In Vitro Degradation Property of Two Fully-Absorbable Poly(lactide-co-glycolide) Meshes

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INTRODUCTION

Meshes are a unique group of medical devices that find use in various surgical procedures. Absorbable meshes are designed for a temporary tissue support and eventually, absorbed by body. Therefore, it is important to understand their degradation behaviors *in vitro* and *in vivo*. Evaluating such properties helps to design products that meet customer expectations. This study investigated the *in vitro* degradation behaviors of two poly(glycolide-co-L-lactide)-based mesh materials. Effects of *in vitro* environment on mesh mechanical properties, molecular weight, and morphology change were determined.

MATERIALS AND METHODS

Two experimentally knitted mesh materials were constructed by using multifilament yarns that were made from a partially-crystalline copolymer of ~90mol% glycolide and ~10mol% L-lactide, all produced in-house (ETHICON, USA). The meshes were not surface-coated, nor were they sterilized. Table 1 lists the mesh properties before *in vitro* degradation. These properties were defined as the baseline properties of the meshes at degradation time 0. For the purpose of this study, meshes were cut into specimens of 100mm by 12.5mm strips for tensile testing and 25mm by 25mm for burst testing. Then they were placed into phosphate buffer solution (PBS) of pH7.3 at 37°C. The pH values were closely monitored during *in vitro* conditioning and the PBS was changed at least once a week to maintain pH level. At each pre-determined time period, 8 specimens were removed from the *in vitro* bath and tested immediately at room temperature for tensile or ball burst strength using Instron mechanical tester. Ball burst test was a modified ASTM D6797-07 test method using these parameters: test area diameter 12.5mm, probe diameter 6.3mm, load cell 500N and crosshead speed 25mm/min. Tensile test was a modified ASTM D5035-11 test method with the testing conditions: gauge length 50mm, load cell 500N and crosshead speed 150mm/min. The morphology of the *in vitro* degraded samples was evaluated by a Nikon image system (SMZ1500 optical microscope (OM), DXM1200C digital camera and NIS-Element imaging software), and the Scanning Electron Microscopy (SEM) using a JEOL JSM-5900LV scanning electron microscope at 5-8KV after gold-sputtering the samples.

RESULTS AND DISCUSSION

Fig 1 illustrates two mesh samples used in this study, which shows Mesh 2 having much larger pores in comparison to Mesh 1. Table 1 provides a list of the initial properties of the meshes (time 0). This table indicates that Mesh 1 had higher tensile and burst strengths than Mesh 2. Fig 2 shows that the percent tensile and burst strength retention (BSR) had similar trends for both meshes as the *in vitro* degradation progressed. The tensile BSR curve had slightly higher values than burst BSR curve. At 2 weeks the meshes retained at least 50% BSR. By 4 weeks the meshes had essentially no strength left. The right plot in Fig 2 displays the change of weight average molecular weight (M_w) with *in vitro* time, which is in agreement with strength retention profile. Figs 3 and 4 show change of mesh morphology, as examined by OM and SEM. These samples had been slowly dried after removal from the *in vitro* bath at each degradation time period. These pictures indicate that although the mesh mechanical strengths had degraded dramatically over time, the mesh still kept its structure integrity; however, slight changes in the filament bundles were observed.

SUMMARY

The *in vivo* degradation behaviors of two absorbable meshes were investigated. The results show that the tensile and burst strengths and the molecular weight of the meshes decreased significantly over time. Polymer mesh morphology changed slightly during degradation. The mesh knitting structures may not affect the material percent strength degradation profile.

Table 1. Initial Mesh Properties (tensile strength is in machine direction)

Mesh	Density (g/m^2)	Tension Strength (N)	Burst Strength (N)	MW (g/mol)
1	51.1±2.3	92.8±10.2	114.8±11.1	58300
2	70.2±1.5	37.0±4.1	80.8±5.	58300

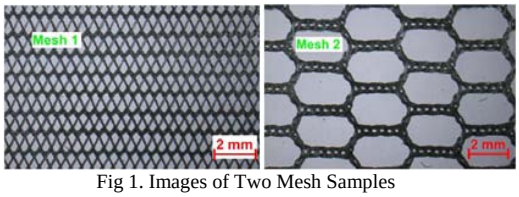

Fig 1. Images of Two Mesh Samples

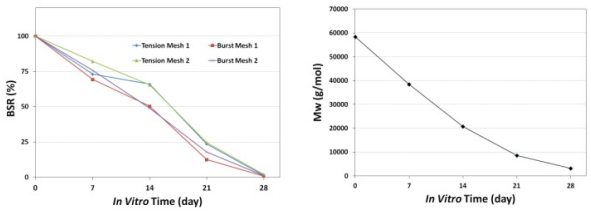

Fig 2. Changes of Mesh Properties during *In Vitro* Degradation

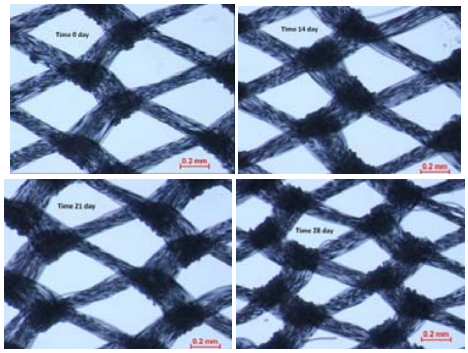

Fig 3. OM Images during *In Vitro* Degradation (Mesh 1)

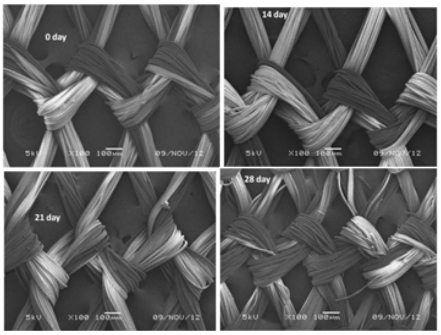

Fig 4. SEM Images during *In Vitro* Degradation (Mesh 1)

ACKNOWLEDGEMENTS

The authors want to thank Dr. David Burwell, Dr. Stephen Rothenburger, Dr. Richard Skula, Robert Tannhauser and Liz Vailhe for reviewing the abstract.