

# || SEMS: RESEARCH PROJECT DESCRIPTION

## 1. Project Background and Description

### **Bioactive composites for vertebroplasty**

Osteoporosis affects 1 in 3 women and 1 in 9 men over the age of 50. Osteoporosis is loss of cancellous (spongy) bone leading to fracture of the femoral neck or compression of vertebral bodies. The second results in a significant stoop for the patient with substantial pain and potential long term damage to the spinal cord.

The current treatment is balloon kyphoplasty, that is opening into the damaged vertebral body inserting a “balloon”, which is expanded to open up the vertebra and restore its height and to retain that height inject a non degradable material such as polymethylmethacrylate (PMMA). However, PMMA is bioinert therefore does not generate new bone formation. Currently, the bone cement used in kyphoplasty is merely joint replacement bone cement with additional bioinert barium sulphate or zirconium oxide opacifier material to increase the radiographic density so that it can easily be seen on X-rays during surgery, however adding opacifier decreases strength and fatigue resistance.

The plan is to optimise a composite based on PMMA, which has been used clinically since the 1950s, and Professor Hill’s bioactive glass. This project will use plain PMMA and instead of adding bioinert opacifier would add one of Professor Hill’s bioglasses at appropriate particle size and shape. Thus the only addition will be bioactive and the properties can be optimised by amount and morphology of the filler particles. The primary requirements are injection viscosity for surgical application, radiographic density and mechanical properties in terms of both compressive strength and fatigue behaviour. Additional considerations will be the bioactivity of the composite material encouraging new bone formation, counteracting the usual continued loss of bone and the potential addition of antibiotics.

## 2. Project Scope

Project objectives:

- Production and optimisation of composites
- Mechanical testing and viscosity measurement
- Assessment of bioactivity in vitro

## 3. Desired Skills from the Student

Key skills needed for the PhD project

This project needs strong materials and mechanical knowledge with interests in composites and in biomedical applications. During this degree the candidate will develop interdisciplinary skills and consideration of the commercialisation of the material developed in the biomedical field.

#### 4. Supervisory Team

Primary: Professor Tanner OBE FEng FRSE PhD(Hon Caus) Bonfield Professor of Biomedical Materials

Secondary: Professor Robert Hill of Physical Sciences in Relation to Dentistry in the School of Medicine and Dentistry