

Biodegradable Stents Designed for Whipple Procedure and Gastrointestinal Surgery: Advancing Postoperative Care

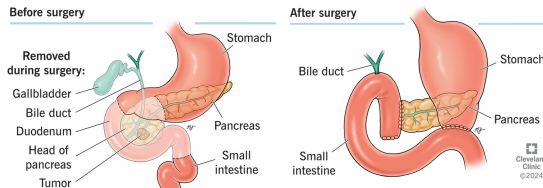
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Introduction

Pancreaticoduodenectomy (Whipple procedure) is performed in approximately 10,000 patients annually in the United States and remains the only curative intervention for periampullary malignancies.¹⁴ During reconstruction, plastic stents are placed in the pancreatic and bile ducts to maintain patency and prevent anastomotic leakage during the critical healing period.¹⁰ However, when these stents fail to dislodge naturally, endoscopic or surgical retrieval becomes necessary, introducing additional procedural risks. Biliary and pancreatic fistulas occur in 10-30% of cases, particularly in patients with small pancreatic ducts, contributing to increased morbidity, prolonged hospitalization, and delayed adjuvant chemotherapy.²



Degradation Study Method

Computational Model: COMSOL Multiphysics models predicted degradation behavior across various suture, coating, and environmental pH combinations.

Media	Composition	pH
NaOH	Sodium cations and hydroxide anions	9.0
PBS	NaCl, KCl, phosphate buffer	7.4
FEDGAS Early	Bile salts, lecithin, high lipids	6.0
FEDGAS Mild	Moderate lipids, mild acidic stress	4.5
FEDGAS Late	Low lipids, worst-case acidic	3.0

Testing Timeline (Days)

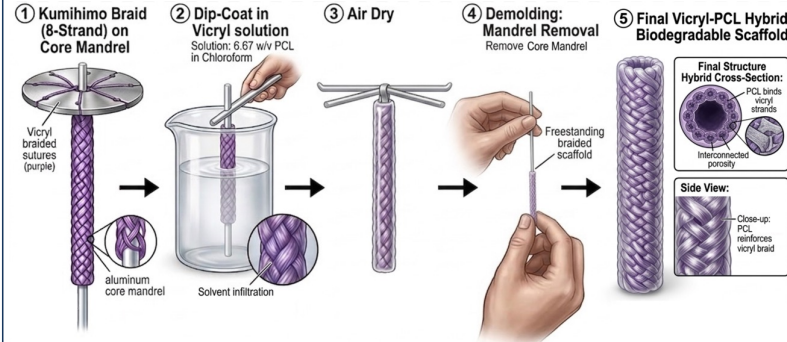


Testing Done On Highlighted Days:

- Wet/Dry massing followed by optical imaging
- Mechanical testing (Young's Modulus, Universal Testing Machine)
- Solution testing (Transmission using Fourier-Transform Infrared Spectroscopy)

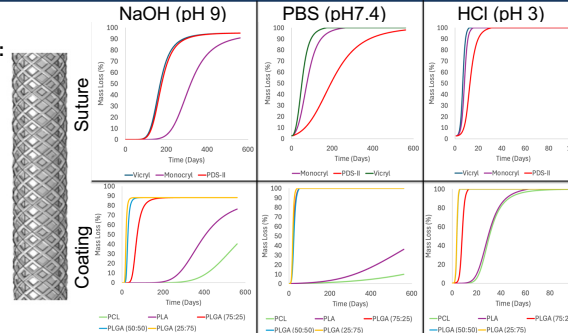
Results

Stent Fabrication

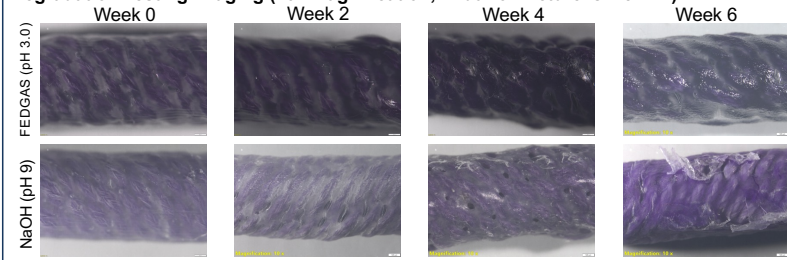


Computational Model

- Suture Material Tested:** Vicryl, Monocryl (poliglecaprone 25), and PDS-II (polydioxanone)
- Dip-Coat Material Tested:** PCL, PLA, PLGA (75:25, 50:50, 25:75)
- Environments Tested:** NaOH, PBS, HCl (pH 3.0, 4.5, and 6.0) with laminar flow

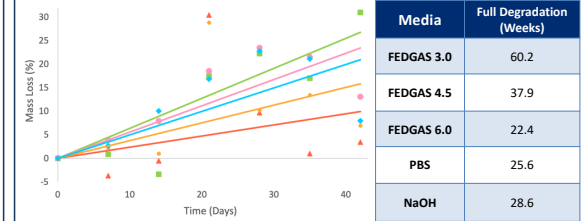


Degradation Testing Imaging (10x Magnification, Width of Picture is 7.5 mm)

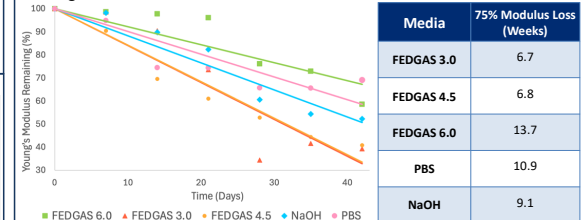


Degradation Testing

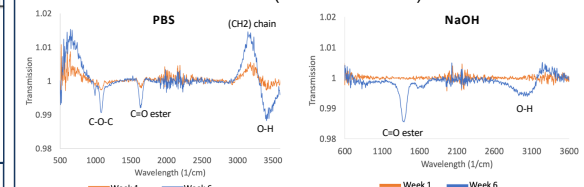
Mass Loss



Young's Modulus of Stents



Transmission from Solutions (PBS and NaOH)



Vicryl: C=O ester, C-O-C

PCL: (CH₂) chain

Both: O-H (polymer hydrolysis)

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Acknowledgements/References

We would like to thank Biorelevant for providing FEDGAS dissolution media and Ethicon for the suture materials used in this study.

