

## ORTHOPEDICS

Orthopedics has to do with a variety of tissue: bone, cartilage, tendon, ligament, muscle. In this regard orthopedic and sports medicine share the same tissue targets. Orthopedics is mostly a surgical discipline while sports medicine is mostly a medical discipline.

### BONE

Bone healing is based on three phenomena called: osteogenesis (the production of new bone from precursor cells in the area), osteoinduction (the ability of stem cells to differentiate into mature cells), and osteoconduction (the presence of a structured scaffold that allows for vascular and cellular migration). After a fracture has occurred, the platelets naturally locally delivered through blood extravasation provide factors that promote these three phenomena. Locally administered platelet such as Platelet Rich Plasma or Platelet-gel greatly enhance these repair mechanisms through supraphysiological levels of growth factors such as PDGF (platelet-derived growth factor), TGF- $\beta$  (transforming factor  $\beta$ ), FGF (fibroblast growth factor), EGF (endothelial growth factor). During surgery platelet gel is administered with bone chips (autograft, allograft, or bone substitutes) in order to sustain osteoconduction. For complete bone repair and bone function, after the first phase of new bone formation, a second phase of bone resorption and remodelling occurs. It has been suggested that platelets provide not only stimulation for osteogenesis but also enhance the bone healing capacity due to bone resorption and remodelling.

Impaired bone healing following fractures or fusion operations in case of nonunions cause pain and disability. **Recalcitrant nonunions**, leading to long-lasting invalidity, are physically and mentally devastating conditions for the patients. There is evidence that almost all fractures, including nonunions, treated with the platelet gel (with external fixation if necessary) are stimulated to get union.

**In total hip replacement** the platelet gel significantly decreases the post-operative blood loss while better osteointegration occurs and the patient experiences less pain. The results are more dramatic in **total knee surgery**. In a recent survey at the Bertram Total Joint Centers, 47 blood units were used while performing standard total knee surgery in 40 patients. In another series of 40 patients submitted to the same surgery performed using the platelet gel, a single blood unit was used overall while the mean hospital stay was reduced by 1.4 days in this group of patients.

Albeit some controversies, most of the clinical reports show an improvement of the bone healing. PRP delivery at the fracture site have been shown to normalize the early parameters (cellular proliferation and chondrogenesis) in diabetic fracture healing, while improving the late parameters (mechanical strength).

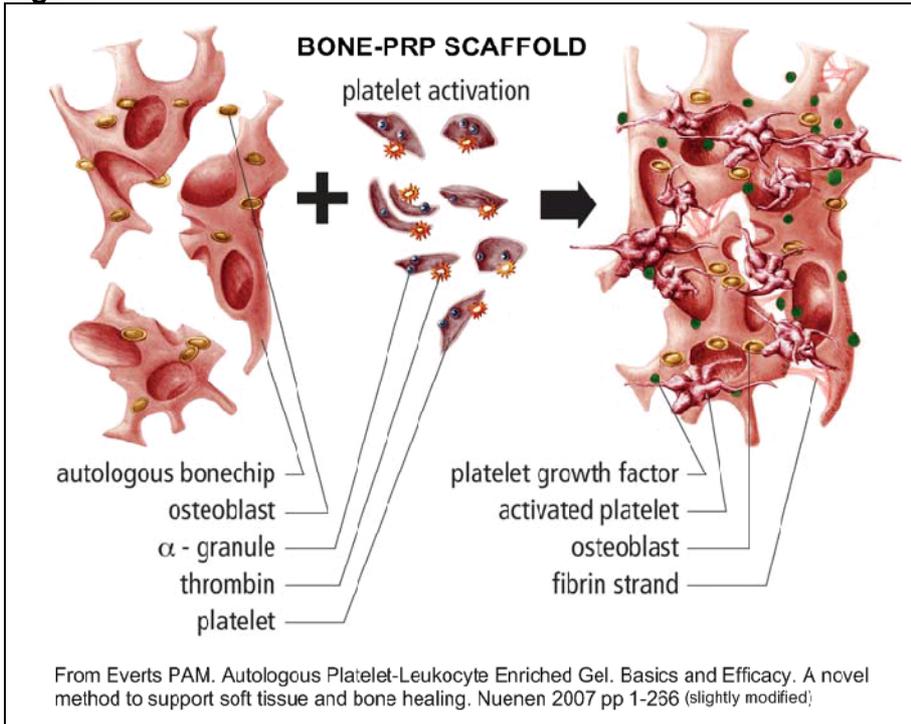
Radiological analysis have revealed an **increased callus volume** two weeks after treatment with the platelet gel. It was also showed that chondral tissue in the callus was gradually and rapidly absorbed suggesting that the platelet gel also accelerates bone remodelling during fracture healing. The bone healing effect is facilitated combining bone graft and/or autologous mesenchymal cell graft.

It must be emphasized that autologous platelet gel in **total joint replacement** procedures has been demonstrated to induce significantly **decrease of the post-operative blood loss**.

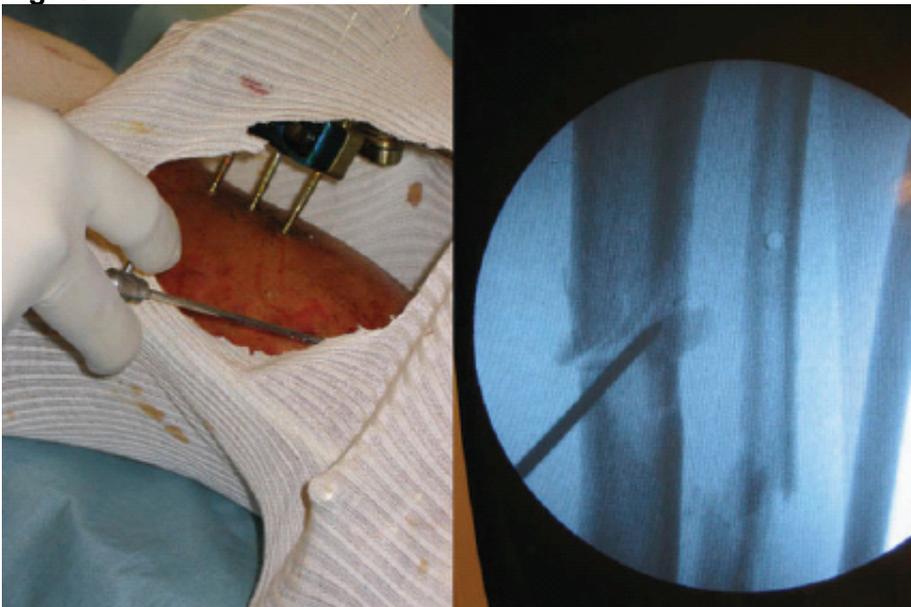
In conclusion the platelet gel treatment supports and promotes bone growth and accelerates fracture healing, particularly in patients who are at risk to develop non-unions. The association of platelet gel, bone graft, and other tissue engineering tools (figure 1) is an attractive mean in the treatment of fractures, spinal fusion, recalcitrant non unions.

The figures provide examples of the echoguided gel injection (figure 2); of the treatment and the outcome of a recalcitrant nonunion (figure 3) and of an explosive foot fracture (figure 4).

**Figure 1**



**Figure 2**

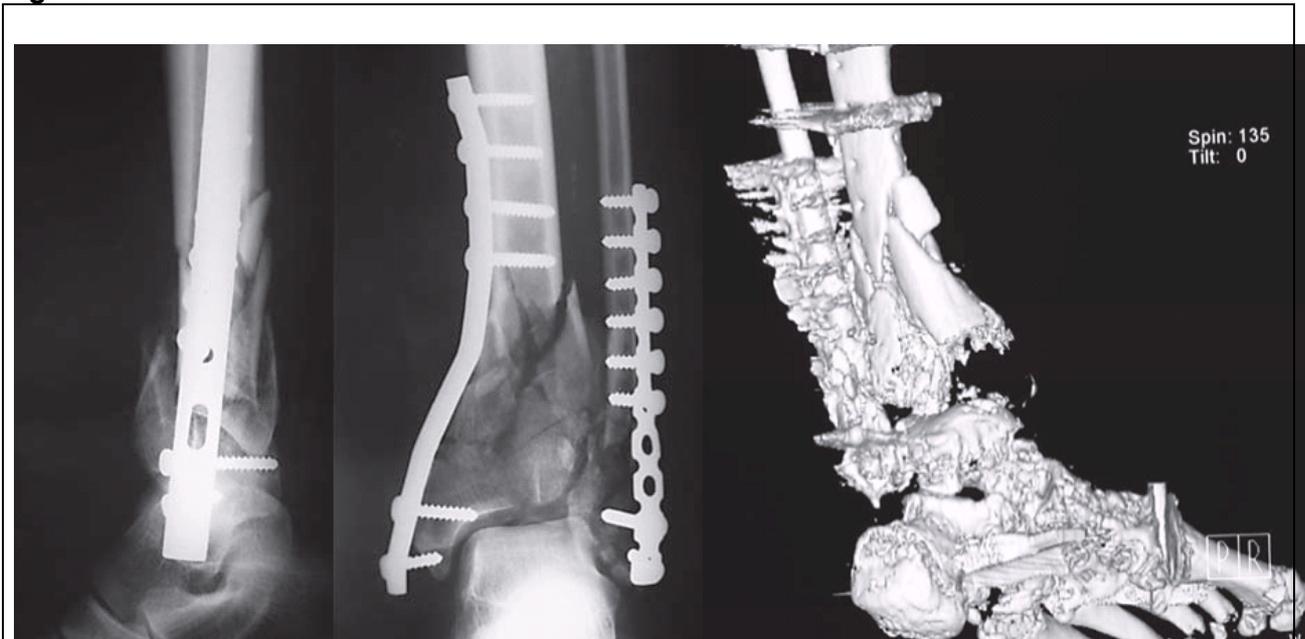


**Figure 3**



Rughetti A et al. Blood Transf 2004;2:37-43

**Figure 4**



Rozman et al. Eur Surg Res 2007;39:170-174

## **CARTILAGE**

In patient with full thickness cartilage loss of the knee and hip conventional arthroscopic surgery usually does poorly. In these patients platelet gel combined with marrow stimulation produced remarkable results. After one year follow up on 50 patients with arthritic knees 75% of those patients have significantly improved using this technique. Similar techniques are relevant for treatment for rotator cuff and tendon repair, hip arthroscopy and hip replacement.

## **TENDONS & LIGAMENTS**

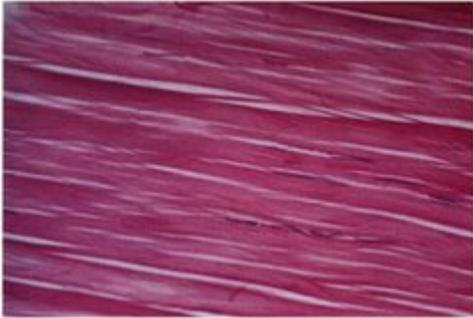
Tendons are the structures that attach muscle to bone. Figure 5 shows the healthy tendon anatomy. Tendons often bear significant force, and as a result are vulnerable to injury. Overuse or damage to the tendon over a long period of time causes the collagen fibers in the tendons to form small tears, a condition called tendonitis. Damage to tendons most often occurs in the knees, ankles, hips, spine, elbows, shoulders, and wrists.

Ligaments are composed of collagen fibers that hold one bone to another, stabilizing the joint and controlling the range of motion. When a ligament is damaged, it is no longer able to support the bones in the joint, which often leads to pain symptoms.

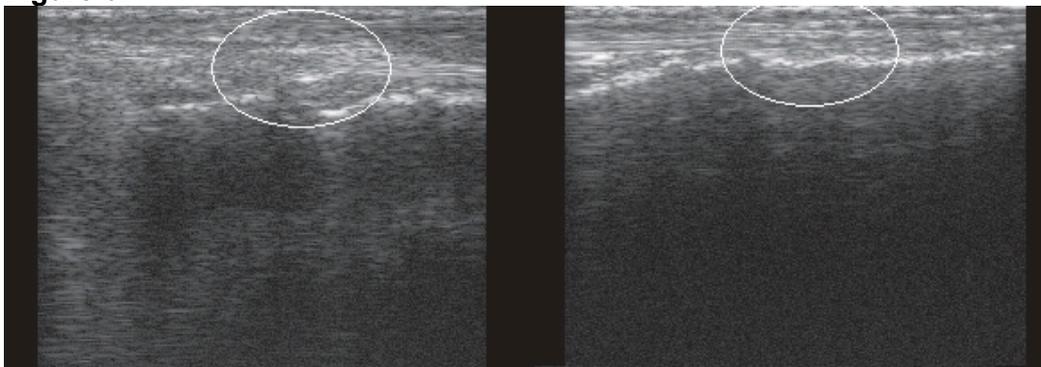
Tendons and ligaments have a poor blood supply and they do not usually heal from damage. If tendons and ligaments become inefficient joint degeneration may occur.

**The regenerative treatment with PRP or platelet gel is indicated for healing and strengthening tendons and ligaments.** Ultrasound guided PRP and platelet gel therapy can be performed on tendons and ligaments all over the body. Cervical, thoracic and lumbar spine, degenerative disc disease, arthritic joints shoulder pain, hip and knee pain. Even the smaller joints of the body can all be treated effectively. Ultrasonograph images of tendon lesions healed with ultrasound-guided topical application of platelet gel are shown in figure 6.

**Figure 5.**

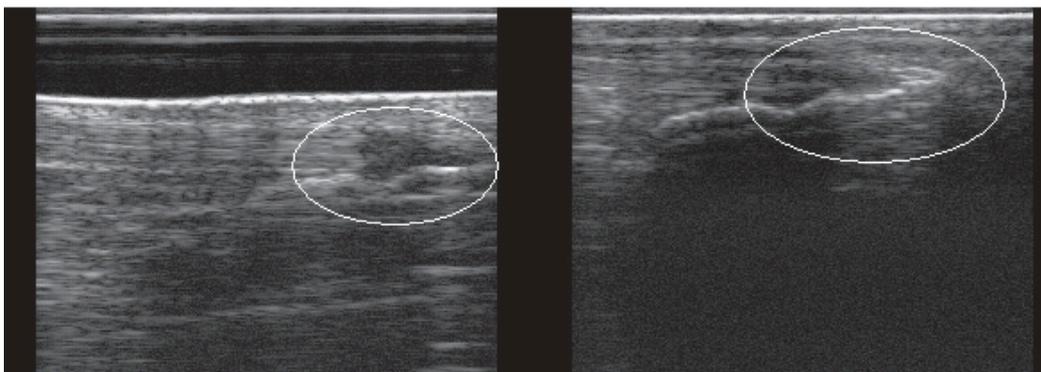


**Figure 6.**



Tibialis anterior tendon rupture

6 weeks after PRP treatment  
complete healing

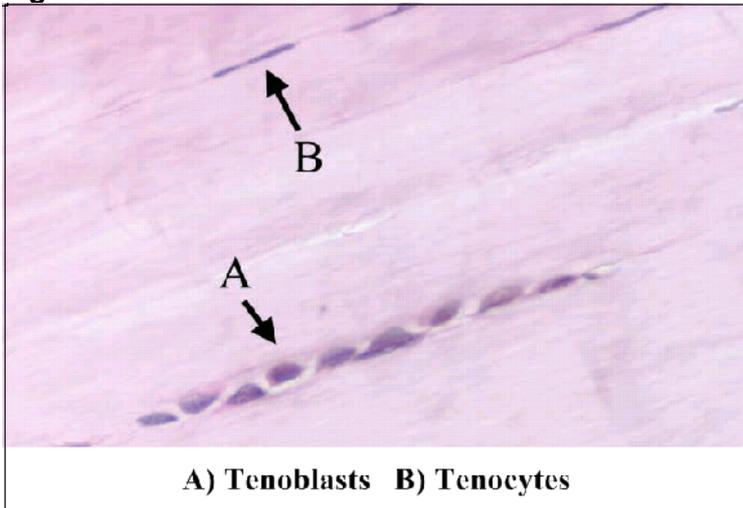


Achilles tendon rupture

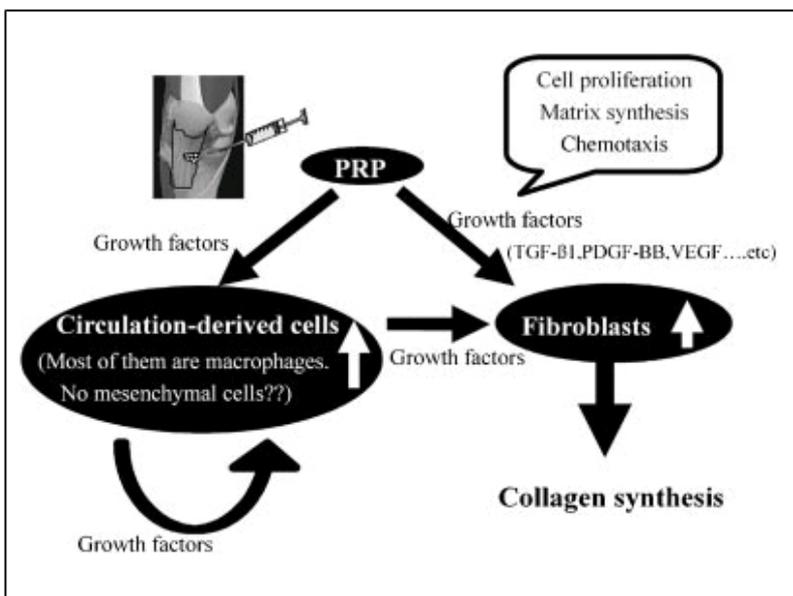
6 weeks after PRP treatment  
complete healing

The platelet-derived growth factor therapy is effective for the early treatment of the acute tendon injury. These factors induce macrophage migration within the lesion and induce their activation thus enhancing a growth factor autocrine loop which is essential for resident fibroblast-like cells such as tenocytes and tenoblasts (figure 7) to accelerate the collagen synthesis and the tendon repair. Recently, this model has been experimental demonstrated at the orthopaedic department of the Kyoto University (Kajikawa et al. J Cell Physiol 2008;215:837-854) (figure 8).

**Figure 7**



**Figure 8**



One of the **most appreciated effect** of this treatment is the pain relief and symptoms improvement which occurs quickly.

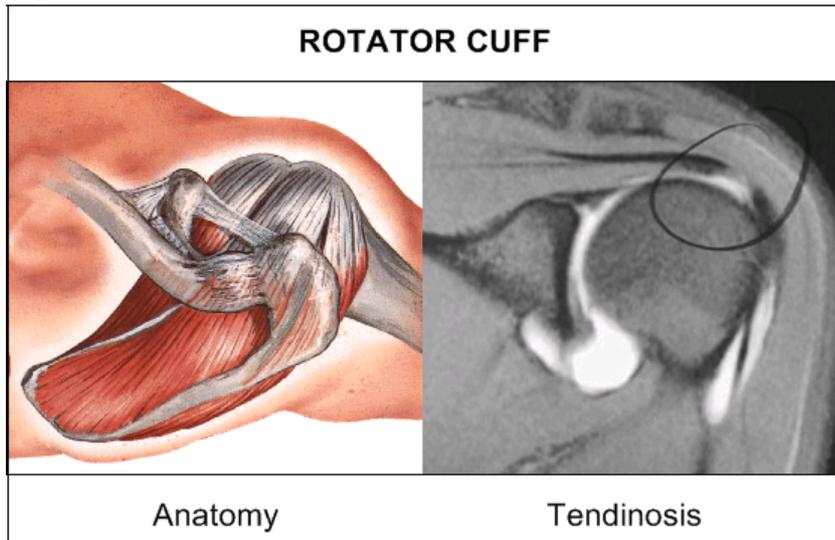
Post-traumatic tendon and ligament ruptures and joint capsular injuries frequently require a surgical intervention. The combination of surgical repair with the application of platelet gel accelerates healing with an improved outcome.

**Anterior cruciate** reconstructive ligament surgery can be performed arthroscopically using the platelet gel to augment healing.

Cuff-rotator degenerative disease are very frequent (see figure 9). **Cuff-rotator surgery** strongly benefits from platelet gel treatment. Several recent studies demonstrated that the use of platelet

gel in **open subacromial decompression (OSD)** is very effective for regaining early shoulder function with better control of postoperative pain. The following very significant results have been described: decreased visual analog scales for pain; decreased pain-related medication; improved range of motion (forward elevation, external rotation, external rotation with arm at 90 degrees abduction, internal rotation, and cross body adduction); faster healing; earlier return to daily activities.

**Figure 9.**



Regeneration therapy with PRP or platelet gel is indicated in the conditions listed below:

**Ankle/foot**

- Chronic anterior talofibular (ATF) ligament strain
- Chronic Achilles tendinosis
- Chronic Peroneal tendon tear
- Plantar Fasciitis
- Osteochondral defect (OCD) talus

**Knee**

- Patellar tendinosis
- Meniscal tears
- Vastus lateral obliquous strain (Jumper's knee)

**Shoulders**

- Rotator cuff - partial tears
- Long head of biceps tendinosis
- Chronic glenohumeral ligament sprains

**Elbows**

- Lateral epicondylitis
- Distal biceps tendon partial tear

**Hand**

- Chronic thumb UCL sprain