

Accelerated Osteogenesis In Extraction Sockets Using A Novel Calcium Sulphate-PRF Combination: A Clinico-Histological Study

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Topic: Material research

Abstract

A pre- requisite for placement of dental implants is availability of sufficient vital bone. Literature reports vertical and horizontal ridge reduction following extraction, primarily in the initial 3 months. Post extraction socket grafting is performed to avoid future complex bone augmentations. The search for an ideal socket graft material is ongoing.

Aim:

To evaluate and compare (clinically, radiographically and histologically) the quantity of newly formed bone in naturally healing human extraction sockets to sockets grafted with a combination of Medical-Grade Calcium Sulphate Hemihydrate (MGCSH) and Platelet Rich Fibrin(PRF).

Methods:

Five patients (both male and females) in the age group of 20-45, who require to undergo multiple extractions in the mandible were selected based on strict inclusion and exclusion criteria. For each patient, one socket received a combination of MGCSH and PRF combination. The other socket was left to heal naturally. Radiographic analysis of the extraction sites were performed pre and post extraction and after 8 weeks, using a standardized radiographic technique. Bone cores were trephined out of the socket after 8-10 weeks. They were decalcified and the amount of new osteoid deposition and trabaculæ formation was evaluated under an Image analyser for determining percentage of vital bone formation.

Results:

36% new bone formation (mostly lamellar) was seen in the grafted sites and 22% in the control sites. Comparisons between the test and control group was performed using un-paired student-t test.

Conclusions and Clinical Implications:

A combination of Calcium Sulphate and PRF is highly osteogenic resulting in faster bone formation in extraction sockets. This can be used as a simple, inexpensive, uncomplicated yet effective socket graft material. Its use can yield tooth extraction healing sites ready to receive dental implants at an earlier stage than conventionally healing sockets.

Background and Aim

Background :

Tooth extraction is usually followed by partial resorption of the residual alveolar ridge. Literature has reported approximately 0.34-7.77mm of horizontal ridge reduction and 0.2-3.25mm of vertical ridge reduction in the 6-12 months following extraction, primarily in the initial 3 months. Thus, it seems prudent to prevent alveolar ridge destruction and make efforts to preserve it during extraction procedures.

A wide variety of grafting materials (autogenous grafts, xenografts, allografts, alloplasts) have been proposed for bone regeneration in an attempt to improve areas for future implant placements. However it is not clear which is the material of choice.

Platelet Rich Fibrin (PRF) is a second generation platelet concentrate. The composition and quantities of growth factors are very stable in the PRF clot due to mechanical process of polymerization during centrifugation. PRF releases slowly high amounts of growth factors such as TGFB-1, PDGF-AB, Vascular endothelial growth factor (VEGF), IGF-1, EGF and HGF and other glycoprotein's (such as Thrombospondin-1) for at least 7 days. These factors play a fundamental role in revascularization and bone regeneration by inducing proliferative effect on the endothelial cells and on osteoprogenitor cells.

Calcium Sulphate is a biocompatible, easily available material reported to be osteogenic in presence of periosteum and/or bone. It resorbs completely, rapidly leaving behind a calcium phosphate based osteoconductive scaffold that guides bone regeneration. Combining it with Calcium Sulphate could result in activation of platelets and delivery of calcium, growth factors over time, sustaining nourishment of the bone defect. Although Calcium Sulphate and PRF have been successfully individually used, no human clinical study using their combination in extraction sockets has been reported.

Aim:

To evaluate and compare the quantity of newly formed bone in naturally healing human extraction sockets to sockets grafted with a combination of Medical-Grade Calcium Sulphate Hemihydrate (MGCSH) and Platelet Rich Fibrin (PRF).

Methods and Materials

Research Design:

This study was a randomized, double-blind, controlled clinical and histological study with a 6 week follow up. Approval was taken from the institutional Ethics Committee.

A split mouth study was carried out wherein patients requiring bilateral extractions were chosen and 1 extraction socket was grafted with the other serving as a control.

Inclusion Criteria:

Patients undergoing extractions for root or crown fractures, non restorable caries and residual roots without any periapical or periodontal pathology.
Patients fulfilling routine surgical protocol for placement of implants.
Patients willing to participate in the study.

Exclusion Criteria:

Patients unwilling to undergo procedures for bone augmentation.
Patient with medical conditions like diabetes, hypertension and those taking medications which are associated with compromised bone healing response (eg: Prolonged Cortisone Therapy)
People who smoke.
Teeth with ongoing pathosis. i.e periodontal or periapical abscess or with traumatic process with damaged one or more bony socket walls.

Clinical procedure:

1 maxillary premolar was extracted bilaterally.

One socket was randomly selected and left to heal naturally.

The other socket was grafted with a Calcium Sulphate (Dentogen – Orthogen Corp,USA) and PRF mix. This mix was covered with a single layer collagen dressing (Collatape – Zimmer Dental, USA). A silk suture was placed to hold the socket graft in place.

After 6 weeks a tissue – core was taken from the extraction site.

Samples were then fixed and routinely processed and embedded in paraffin.

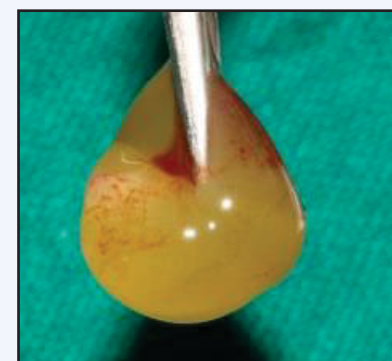
The specimens were then sectioned to obtain 4 m thick sections which were stained with hematoxylin and eosin. Histo-morphometric measurements were performed on 4-6 fields from each section and its percentage area occupied by lamellar bone was evaluated. The lamellar bone with abundant osteoblasts and regular osteocytes was considered mature bone, whereas woven bone with irregular large osteocytes were considered as immature bone.



Pre-Treatment



Extraction done (Tooth 14)



Platelet Rich Fibrin plug



Calcium Sulphate mix



Socket grafted with CS-PRF mix



Socket graft covered with a collagen dressing



Sutures placed

Results

Fig 1

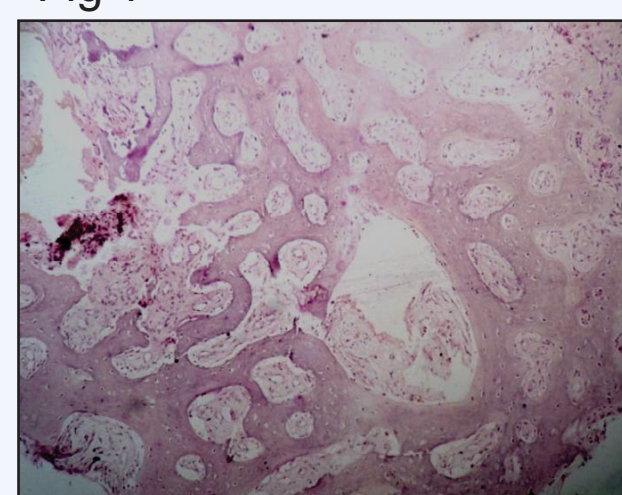


Fig 2

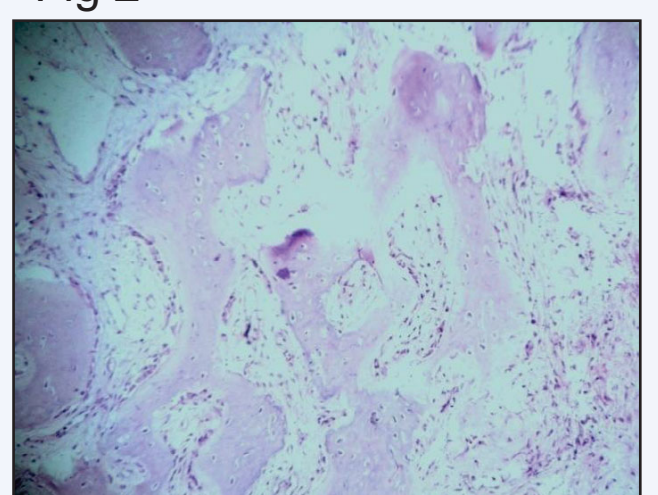
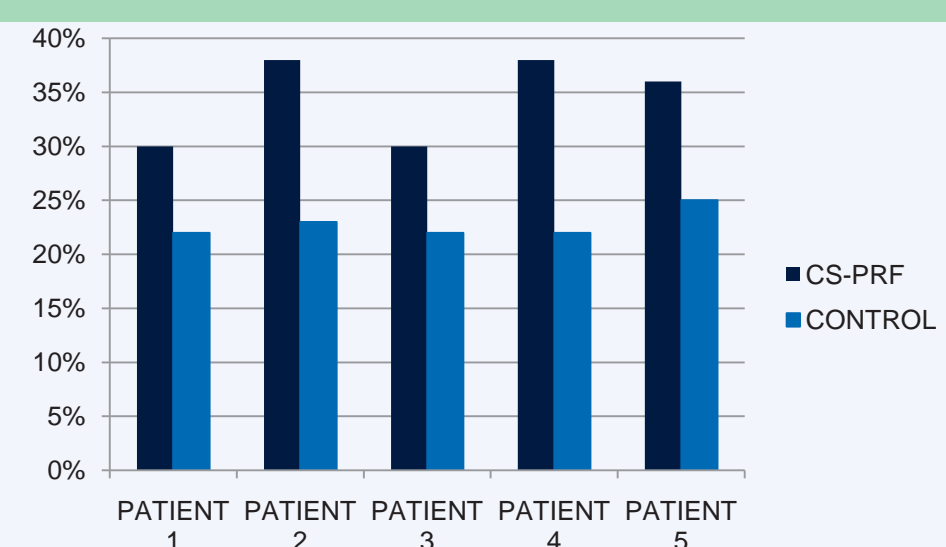


Fig 1 (CS-PRF) shows lamellar mature bone filling the socket, which has regular osteocytes, with angiogenesis and mature collagen stroma indicating bone fill in the CS-PRF socket. There is absence of any inflammatory response.
Fig 2 (CONTROL) shows more connective tissue stroma with lamellar and woven bone. Woven bone presents with large osteocytic spaces and loose connective tissue. This was depicted in the control site.



Conclusions

A combination of Calcium Sulphate and PRF is highly osteogenic resulting in faster bone formation in extraction sockets.

This can be used as a simple, inexpensive, uncomplicated yet effective socket graft material.

Its use can yield tooth extraction healing sites ready to receive dental implants at an earlier stage than conventionally healing sockets.

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