Antimicrobial Absorbable Multifilament Braided Sutures: A Preliminary Report

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Introduction: Consistent interest in upgrading the performance of absorbable multifilament braided sutures to improve their knot tie-down and handling characteristics while reducing the suture capillarity and likelihood of harboring microorganisms led to the development of a number of absorbable, lubricious coatings over the past three decades. However, most of these coatings were developed as analogs of non-absorbable surface lubricants without addressing the specific requirements for the unique class of absorbable sutures on a scientific basis. Early on, this prompted Shalaby and Jamiolkowski[1] to identify a few of the basic criteria for developing an absorbable coating for absorbable suture braids based on thermal property and molecular weight requirements. Meanwhile, continued development of unique absorbable suture braids with a broad range of physiochemical and surface charac-teristics, as well as the genesis of the new family of polyaxial absorbable polymers with unique thermal and solubility characteristics[2,3], provided a strong incentive to initiate the study reported in this communication. The study, subject of this report, represents the first segment of a tailor-made combination of an absorbable suture and an absorbable polymeric carrier of a bioactive agent[4].

Materials and Methods: Polyaxial segmented glycolide copolymer sutures were prepared as per an earlier report[2] to have the properties described in Table I. Sutures were coated with a solution of polyaxial ε-caprolactone copolymer (PCC) in acetone which also contained triclosan as described previously[4]. Briefly, the suture was dipped in the coating solution and dried with a heat lamp. Lengths (approximately 3.75") of coated suture having equal weight were placed into tubes with 5 ml of phosphate buffer (pH 7.4). At specified time periods, the sutures were removed, cut into pieces of about ¼" in length, dried, and used in subsequent experiments.

• Agar Disc Diffusion Method: *Staphylococcus aureus* (*S. aureus*) was added to saline or tryptic soy broth to match a 0.5 McFarland Standard and swabbed onto Mueller-Hinton agar. At each time period, suture pieces were plated and incubated at 37ºC for 16 hours. Controls were tetracycline and gentamycin antibiotic discs. "Day 0" samples were not placed in buffer. After incubation, zones of inhibited growth around the sutures were measured.

• Periodic Eluent Testing: At each time period, eluents from SPG1 suture were removed and diluted with *S. aureus*-inoculated tryptic soy medium (30:70 v/v) according to 0.5 McFarland Standard. Cultures were incubated at 37°C for 16 hours. Bacterial growth was measured using a spectrophotometer.

Results and Discussion: Antimicrobial susceptibility testing of the two sutures showed that both were effective in the growth inhibition of *S. aureus* (Tables II and III). In the first 7 days, zones of inhibition surrounding SPG2 were larger than those surrounding SPG1. By day 14, the zones were comparable for both sutures. In fact, inhibited growth surrounding SPG2 was observed for 21 days, which may be the result of an optimum braid-coating combination, where the respective chains intermix at the interface leading to drug uniformity across the surface and perhaps at the subsurface. Eluents from SPG1 also had a sustained inhibitory effect on *S. aureus* over 14 days.

Table I. Suture and Coating Data

Suture	SPG1	SPG2
Size	0	2-0
Add-on weight of coating (% of uncoated suture wt)	5%	5.5%
Amount of triclosan (w/w % of triclosan/PCC)	3%	10%
Coating solution (w/v % of PCC/acetone)	15%	15%

Table II. Zones of Inhibition for *S. aureus*

	Average Zones of Inhibition* (mm)	
Day	SPG1	SPG2
0	17.5	33.8
7	18.2	25.5
14	16.7	18.2
21	no data	18.0

*Average of three samples

Table III. Inhibition of *S. aureus* using SPG1 Eluent

Day	Growth Inhibition (%)
2	85.1
7	79.6
14	72.0

Conclusions: The results of the present study indicate that coated SPG sutures with 3% triclosan in the coating exhibit antimicrobial activity for 14 days. Moreover, antimicrobial activity for SPG2 continued for 21 days and may potentially extend for longer periods of time. The use of a polyaxial coating on a polyaxial polymer braid resulted in a prolonged drug release and is an effective way to develop optimal suture-coating combinations.

References:

1. Shalaby S.W. and Jamiolkowski D.D., U.S. Patent 4,105,034 (1978).
2. Shalaby S.W., U.S. Patent 6,462,169 (2002).
3. Shalaby S.W., et al., Chapter 8 in *Absorbable and Biodegradable Polymers* (Shalaby and Burg Eds), CRC Press, Boca Raton (2006).
4. Shalaby S.W., U.S. Patent application filed 2006.