Mechanical Properties of a Fiber Loaded Calcium Phosphate Cement *In Vitro*

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Statement of Purpose: Calcium phosphate cements (CPC) are used in fill bone voids and defects in the body. These biomaterials are quite brittle, so 82/18 poly (L-lactide co-glycolide) polymer fibers were blended into the CPC powder to increase the toughness of the biomaterial. This study evaluated the degradation of mechanical properties of a fiber loaded calcium phosphate cement (FCPC) *in vitro* and compare it to a similar calcium phosphate cement (CPC). Also in this study, the relationship between polymer molecular weight and FCPC toughness was defined.

Methods: Three point bend and compression samples of FCPC and CPC were prepared. The samples were placed in 250ml glass bottles and submerged in phosphate buffered saline (Sigma P/N 3813). These bottles were kept in a constant temperature water bath at 37°C. Each month, samples were removed for testing. Fiber molecular weight was determined through the degradation by using gel permeation chromatography (GPC).

Results / Discussion: The work of fracture results from the *in vitro* soaking are shown graphically in Figure 1. FCPC had an initial work of fracture of 435J/m^2 and CPC was initially 9J/m^2. The work of fracture of FCPC decreased each month during the soaking period, as seen in Figure 1. CPC had a similar work of fracture throughout the six months. After six months of soaking, the work of fracture of the FCPC decreased by 98%, to a value similar to the CPC, ~9J/m^2.

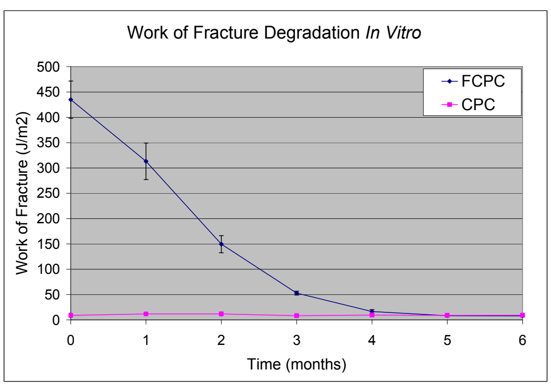
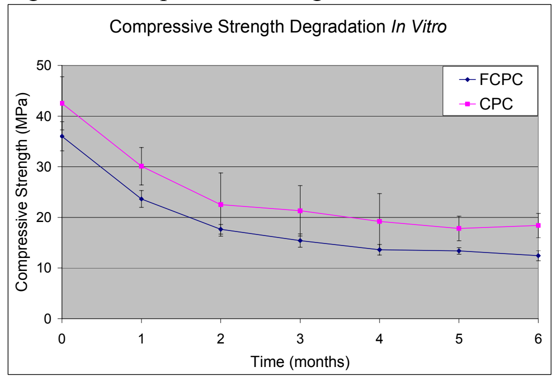


Figure 1: Work of Fracture Results of FCPC and CPC

The compression test results are shown graphically in Figure 2. FCPC had an average compressive strength of 36MPa at time zero and CPC was 43MPa at time zero. The compressive strength for both FCPC and CPC follow a similar decreasing trend. Both materials lost approximately 60% of their compressive strength after six months of *in vitro* soaking; FCPC was 12MPa and CPC 18MPa.

Figure 2: Compressive Strength of FCPC and CPC



The molecular weight results are shown in Figure 3. Initially, the 82/18 poly (L-lactide co-glycolide) fiber had a molecular weight of 89,160g/mol. As expected, the polymer fiber degraded over the soaking time. After 6 months the fibers were still present in the material, but they lost 87% from the initial molecular weight.

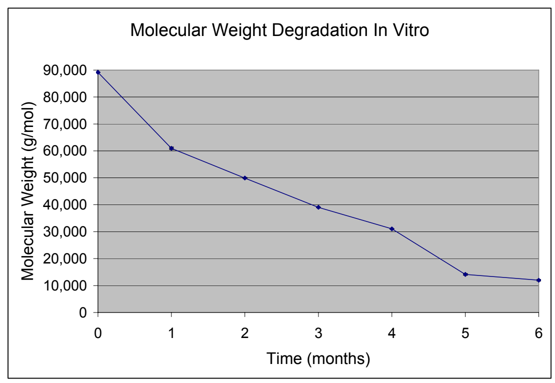


Figure 3: Molecular Weight of 82/18 PLLGA fiber

Conclusions: This study confirms that FCPC has increased toughness over CPC for several months. The relationship between work of fracture and fiber molecular weight was determined to be directly proportional. As the work of fracture decreased, the molecular weight also decreased. The initial molecular weight is 90,000 g/mol and decreases to 12,000 g/mol after 6 months of *in vitro* soaking due to hydrolysis. FCPC is initially an order of magnitude tougher than CPC and continues to be tougher than CPC for 4 months. This study also showed that although CPC has a greater initial compressive strength, the two materials decrease equally over the course of 6 months.

Future Studies: The study will be repeated using simulated body fluid instead of PBS. The next study will also include a more viscous putty version of both FCPC and CPC.