In Vitro Properties of Lactide-rich PLGA Multifilament Braids

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Statement of Purpose: Poly(lactide-co-glycolide) (PLGA) copolymers have been used extensively in biomaterial applications. Since the 1980s, glycolide-rich PLGA copolymers have been utilized as multifilament sutures [1] while poly(L-lactide) has been used in various molded orthopaedic implants [2]. Deliberate control over *in vitro* performance properties (specifically strength and mass loss) can be achieved by manipulating the copolymer ratio of glycolide to lactide. Here we investigate *in vitro* properties of 2 commercial (CB) and 4 experimental multifilament braids (EB) composed of PLGA. More specifically, we focused on lactide-rich PLGA compositions as these materials have the potential to better address clinical situations where longer duration wound support may be desirable. Examples of these situations may include: Bone to bone healing, reattachment of soft tissue to bone, slower healing as in diabetic patients, etc. While the comparative data presented here was derived based on a braided suture substrate, the effect of composition within the ranges experimented would be expected to broadly translate to other implants which could be crafted from PLGA.

Methods: PLGA resins (having glycolide/lactide ratios of 18/82, 15/85, 10/90, and 5/95) were melt spun into multifilament yarns, drawn offline in a non-contact horizontal oven, braided on 16 carrier Rateras™, post-treated to remove residual monomer, and termed EB 18/82, EB 15/85, EB 10/90, and EB 5/95 respectively. These experimental braids were subjected to water wash and drying steps before and after post-treatment to ensure monomer and spin finish removal. The experimental and finished commercial PLGA multifilament braids having glycolide/lactide ratios of 5/95 and 93/7 (hereon referred to as CB 5/95 and CB 93/7) were immersed in Sorenson's buffer solution (pH = 7.27) at 37°C. Straight pull and simple knot pull tensile tests (n=10) were conducted on the braids prior to immersion (T0) and at specific intervals over the immersion time. In addition, gravimetric mass loss, DSC, GPC, and ^{1}H-NMR analyses were performed on dried samples of each braids to further characterize the role that copolymer composition played in the *in vitro* degradation.

Results: Complete strength loss of the glycolide-rich CB 93/7 occurred within 4 weeks of *in vitro* immersion. While testing of all samples is not yet complete for all compositions, results to-date indicate the highest lactide composition braids have the longest *in vitro* strength retention (Figure 1). Note, each of these straight pull *in vitro* strength retention profiles were normalized based upon their initial (T0) strength. As expected, the relative hydrophobicity of lactide (with respect to glycolide) results in extended *in vitro* longevity. CB 5/95 retained 68% of its initial tensile strength after 1 year *in vitro* immersion. Differences in strength retention between EB 5/95 and CB 5/95 are likely the result of slight differences in processing conditions. The immersion time for roughly 50% strength loss (identified here as one indicator of wound support duration) with EB 18/82, EB 15/85, and EB 10/90 were between 20-28 weeks. ^{1}H-NMR results (Figure 2) indicated that early hydrolysis led to a decrease in the glycolide / lactide ratio for these intermediate glycolide / lactide ratio copolymers. As CB 93/7 was not tested by ^{1}H-NMR for any time intervals beyond complete straight pull strength loss, it is not known whether this decrease in glycolide / lactide ratio would be discernable. Key observations from other characterization data not presented, include the follow: (1) For all compositions tested, measurable mass loss occurred only after the majority of strength was lost, (2) Mw was highly correlated with straight pull *in vitro* strength, and (3) crystallization behavior [via DSC] varied and was dependent upon glycolide / lactide ratio.

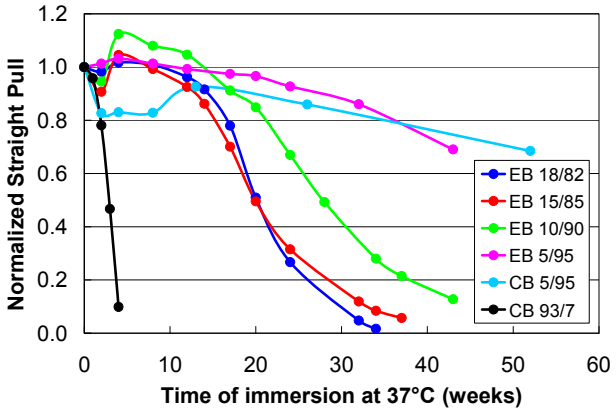

Figure 1. Normalized straight pull over *in vitro* immersion time

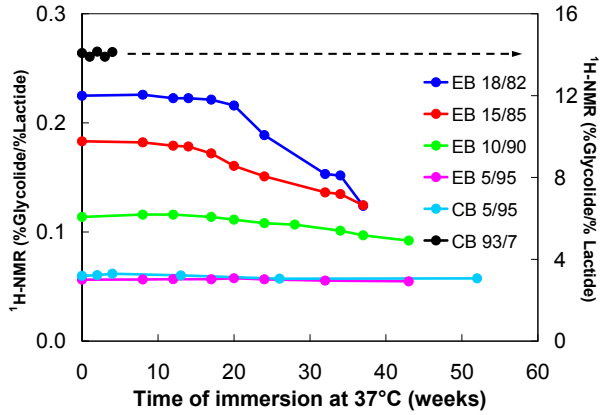

Figure 2. Change in braid composition over *in vitro* immersion time

Conclusions: These preliminary results confirm the expected *in vitro* longevity of the PLGA copolymers. These results also suggest that these copolymers offer a range of intermediate *in vitro* absorption times that may be desired in many clinical applications were extended wound support is required.

References: [1] Roby MS. Sutures/Biomaterials Science. [2] Middleton JC. Biomaterials 2000; 21:2335-2346.