Why PRF Does Not Work for Bone Regeneration

Have you ever asked yourself why orthopedic groups have no interest in researching PRF and why orthopedic surgeons do not use or put PRF in bone? With their vast knowledge and research of bone and extensive study dedicated to bone, they know this subject very well and they know that using PRF will only delay the healing process and not work for bone regeneration.

First, let's look at what biologically active molecules are found in platelet concentrated formulas. An article published in the journal *Platelets,* found the following molecules in a common platelet concentration product. No matter how you treat blood, the platelet concentration products will have the same contents but possible different proportions.

Cytokine, chemokine, and growth factor profile of platelet-rich plasma.

IL-1b, IL-1ra, IL-4, IL-6, IL-8, IL-12, IL-13, IL-17, INF-γ, TNF-α, MCP-1, MIP-1a, RANTES, bFGF, PDGF, and VEGF IL-2, IL-5, IL-7, IL-9, IL-10, IL-15 G-CSF, GM-CSF, Eotaxin, CXCL10 chemokine (IP-10), and MIP 1b

Of these molecules, 24 of them are inflammatory cytokines and three of them are growth factors. One thing that is a fact, is that inflammation stops bone formation and PRP is full of inflammatory molecules which will prevent bone from forming.

The three growth factors are:

- bFGF,
- VEGF
- PDGF

bFGF is a fibroblast growth factor. Fibroblast growth factor stimulates fibroblasts to grow into the clot and convert the clot into granulation tissue.

VEGF stimulates blood vessel formation to vascularize the clot and convert it into granulation tissue.

PDGF Platelet derived growth factor blocks stem cells from becoming bone cells and aids in the formation of fibroblasts.

All the molecules in platelet concentrated preparations are designed to quickly convert the clot into granulation tissue. Bone cells will not produce bone in the presence of inflammation. Bone cells do not enter into a clot or PRF. There are no growth factors in platelet concentrations that stimulates bone formation. The studies have shown that PRF does not aid bone growth and performs no better than no graft.

The next question to ask yourself is: if all the molecules in platelet preparations inhibit bone formation, then why have all the studies shown that PRF does not aid in bone, but why does PRF not clinically produce poorer results than no graft. For this answer, we need to look at how bone heals histologically.

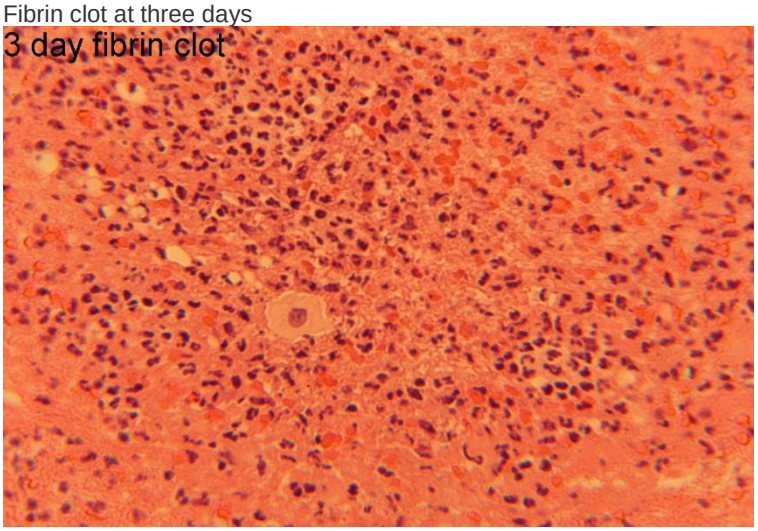
Here is a simple explanation of how bone heals so you will understand why PRF does not work.

When bone is injured, the first phase of healing is a fibrin clot. The fibrin clot is composed of fibrin, red blood cells and acute inflammatory cells. The fibrin clot is exclusively for homeostasis. There are no bone growth factors in blood or platelets because bone cells *never* encounter fibrin or a blood clot. There are growth factors in platelets and they are present to facilitate the removal of fibrin as soon as possible because after homeostasis, the presence of the fibrin clot delays the process of bone formation.

The growth factors in platelets stimulate the conversion of fibrin into healthy granulation tissue. At one week, the fibrin clot is being converted into healthy granulation tissue. The granulation tissue is composed of capillaries and white blood cell infiltrate.

The purpose of granulation tissue is to remove damaged tissue. The granulation tissue is present for a few weeks and as the damage heals, the inflammation subsides. Fibroblasts then arrive, and the granulation tissue is converted into dense collagen. Bone cells *never* enter granulation tissue. Osteoblasts hate inflammation and will not produce bone in areas of inflammation. Bone cells do not enter the defect until it is composed of collagen which happens around the fourth week. Osteoblasts are never present in fibrin and the fibrin disappears weeks before osteoblasts begin entering and mineralizing the defect.

Fibrin clot at three days



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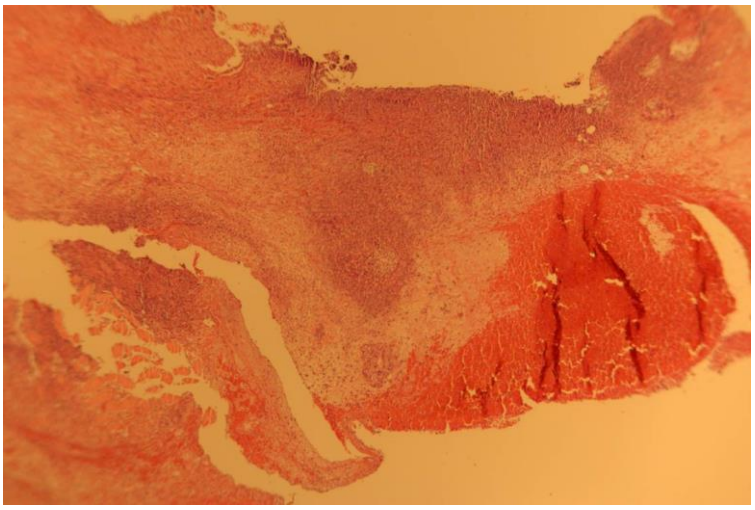
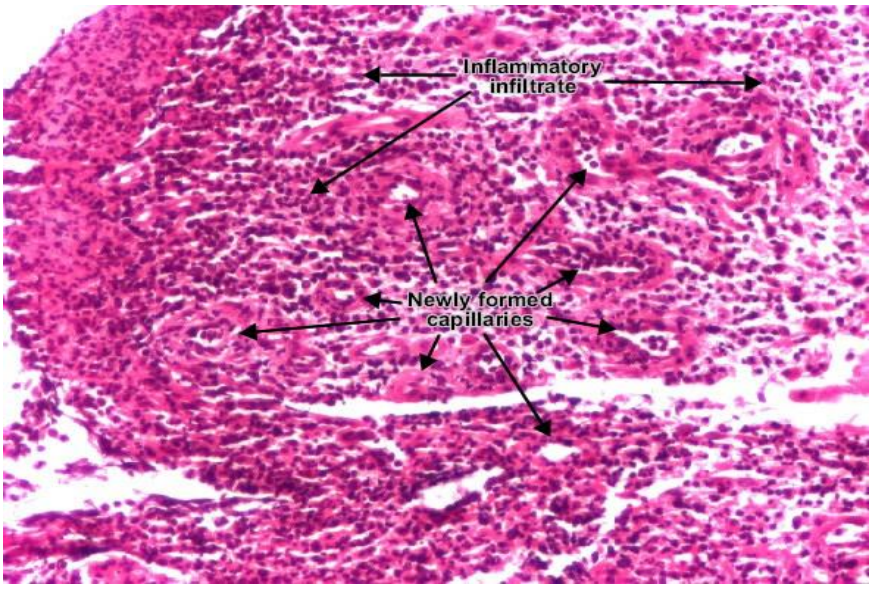


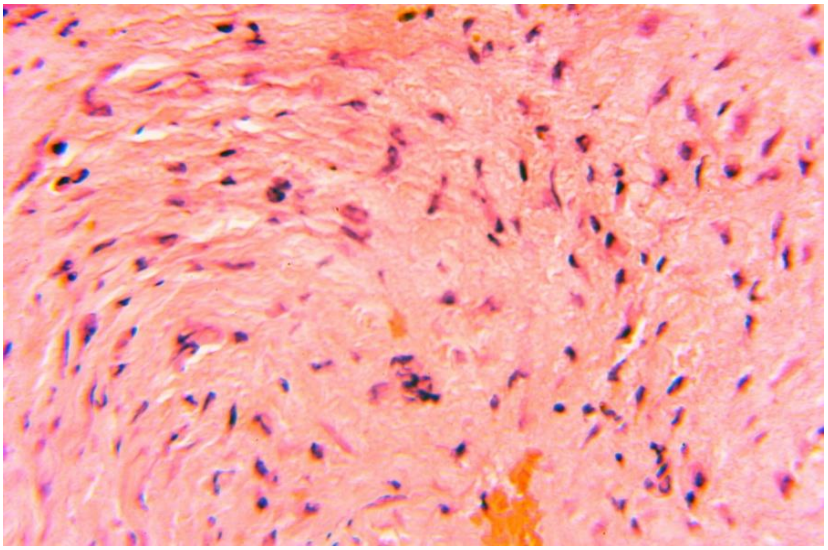
Fibrin transitioning into healthy granulation tissue at one week

The growth factors in platelet preparations stimulate the conversion of fibrin into healthy granulation tissue and no bone cells ever enter the fibrin clot.

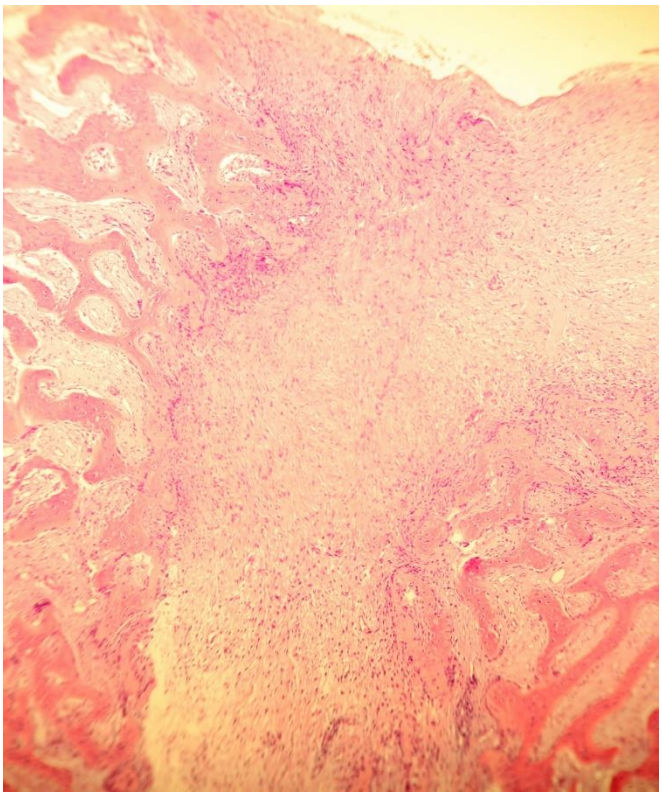


Healthy granulation tissue

The purpose of granulation tissue is to remove damaged tissue. The granulation tissue is present for a few weeks and as the damage is cleared, the inflammation subsides. Fibroblasts then arrive, and the granulation tissue is converted into dense collagen.

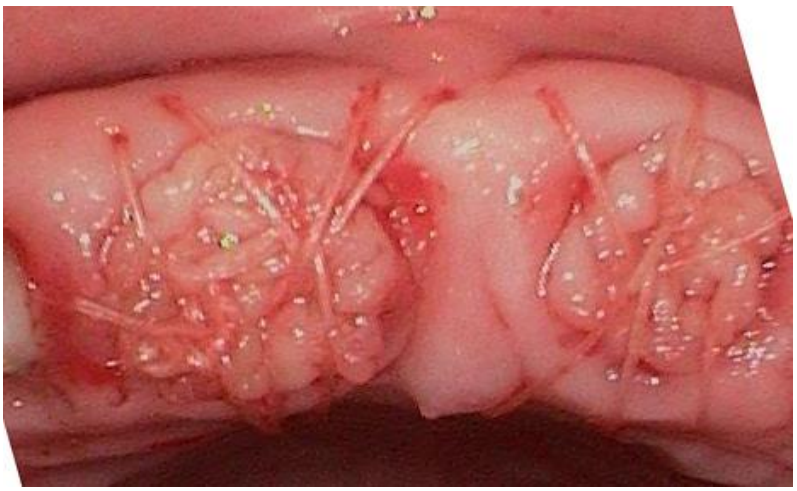


Collagen plug at 4 weeks

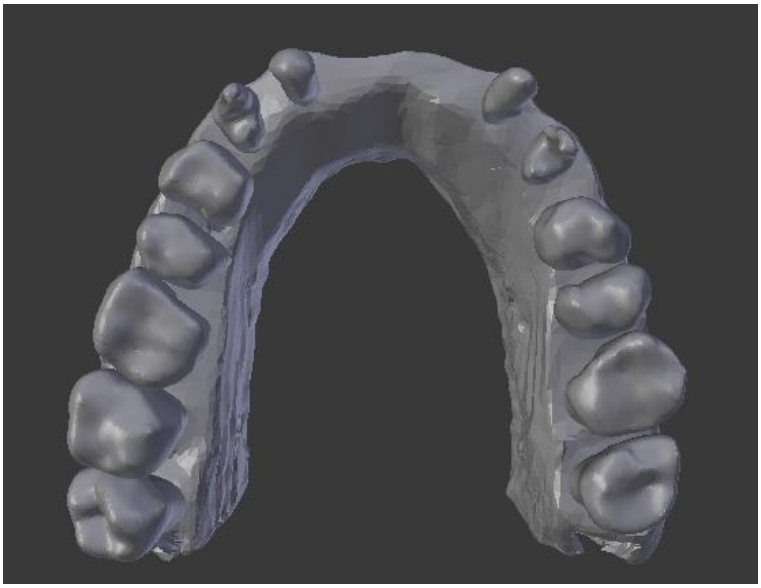


Bone replacing collagen plug at 6 weeks after extraction. Bone does not enter the defect until collagen is formed.

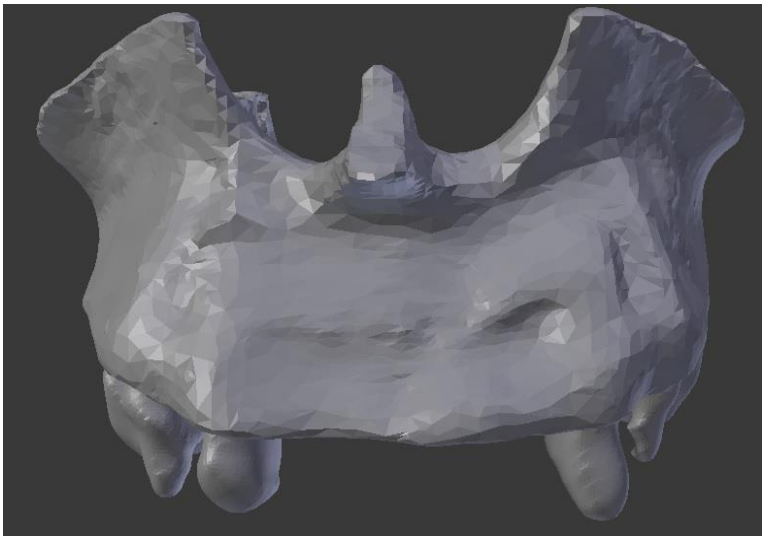
PRF Case Failure



The following patient was grafted with PRF. She started with a great ridge and thick biotype. Unfortunately, due to failure of PRF to preserve the ridge, she now needs extensive and expensive regenerative therapy.



Occlusal view, Anterior ridge collapse



With an understanding of how bone forms, it is obvious why concentrated platelet preparations provide no benefit for bone regeneration. The platelet preparations are removed long before bone cells enter the defect and the contents of the platelet preparations have no effect on bone formation. Even though the contents of platelet preparations inhibit bone formation, they have no effect on bone formation because they are removed from the site long before bone cells arrive.