Calcium Sulfate Barriers

A Literary and Anecdotal Overview

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History and Chemistry

- Calcium sulfate hemi-hydrate (plaster of Paris) was discovered in 1798
- A large gypsum deposit at Montmartre in Paris led gypsum plaster to be commonly called plaster of Paris
- Gypsum + heat = plaster of Paris
- A long history of use in medicine and dentistry, over 110 years
- Two forms exist alpha and beta. Alpha hemi-hydrate crystals are larger and more prismatic in structure and therefore structurally stronger when set

Biocompatibility

- Upon implantation into the body, calcium sulfate dissolves into calcium and sulfate ions and the calcium ions combine with phosphate ions from the body fluids to form calcium phosphate. This forms an osteoconductive lattice of biologic apatite that stimulates bone growth into the defect. As the calcium sulfate undergoes degradation in the osseous defect, a local decrease in pH occurs which results in the demineralization of the defect walls producing a release of growth factors that enhances bone regeneration.
- Calcium sulfate stimulates angiogenesis.
- It has often been shown that tissue will often migrate over calcium sulfate if primary closure cannot be obtained.

Clinical uses

- Calcium sulfate can be used as a carrier for antibiotics, as a binder for other graft materials, as a stand alone graft material, or as a barrier over graft materials.
- It is the simplest synthetic bone graft material with the longest history of safe use in medicine and dentistry
- It was first used to obliterate bone cavities caused by tuberculosis

Biocompatible, but???

- Plaster of Paris has great finishing properties but very poor structural strength.
- Several different additives and compositions have been derived in order to make up for its shortcomings

Materials Used in Study Club

- Cal Forma: calcium sulfate alpha hemi-hydrate with hydroxypropylmethylcellulose which acts as a thickening agent and stabilizer
- Cal Matrix: calcium sulfate alpha hemi-hydrate with carboxymethylcellulose which maintains shape and functionality
- Originally marketed by Lifecore Biomedical
- Lifecore's dental products were assumed by Keystone Dental
- Cal Forma and Cal Matrix were discontinued by Keystone over three years ago
- Cal Forma set rapidly and was difficult to handle
- Lifecore used to sell Capset , calcium sulfate hemi-hydrate, which has also been discontinued

Another we've tried

- Bond Bone sold by MIS
- $180.00 for three 0.5 cc applicators
- A combination of calcium sulfate hemi-hydrate and calcium sulfate di-hydrate in a unique particle size distribution
- Sets in 3-5 minutes in the presence of blood and saliva

Study Club Case Using Cal Forma and Cal Matrix

- Go to Rob Hardwick March 2006

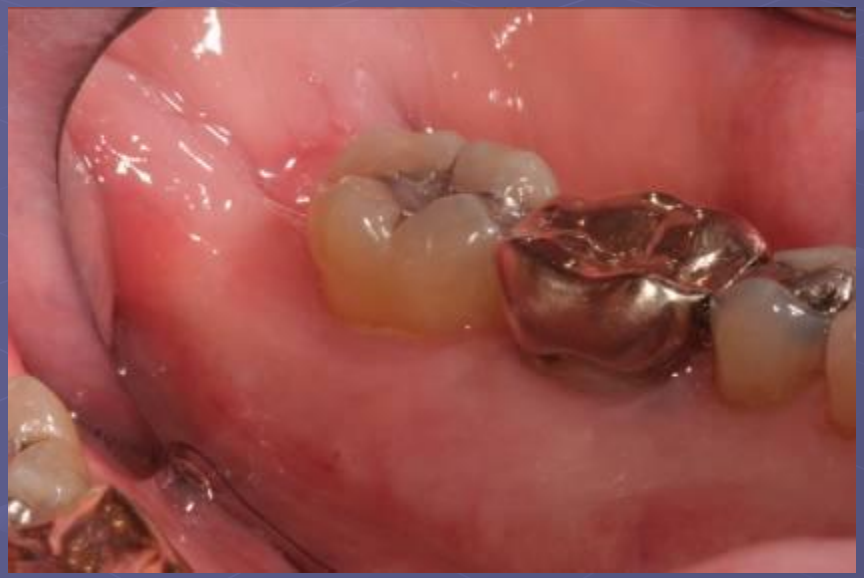
Follow up implant placement November 2006

Bond Bone as a barrier over Puros particulate

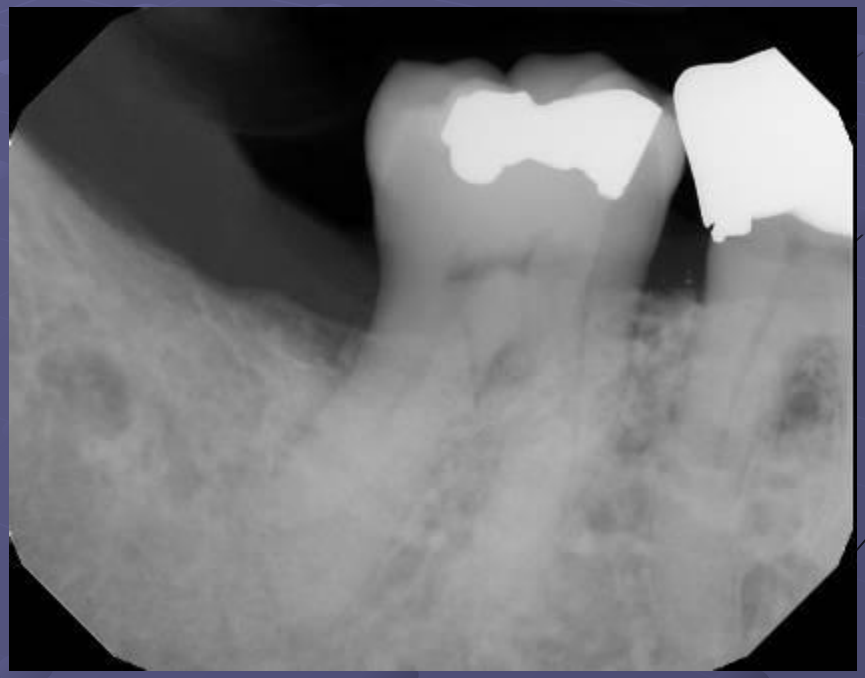
Two week follow up and suture removal

One month follow up

Three month follow up



Pre surgery and 3 month post surgery radiographs



Clinical Studies

- J Periodontal Implant Sci. 2012 December; 42(6): 237–242.
- Published online 2012 December 31. doi: 10.5051/jpis.2012.42.6.237
- PMCID: PMC3543940
- **Evaluation of calcium sulphate barrier to collagen membrane in intrabony defects**
- Shilpa BudhirajaShilpa Budhiraja,1 Neeta BhavsarShilpa Budhiraja,1 Neeta Bhavsar,2 Santosh KumarShilpa Budhiraja,1 Neeta Bhavsar,2 Santosh Kumar, 1 Khushboo DesaiShilpa Budhiraja,1 Neeta Bhavsar,2

- Twelve patients having chronic periodontal disease aged 20 to 50 years and with a probing depth >6 mm were selected. Classification of patient defects into experimental and control groups was made randomly. In the test group, a calcium sulphate barrier membrane, Dento Gen, and in control group, a collagen membrane, was used in conjunction with decalcified freeze-dried bone graft in both sides of the split mouth study.

Results

- The calcium sulfate barrier was comparable to the collagen membrane in achieving clinical benefits. It provides an economical alternative to collagen membranes

Material Used

- DentoGen, calcium sulfate hemihydrate
- Distributed by Orthogen
- Around $40 for a single use
- Comes with 0.5 g of calcium sulfate hemihydrate and regular ,12-15 minute set time, and fast set, 2-4 minute set time liquid
- Salvin makes the same product and calls it Graft Set. Similar price

Calcium sulfate as a barrier over a composite graft

- 100 patients with non-furcation osseous defects
- Defects were grafted with a composite graft of DFDBA, calcium sulfate, tetracycline, and porous hydroxyapatite
- Covered with a barrier of calcium sulfate
- Clinical results showed that recession increased from 0.8 mm to 1.8 mm, the mean probing depth decreased from 8.5 mm to 3.8 mm, and the attachment level improved from 9.3 mm to 5.5 mm
- J. Periodontology 2004 May, 75 (5) 885-92

Bond Bone study

- 40 patients who had a total of 60 teeth extracted
- Bond Bone was used alone as the graft material
- If a dehiscence was present, a resorbable collagen barrier, Cytoplast RTM was placed
- In sites with a large amount of exposure they used a Cytoplast TXT (PTFE) membrane
- In most cases primary closure was not obtained
- “Enhancing Extraction Socket Therapy with Biphasic Calcium Sulfate” R. Horowitz, et al Compendium June 2012, Vol 33, Issue 6

Results

- They found that Bond Bone fully resorbs and is replaced by vital bone in four months time
- Clinically the sockets maintained volume and had similar bone density when drilled for the placement of implants
- The had 100% success rate in implant placement and loading

DentoGen vs NanoGen

- Extraction site reconstruction was compared using two forms of calcium sulfate, DentoGen and nano crystalline NanoGen in immediate extraction sockets.
- Only three cases, one treated with DentoGen and two treated with NanoGen
- Full thickness flaps were elevated, the sockets were debrided then decorticated with a ½ round bur, the graft material was placed and the flaps were sutured, no barrier was used

Results

- At 4 months post grafting no difference was seen between the two materials
- Radiograhic assessment showed almost complete graft resorption and replacement with spongy bone with a density comparable to the surrounding bone.
- Histopathology assessment of the sites revealed 100% vital bone
- The calcium sulfate was found to resorb too quickly, 4-6 weeks, before bone could regenerate resulting in a decreased volume of regenerated bone compared to the graft.
- Although the NanoGen supposedly takes longer to resorb, 12 weeks, it still did not maintain volume.
- Jain A., et al Int. Journal of Oral Implantology Clinical Research 2012; 3(1): 58-61

Conclusions

- Calcium sulfate is a tried and true synthetic grafting material
- The rapid rate of resorption of the material may cause a problem because the volume of the graft may not be maintained for a sufficient time to allow for reliable bone growth
- Modifications to the formulation have been used and marketed in an attempt to improve results.
- For smaller osseous defects and socket preservation it is an effective and inexpensive material
- As a material for ridge augmentation…?

Discussion