

## Calcium Sulphate Antibiotic Carriers

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Received date: July 20, 2015, Accepted date: July 24, 2015, Published date: July 30, 2015

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**Keywords:** Antibiotic carriers; Calcium sulphate

### Editorial

Despite gradual advances in surgical techniques and antimicrobial agents, the treatment of osteomyelitis remains a challenge. Its treatment constitute extensive surgical debridement and prolonged parental antibiotic administration. However, the relapse rate remains high, the primary contributing factor is the formation of a bacterial biofilm. It is formed through the bacterial adhesion to the medical devices or fragments of dead tissue such as sequestra of dead bone. Lambe, et al. with biofilm, antibiotics have poor penetration and often require three to four folds in concentration to achieve bactericidal activities [1]. The balance of achieving a high-enough concentration of antibiotic at the site of infection while avoiding systemic toxicity can be problematic [2]. Poor perfusion in diabetic patients or devascularization of an infected bone with changes in local pH will further limit diffusion of parental antibiotics at where it is needed the most [3].

In an attempt to overcome these problems, systems of local antibiotic release have been developed as a solution to the problem. One of most commonly used delivery materials is Polymethylmethacrylate (PMMA). However, it has a number of disadvantages [4]. PMMA is not biodegradable and therefore a second operation is required for it to be removed once drug is released. As if it is left in place, it will prevent bone ingrowth [5] and become a potential space for future infection. In Nuet et al. study, 18 out of 20 retrieved implanted PMMA beads showed bacterial growth [6]. 19 out of the 28 strains of bacteria cultured were gentamicin-resistant organisms. In addition, PMMA has a poor elution profile. It initially releases a bolus of high concentrations followed by a rapid decline to sub-optimal concentrations [7,8].

The ideal bone graft substitute should be osteoinductive, osteoconductive, bioresorbable and providing structural support. Biodegradable and absorbable carriers such as polylactic acid, polyglycolic acid, hydroxyapatite, calcium phosphate and collagen materials have been developed. Calcium sulphate has been used as a bone graft substitute since the later 1800s [9]. In 1977, a medical grade calcium sulphate impregnated with tobramycin was introduced. Synthetic calcium sulphate was first introduced in 2000 as a 100% pure, biocompatible and completely reabsorbable bone graft substitute. This avoids any complications and systemic toxicity associated with naturally occurring mineral sources of calcium sulphate [10].

The advantages over other antibiotic delivery systems include its biodegradability, its predicable elution properties, its osteoconductivity, and its ability to fill dead space. Calcium sulphate obliterates the dead space [11]. This restores morphology and prevents

soft tissue ingrowth. It stimulates new bone growth and can become incorporated when in contact with periosteum or living bone. Coetzee, recent studies have shown that osteoblasts attach to and reabsorb calcium sulphate [12]. Calcium sulphate also provides an osteoconductive environment for osteogenesis and vascular ingrowth [13].

Elution of antibiotics from calcium sulphate has been shown to be predictable. It provides high local levels of antibiotic and gradual dissolution. This high concentration of local released antibiotics works against resistant organisms. In vitro testing, elution has been shown to last up to 28 days. And at 14 days, elution concentrations of antibiotic are 200 times greater than the minimal inhibitory concentration for specific bacteria [10]. It is ideal in situations when blood supply is compromised such as in diabetic patients.

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