A Preliminary Study of a Partially Resorbable Mesh During *in vitro* Degradation

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INTRODUCTION

Lightweight meshes lead to a reduced foreign-body reaction in surgery compared to heavyweight and/or multifilament meshes [1, 2]. However, there may be a need for a stronger mesh before tissue healing occurs. To improve the initial mechanical property and the handling characteristics of these lightweight meshes, biodegradable fibers are introduced into nondegradable polypropylene (PP) meshes. These resorbable elements function as reinforcements to a PP mesh during implantation but degrade slowly once implanted, leaving the nondegradable mesh permanently in the body. Given that the resorbable fibers function in a mechanical capacity and undergo continual degradation once implanted, one could expect such meshes to exhibit a dynamic profile of mechanical properties during degradation. To characterize this profile, an *in vitro* degradation study was conducted.

MATERIALS AND METHODS

The experimental meshes consist of monofilaments knitted in a distinct pattern with pore sizes measuring ~3 mm along the major axis and ~1 mm in the minor axis. The backbone of PP fibers is reinforced with resorbable fibers both in machine and cross directions. The resorbable fibers are made of a copolymer of glycolide and ε-caprolactone and make up ~50% of the total mesh weight. *In vitro* degradation was preformed by submersing mesh samples in a buffer solution of pH 7.3 and 37°C. The mesh samples were subjected to tensile testing and Mullen burst testing. For tensile testing, samples were prepared as 1×6 inch strips and tested using an Instron 5500 unit with a 100-lb load cell, 3-inch gauge length and 12-in/min crosshead speed. By treating the mesh samples as a continuum, the Young's modulus was obtained by performing a regression on the quasi-linear region of the force-displacement curve. For burst pressure testing, the mesh samples were prepared as 3×3 inch sheets and analyzed using a Mullen burst tester. Four samples were removed every week and subjected to testing and results were averaged together within each time period. Additionally, optical microscopy (Nikon SMZ 1500) was used to monitor visual signs of degradation within the mesh samples.

RESULTS AND DISCUSSIONS

Figures 1, 2, and 3 exhibit the measured mechanical properties of the mesh samples as *in vitro* degradation progressed, and Fig 4 displays optical microscopy images from key points in the degradation process. It is clear from these figures that the reinforcing effects of degradable components in the mesh sample were gone in ~3 weeks. However, optical microscope did not show visible material loss in the resorbable fibers until 5 weeks *in vitro*. All three mechanical quantities measured decreased from their initial values to a relatively stable value in roughly three weeks. The resorbable fibers in the mesh end their contribution to the tensile strength after two weeks and their contribution to the burst strength by three weeks during in vitro degradation although they remain present in the mesh for much longer (see Fig 4). A further study is planned to compare the in vitro and in vivo results.

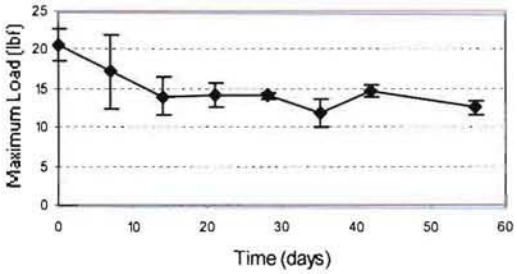

Figure 1. Change in maximum tensile strength with respect to *in vitro* time.

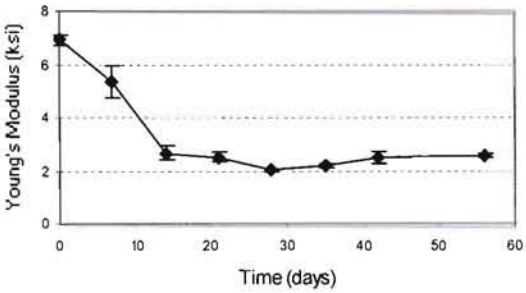

Figure 2. Change in Young's Modulus with respect to *in vitro* time.

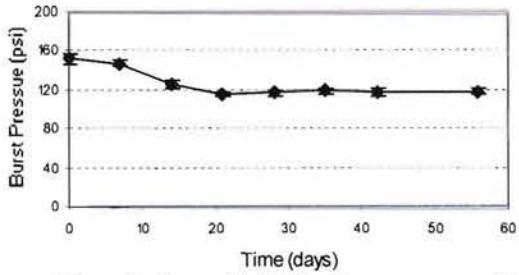

Figure 3. Change in Mullen Burst pressure with respect to *in vitro* time.

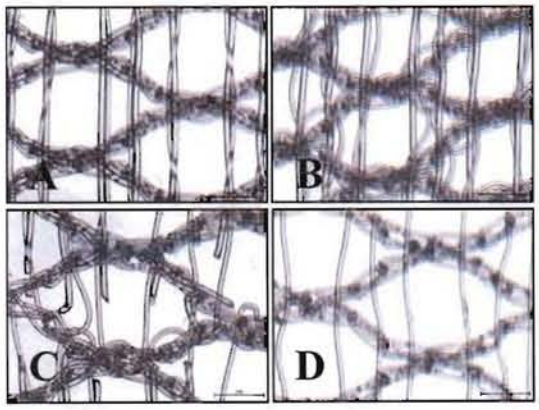

Figure 4. Optical microscopy images of mesh samples at 3x (original magnification). (A) Control. (B) 3 weeks degradation, noticeable loss of tension in fibers. (C) 5 weeks degradation, first signs of damage in resorbable fibers. (D) 8 weeks degradation, little or no evidence of resorbable fibers remains.

SUMMARY

Partially resorbable meshes are designed to exhibit two distinct mechanical behaviors: an initial set of properties that cater to a surgeon's needs during the course of healing, and a final set of properties optimum for tissue remodeling and healing. This study has confirmed that these two distinct behaviors exist.

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REFERENCES

1. Bellon J et al. J. Am Surgery 194 (2007)
2. Schug-Pab C et al. Surg Endosc 22 (2008)