and plasma from the blood cells. The resulting fluid has a high concentration of platelets and thus of growth factors. This PRP fluid can then be injected into an injured area to help accelerate healing.

What are the potential uses of PRP?

Treatment with PRP can help reduce pain in patients who suffer from chronic conditions such as a tendon injury, muscle strain, ligament sprain, or osteoarthritis. PRP treatment may also promote healing in surgical patients.

Tendon injuries

For individuals with chronic tendon injuries, PRP has become an attractive option, partly because these injuries have traditionally been difficult to treat. Generally, rest, activity modification, oral or topical anti-inflammatory medications, selective cortisone injections, physical therapy, and bracing are recommended. When these treatment modalities fail to relieve the pain, surgery is usually the best option. During surgery, the damaged portion of the tendon is removed, and the tendon is then repaired by suturing the healthy ends together. But what if we could instead stimulate the body to heal the damaged tissue?

Previous orthopaedic research has focused on the use of PRP to treat chronic tendon injuries such as lateral epicondylitis (tennis elbow), patellar tendonitis (jumper's knee)(**Fig. 2**), Achilles tendonitis, and plantar fasciitis. PRP seems to be most effective in treating lateral epicondylitis, often working better than cortisone injections. Although pain relief was noted when PRP treatments were performed on the elbow, whether the tissue actually regenerated was not determined. Moreover, research has not yet confirmed whether PRP therapy is more effective than standard treatments for other types of chronic tendon injuries. There are 2 principal reasons for this uncertainty: 1) we do not know the exact concentration of platelets needed; and 2) we do not know the precise number or the proper timing of injections to treat each condition.

Strains and sprains

PRP therapy may also be an option for treating other musculoskeletal conditions, including acute injuries such as muscle strains and ligament sprains, particularly of the knee and elbow. Recently, PRP therapy gained national attention in the sports medicine field when some professional athletes, including 2 members of the Pittsburgh Steelers and pro-golfer Tiger Woods, underwent treatments to speed up the healing process and their return to competition. While this does sound promising, only further research will confirm whether PRP therapy can truly produce these benefits.

Osteoarthritis

Osteoarthritis, or loss of cartilage in the joints, is the most common type of joint disorder and a significant cause of pain for sufferers. Currently, there is no cure for osteoarthritis. Ultimately, when joints such as the knee or hip are severely damaged, arthroplasty (surgical joint replacement) is the only option for relieving pain and regaining mobility. Studies are currently underway to determine whether PRP injections are effective in reducing pain and even slowing down deterioration in these arthritic joints.

Surgical supplement

Another potential use of PRP is as a supplement during certain types of surgeries—for example, rotator cuff tendon repairs and fracture repairs—to promote the healing of tendons and bones. It is also being considered for use in surgeries to help repair or reconstruct torn sections of cartilage. Further research into this treatment modality will help to determine whether PRP therapy can fulfill its promise.

PRP therapy: not for everyone

A patient who has tried various nonsurgical treatments, such as rest from activity, bracing, and physical therapy, but continues to experience symptoms for longer than 6 months, may be a candidate for PRP therapy. PRP therapy is not for everyone, however. First of all, because the treatment has not yet been approved by insurance companies, the patient must assume the full cost of PRP preparation and injection. Moreover, patients with cerebral palsy or Parkinson's disease are not good candidates. The therapy is also not recommended for those patients who are undergoing treatment for cancer or for infections such as hepatitis. Additionally, PRP therapy is not suitable for patients who suffer from multiple medical conditions, bleeding disorders, or who have been prescribed a high dosage of Coumadin®, Plavix®, or other blood thinners.

A promising option

When appropriate, PRP therapy presents an attractive option for patients and physicians alike. It may create a superior healing environment and speed healing time for certain types of surgically repaired tissues; it should thus allow individuals to return to work or sports sooner. Moreover, PRP therapy may offer pain relief or even eliminate the need for surgery in patients with a number of chronic conditions, such as tendon problems and arthritis. Furthermore, no significant side effects have been associated with PRP use; the chief complaint has been temporary pain at the injection site. PRP thus remains a promising option to treat and potentially cure a number of different types of musculoskeletal conditions.

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Hydrate Well to Play Well

Did you know that your body is mostly water? In fact, 60% of your body consists of water. Two-thirds of this water is intracellular (contained within your cells) and 1/3 extracellular (existing outside your cells). Extracellular fluids include your blood plasma, lymph (the fluid from the spaces between body tissues that collects in your lymphatic vessels), and various bodily fluids such as your cerebrospinal (within the cavities of your brain and spine) and pleural (around the membranes of your lungs) fluids. Without plenty of water, your body cannot operate efficiently. Just to maintain proper functions, such as regulating your temperature, carrying out metabolic reactions, delivering vitamins and minerals to your cells, transporting nutrients, and eliminating waste, your body requires ½ to 1 fluid ounce (fl oz) of water per pound (lb) per day. Exactly how much water you need therefore depends on your overall weight and other factors. If, for instance, you weigh 150 lbs, this means you need approximately 2.5 quarts of water per day.

Following an exercise routine or playing sports will cause you to sweat more and to burn more fuel. This is because sweating is your body's primary mechanism for cooling itself off during exercise. When sweat breaks out on your skin it transforms and evaporates, carrying heat away from the body. Sweating also helps you maintain constant energy levels while working out. All of this means you will need additional fluids to maintain a healthy water balance. It is therefore important to drink plenty of water before, during, and after exercise.

Recommendations for fluid replacement

The National Athletic Trainers' Association recommends that you drink 17 to 20 fl oz of water 2 to 3 hours before an athletic event and 7 to 10 fl oz every 10 to 20 minutes during an event. However, due to such factors as your height and weight, fitness level, hydration status, and clothing, as well as the humidity, temperature, and the type of activity involved, you may perspire more and therefore need to hydrate more.

Following an event or competition, you should aim to restore your body to its fully hydrated state, but how do you know how much liquid to consume? It is standard procedure in some sports, particularly football, to record an athlete's weight before and after practice because weight loss from perspiration should not exceed more than 2% of total body weight for any single training session. This means that if you are a 150-pound athlete you should not lose more than 3 lbs in 1 exercise session. As a rule, you will need to consume 16 to 20 fl oz of water per pound of body weight lost in order to rehydrate. Thus if you lose 5 lbs, you will need to drink at least 80 fl oz of water. While this may sound like a lot of liquid, keep in mind that a typical soda bottle holds 20 fl oz.

Sports drinks or water?

Nutrients such as sodium, calcium, and potassium—also known as electrolytes—play a key role in hydration. They transport water throughout your body and are essential for proper water retention as well as muscle contraction. As you sweat, you lose electrolytes along with water. If as an athlete, you eat proper meals before and after a sporting event, water is your best option for fluid replacement. If, on the other hand, you are in a competition environment where you may be sweating excessively and not have the opportunity to eat or hydrate right away, a sports carbohydrate beverage (such as Gatorade™ or Powerade™) may be preferable for replenishing water and lost electrolytes quickly. Be aware, however, that sports drinks should always be used in combination with water and not as a replacement for it. Drinking them in excess is known to cause an upset stomach and can raise sodium levels. It is also important to note that while water has 0 calories, sports drinks may pack over 90 calories per serving—an important consideration if you are exercising for weight loss.

Dehydration

It is easy to become slightly dehydrated while exercising because your body cannot replenish the amount of water lost through sweat and evaporation quickly enough. As discussed, a loss of more than 2% of your total body weight indicates that you are moderately to severely dehydrated. At the severe level, your body can no longer carry out proper cardiovascular and thermoregulatory responses. The amount of blood that your heart can pump is also significantly reduced which, in turn, means that there is less oxygen moving through your body. Moreover, with less water available for sweating, less heat is dissipated; consequently, your body temperature rises, putting you at risk for heat-related illnesses. Furthermore, dehydration impedes athletic performance. For instance, it can decrease the duration for which you can exercise by over 50%. You should therefore begin every exercise session completely hydrated. If you exercise on consecutive days or multiple times a day, you are at increased risk of dehydration.

How do you know you are dehydrated?

Thirst is a message from your brain that you are becoming dehydrated. Another symptom of dehydration is a pale or white tongue. If dehydration progresses, you may also experience excessive thirst, dry-mouth, fatigue, dizziness, headache, chills, cramps, nausea, and vomiting. Additionally, you should be aware that dehydration is a contributing risk factor for heat-related illnesses such as heat cramps, heat exhaustion, and heat stroke.

Skin turgor test

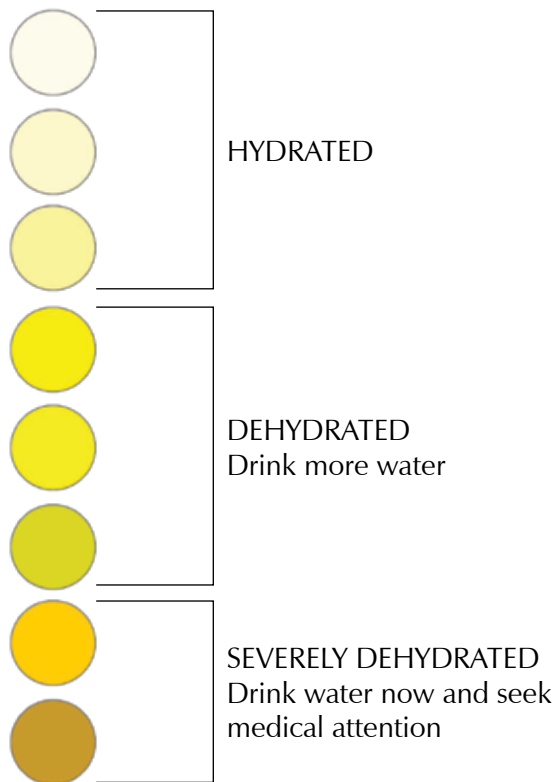
A simple test you can perform yourself to determine whether or not you are dehydrated is the skin turgor test. Just pinch the skin on the back of your hand. If your skin is

well-hydrated, the pinched area will return to its normal position right away. If your skin is dehydrated, it will remain elevated, taking longer to return to normal.

The color of urine

Another way to gauge whether you are properly hydrated is to note the color of your urine (**Fig.**). Normal urine is a light yellow, similar to the color of lemonade. If your urine is darker in color, it indicates that you are dehydrated. Noting the color of your urine is also a good way to check whether you have fully rehydrated after a sporting event or competition. Overall, it should take no longer than 6 hours for you to rehydrate after an event.

Fig. Urine color chart



Pay attention and carry a water bottle

By taking precautions and cultivating good hydration habits, you can easily avoid dehydration and its consequences. It is also important to know your own body. Pay attention to the signs and symptoms of dehydration and know when you may need to take a break to rehydrate. Additionally, keep in mind the amounts of water you should optimally drink before, during, and after your athletic events. Finally, try to practice good hydration habits, such as carrying a refillable water bottle with you at all times. You'll drink more water than you think when it's constantly at your disposal.

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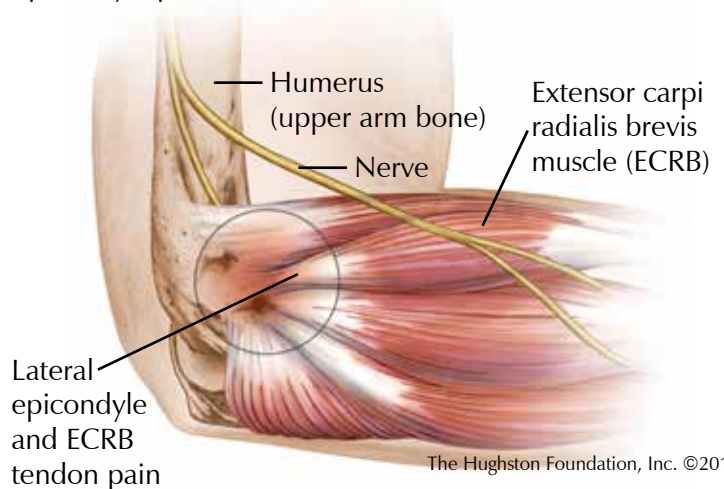
Lateral Epicondylitis TAMING TENNIS ELBOW

Lateral epicondylitis is a common painful condition of the elbow caused by overuse of the muscles of the forearm. Popularly known as tennis elbow because of its association with the sport, it is both a repetitive strain injury and a tendinopathy (diseased or abnormal condition of the tendon). Various studies have identified the repetitive wrist extension or forearm rotation and supination (turning toward the outside) involved in such activities as racquet sports and using heavy tools for manual labor as the primary risk factors for lateral epicondylitis. In many cases, however, the condition cannot be linked to any kind of precipitating activity and so is said to be of insidious onset (coming on slowly without obvious symptoms). Regardless of the cause, once the muscles and the tendons (tissue that connects muscle to bone) that attach to the lateral epicondyle become chronically irritated and the attachment begins to degenerate, everyday activities, such as gripping or holding household objects, can be painful. Lateral epicondylitis affects 1 to 3% of the adult population, most often those between the ages of 30 and 50, and affects women slightly more often than men.

Elbow anatomy

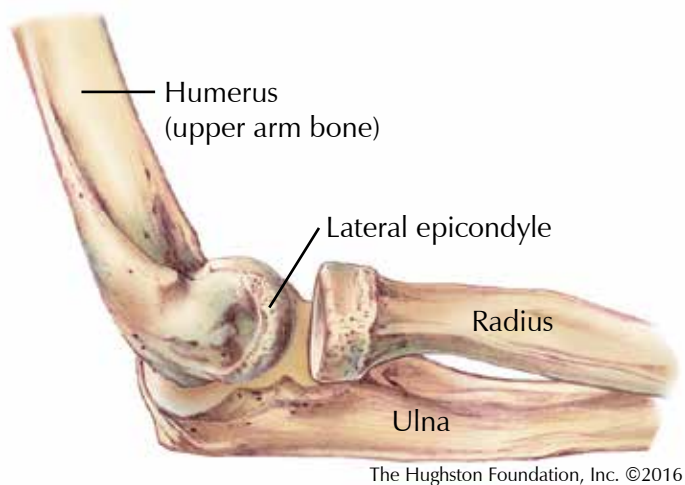
The elbow joint is held together by muscles, tendons, and ligaments (tissue that connects bones) (**Fig. 1**). It is a hinge joint that allows us to flex (bend), extend (straighten), and rotate the forearm. The bony projection that can be palpated on the outside of the elbow is the lateral epicondyle. It extends off the condyle, or rounded, knuckle-like bone ending, of the humerus (upper arm bone) which articulates with the radius and ulna (forearm bones) to form the joint (**Fig. 2**). The muscles that extend the wrist, such as the extensor carpi radialis brevis (ECRB), originate from the lateral epicondyle.

Fig. 1. Elbow anatomy and a source of lateral epicondyle pain



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Fig. 2. Elbow bone anatomy



Sources of pain

The most common source of the pain associated with lateral epicondylitis is the ECRB muscle. Repetitive or overuse activities can cause microtrauma to the fibers of the muscle, resulting in microscopic tears and the release of inflammatory chemicals that induce pain. The pain may also be caused by the tendons that attach to the epicondyle or, alternatively, from conditions inside the joint, such as synovitis (inflammation of the synovium or joint lining) or plica band (inflammation and enlargement of a part of the joint lining). Typically, the pain is felt on the outside of the elbow in the portion of the ECRB closest to the joint, and the lateral epicondyle itself may be tender. The pain of lateral epicondylitis can be reproduced with resisted wrist and finger extension, and most patients complain of a weak and painful grip.

Nonsurgical treatment options

The majority of lateral epicondylitis or tennis elbow cases resolve on their own without formal treatment. When pain persists, it usually prompts a person to visit a physician or orthopaedist. The appointment will include a detailed history, physical exam, and x-rays; if the problem is severe enough, the doctor may order an MRI.

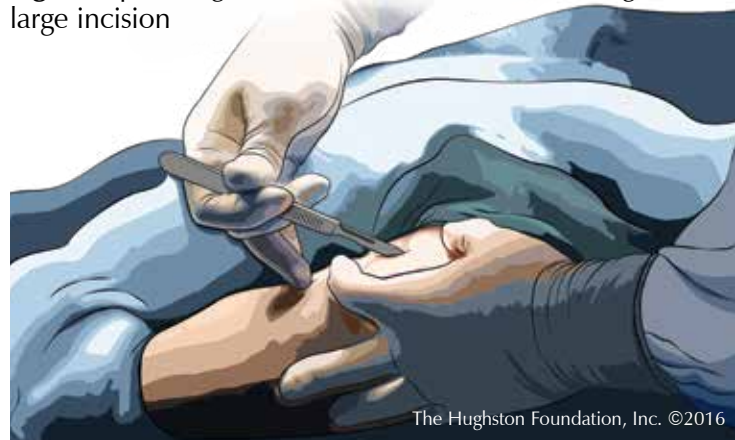
Standard nonoperative treatment for lateral epicondylitis consists of taking oral nonsteroidal anti-inflammatory drugs (NSAIDs), modifying activity, using orthotic braces (such as tennis elbow straps), and undergoing physical therapy. Another nonsurgical measure is to inject steroidal medication directly into the identified site to decrease pain and inflammation. As the effectiveness of steroid injections is generally mixed, some novel injection techniques have emerged. For example, an autologous (from one's own body) platelet concentrate (consisting mainly of blood plasma and platelets or cell fragments involved in clotting) can be injected into the affected elbow to stimulate a healing response. Also known as platelet-rich plasma (PRP) therapy, these injections have shown promising results in some

studies, but more research is needed to determine their real efficacy.^{1,2} It is also important to note that between 80 and 95% of all cases of epicondylitis resolve without operative treatment.

Surgical treatment options

When refractory or stubborn cases of lateral epicondylitis fail to respond to nonoperative treatment, surgical options can be considered. Traditional surgery for tennis elbow has consisted of large, open techniques that expose the extensor muscles and identify and excise (remove) the damaged tissue (**Fig. 3**). Such procedures have typically included tendon repair where the healthy tissue is reattached to the bone. More recently, less invasive surgical techniques, such as arthroscopy (inserting a tiny fiber-optic video camera and instruments into the joint) have been developed. Unlike traditional open surgery, arthroscopic treatment of lateral epicondylitis requires only a small percutaneous (through the skin) incision and a shorter recovery period. It also allows the surgeon to identify and treat any additional intra-articular pathology (disease process within the joint).

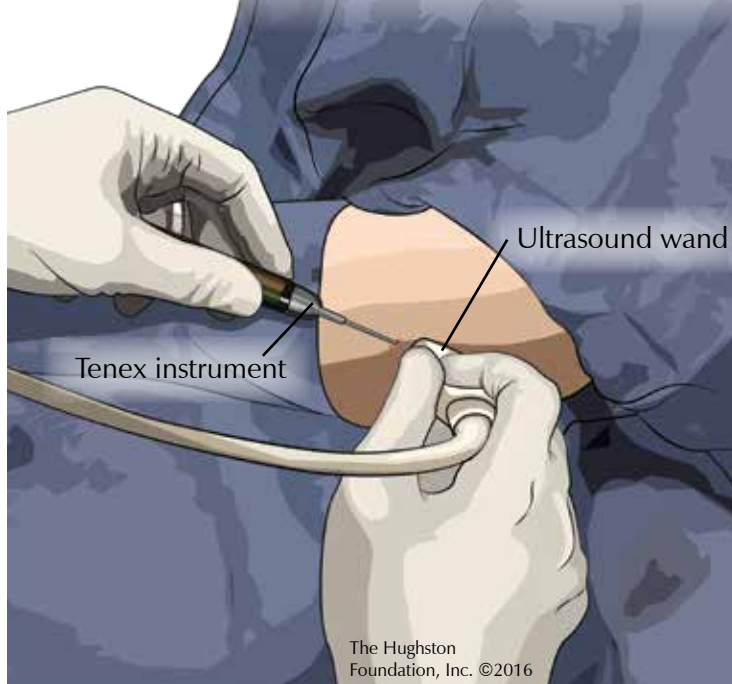
Fig. 3. Open surgical treatment on the elbow using a large incision



New treatment

A new minimally invasive technique known as a percutaneous tenotomy (tendon resection) that uses the Tenex Health TX System™ is currently evolving. The procedure uses a percutaneous incision and ultrasound guidance above the skin rather than a scope to identify diseased tissue (**Fig. 4**). A special hand-held tool is then used to mechanically break up the tissue and flush it out.³ Preliminary research on this treatment has been promising. One recent study including a 3-year follow-up showed excellent functional outcomes and high patient satisfaction.⁴ Additionally, postprocedure ultrasound evaluation of the tendon showed a good tissue-healing response in the diseased area. The theoretical advantages of this technique over other techniques include a much smaller incision, the ability to target the diseased area with minimal disruption to healthy tissue, decreased postoperative pain, and a shorter recovery period. Despite these advantages,

Fig. 4. Tenex Health TX System™ uses a small incision and ultrasound guidance to treat tennis elbow



more research is needed to establish this procedure as a preferred treatment for lateral epicondylitis.

Good results

Lateral epicondylitis or tennis elbow is a common yet potentially debilitating condition that can limit the performance of everyday activities. While most cases resolve on their own or with nonsurgical treatment, more difficult or refractory cases may require surgery. When surgery is needed, new arthroscopic and other minimally invasive techniques, particularly percutaneous tenotomy with Tenex Health TX System™, have shown good results for patients.

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Managing the Polytrauma Patient

Every day, individuals are brought to emergency rooms or trauma centers with multiple injuries as a result of traumatic events such as car or motorcycle crashes or other high-energy impacts to the body, including falls from heights, crush injuries, or gunshots. A person involved in a traumatic event who has sustained multiple injuries is a polytrauma patient (Fig.). The term polytrauma comes from the ancient Greek words *poly-*, meaning many or multiple, and *trauma*, meaning a wound or an injury to living tissue caused by an external agent. The Centers for Disease Control (CDC) reports that 192,000 people under the age of 46 died from traumatic injuries in 2014. The CDC also states that, after heart disease and cancer, trauma is the leading cause of death for adults over the age of 45. However, current advances in treatment are helping to improve outcomes for polytrauma patients.

A multidisciplinary approach

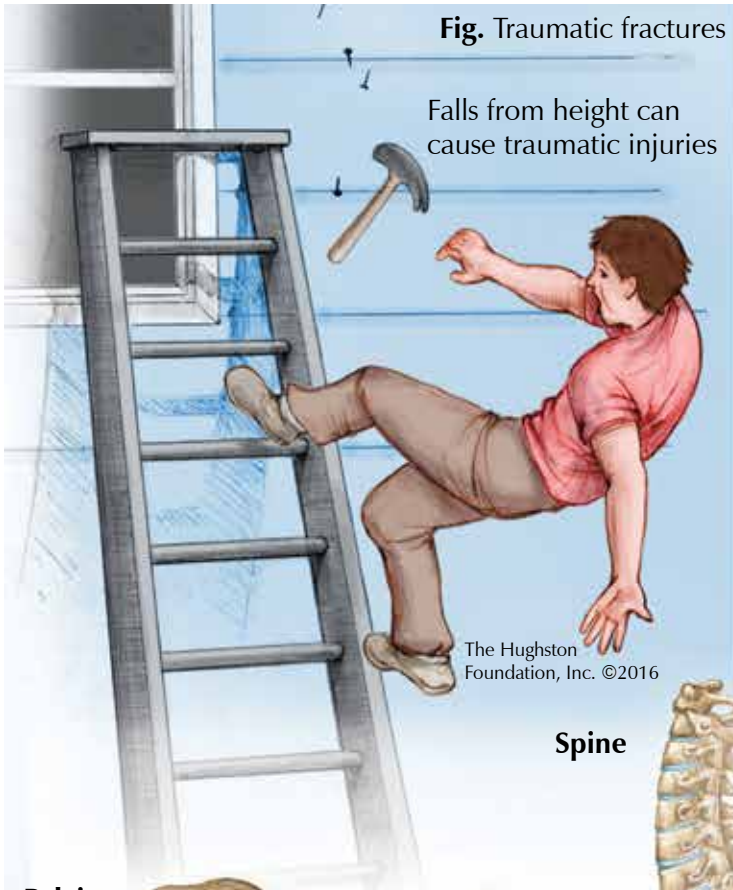
Treatment of the polytrauma patient requires both a multidisciplinary approach and the proper timing of musculoskeletal care. Thus a coordinated effort by several highly specialized medical teams is usually required to manage and stabilize the polytrauma patient. The first responders take care of the initial resuscitation and transport of the patient by ambulance or helicopter to either the hospital or trauma center. There the patient is triaged and initially listed as being in 1 of 4 possible conditions: 1) physiologically stable; 2) unstable; 3) borderline; or 4) in extremis (extremely unstable). As traumatically sustained injuries often cause either internal bleeding or bleeding from an injured extremity, the amount of blood lost usually determines the patient's condition. This blood loss is initially treated by administering fluids directly into the patient's blood stream or through blood transfusions. The emergency medicine team then works to further stabilize the patient through lifesaving protocols and to evaluate the patient's injuries by obtaining the proper imaging. Based on these images, the radiologist then aids in diagnosing these injuries, and an interventional radiologist can often treat ongoing bleeding through minimally invasive techniques.

Next, the orthopaedic trauma surgeon is responsible for stabilizing the patient's musculoskeletal injuries based on his or her condition. As fractures can cause ongoing bleeding—for example, patients with pelvic or femur fractures can lose several liters of blood—temporarily splinting, and so stabilizing, a fracture can be lifesaving.

Afterward, depending on the patient's clinical condition, treatment consists of 1 of 2 basic approaches for musculoskeletal stabilization: damage control orthopaedics (DCO) or early total care (ETC). Once the patient has been stabilized through 1 of these treatment protocols, intensive care unit (ICU) physicians and nurses assume the major

Fig. Traumatic fractures

Falls from height can cause traumatic injuries



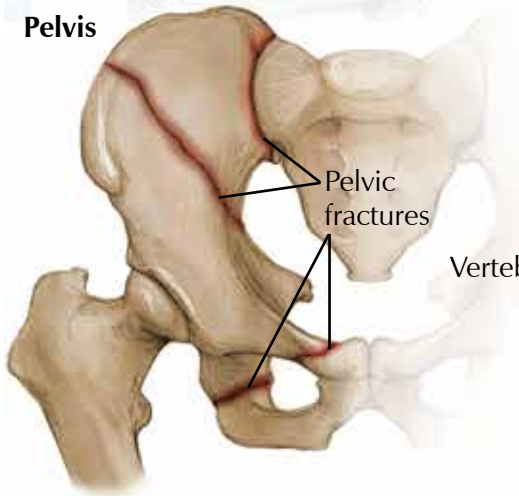
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Spine



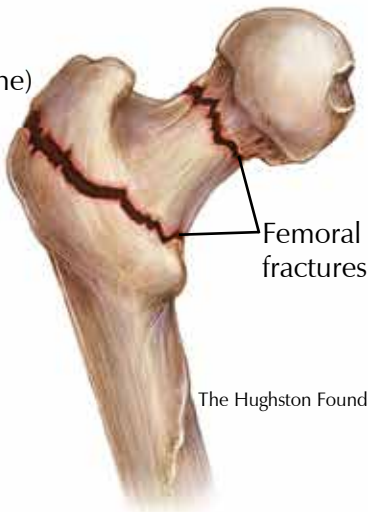
Vertebral fractures

Pelvis



Pelvic fractures

Femur (thighbone)



Femoral fractures

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responsibility for the patient's care. The patient will remain in the ICU until his or her clinical condition improves enough to allow transfer to a regular hospital floor bed.

What is damage control orthopaedics (DCO)?

DCO is the performance of lifesaving interventions through rapid fracture stabilization to stop the cycle of ongoing musculoskeletal injury and bleeding. In patients with unstable pelvic fractures, the pelvis can be a source of ongoing bleeding. Thus pelvic binders or sheets are often applied around the patient's pelvis to compress the area and stop the bleeding. Additionally, external fixators—pins placed into the bone that are connected to bars and clamps applied outside the body—are frequently positioned to stabilize fractures and soft tissue injuries of not only the pelvic area, but also the extremities. These interventions are able to stabilize the patient quickly without the added insult to the body that more invasive surgery would entail.

What is early total care (ETC)?

ETC is the performance of definitive fracture stabilization at the time of the initial surgery. One advantage of this approach is that it can enable the patient to get back on his or her feet sooner. It can also help prevent other health issues, such as pneumonia, ulcers from lying in bed, blood vessel abnormalities (such as blood clots), gastrointestinal problems, and even mood disorders, from occurring due to the more rapid mobilization of the patient after surgery. However, as surgery involving definitive fracture stabilization often takes more time and is more invasive, performing this type of treatment on an otherwise unstable patient can add insult to injury. ETC should therefore be performed only on those patients who are already in stable condition.

Better management, better outcomes

Two major factors affecting early survival of the polytrauma patient are the initial status of the patient (determined largely by the amount of blood loss sustained) and the time to transfer the patient to a trauma center. Brain injury, which is often the result of blunt trauma, can cause early death in the polytrauma patient, while sepsis (an inflammatory response caused by infection and involving the entire body) typically causes death later on. Fortunately, advances in diagnosis and treatment of traumatic musculoskeletal injuries—including prehospital, interventional, surgical, and intensive care—have led to increased survival rates for polytrauma patients.

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