Biodegradable, Injectable, Micro-Phase Separated Polyurethane Foams

*Albert W. Hinman, Jonathan M. Page, and Scott A. Guelcher*

**Introduction**
Injectable, polyurethane foams are a promising candidate in soft tissue regenerative medicine to replace skin graft therapy: alleviating the expensive costs and invasive procedures that skin grafts employ. Two novel, liquid isocyanates were tested in various foam formulations for this purpose. The isocyanates, PLD (para-amino benzoic acid-lactide-diethylene glycol) and PGD (para-amino benzoic acid-glycolide-diethylene glycol), are synthesized from non-toxic precursors and should degrade hydrolytically. Degradable polyurethanes typically need chemical cross linking in order to maintain structural integrity. PGD polyurethane foams were found to form physical cross links via hydrogen bonded hard segments. There is also evidence of micro-phase separation of the hard segment. PGD formulations are one of the first fully biodegradable, injectable, micro-phase separated polyurethane foam.

**Objective**

To synthesize, characterize, and optimize an injectable polyurethane foam formulation for the use of soft tissue repair application.

**Methods**

**Foam Synthesis**

- Foams were crystallized through hard mixing: under water (hard segment blowing agent), disocyanate (hard segment: polyd, soft segment: polyol without a polymeric diisocyanate filter hard (polyurea foamer), napha red (calibrator), and blowing agent (tetrahydrofuran, TEVA)

**Mechanical Analysis**

- Thermal analysis was performed using a TA Q800 for static segment, and a TA Q800 dynamical mechanical analyzer on a TA Q800 for static segment.

**Results**

**Conclusions & Future Work**

PGD and PLD are both able to produce a stable foam with >80% porosity. PGD foams were found to have more stable mechanical and degradation properties. Thermal analysis, ATR-FTIR and WAXD illustrated that these properties were caused by micro-phase separation of the hard segment. It was also shown that the micro-phase separation can be enhanced by increasing the hard segment or using a polyester soft segment. For future works, in vitro cytotoxicity and in vivo testing can elucidate the biostability of the foam.

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