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Barbed Sutures For Wound Closure: *In Vivo* Wound Security, Tissue Compatibility And Cosmesis Measurements

G.T. Rodeheaver¹, A. Piñeros-Fernandez¹, L.S. Salopek¹, P.A. Rodeheaver¹, J.C. Leung², G.L. Ruff², S.D. Batchelor²

¹ *Univeristy of Virginia, Charlottesville, VA,* ² *Quill Medical, Inc., Research Triangle Park, NC*

Introduction

Barbed sutures have broad surgical applications,¹ including their FDA-cleared uses in cosmetic surgery and wound closure. *In vivo* wound security, tissue compatibility, and scar cosmesis after wound repair with barbed sutures are of particular interest to surgeons. A study was designed to address these outcomes using two different animal models - rat abdomen and porcine dermis.

Materials and Methods

Barbed Sutures: Barbed polydioxanone (PDO) sutures (sizes 2-0 and 3-0), were fabricated with specific barb geometry parameters based on optimization studies² that indicated favorable wound holding compared with a conventional suture of one size smaller. Each suture contained a spiral array of barbs that were equally divided into two opposing segments.



In Vivo Rat Abdomen: A total of 40 rats were used. A 60-mm wound was created through the abdominal wall after it was exposed following a midline skin incision. The test sites for suture closure were two 15-mm segments marked 7.5-22.5 mm and 37.5-52.5 mm, respectively. One was closed with a running, over-and-over 3-0 barbed PDO suture and the other with knotted, interrupted 4-0 PDS II (Ethicon Inc.) sutures. Analysis at 0, 2, and 4 weeks included wound strength (10 rats at each time point) and histology (5 rats each at 2 and 4 weeks).

In Vivo Porcine Dermis: A total of 3 pigs were employed with one for each of the three analysis periods - 0, 2, and 6 weeks. Twelve pairs of full-thickness, 4-cm dorsolateral skin incisions were made on each pig. Each pair was closed with a 2-0 barbed PDO suture and a 3-0 PDS II suture, using a continuous sinusoidal dermal technique. One pig was sacrificed at each analysis time point for wound strength (12 pairs at 0 week, 10 pairs each at 2 and 6 weeks), histology (2 pairs each at 2 and 6 weeks), and cosmesis (12 pairs at 6 weeks).

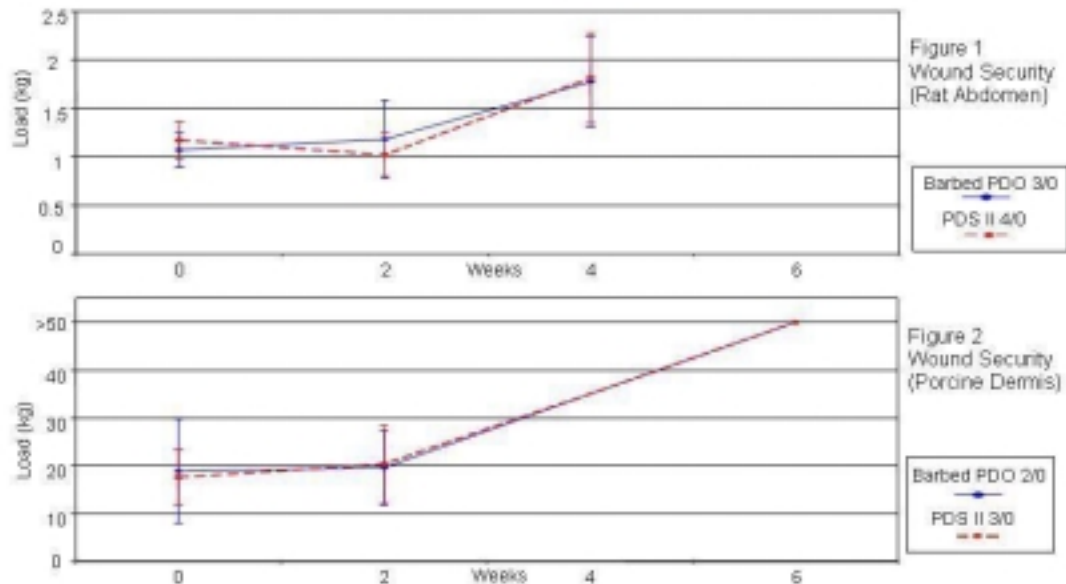
Wound Strength Measurement: Each excised tissue specimen was mounted on an Instron (Model 1123) tensiometer and separated at a rate of 20 mm/min for peak force determination.

Histological Evaluation: Modeled after a protocol by Scott,³ the tissue response of each suture was rated from none (0) to marked (3), based on the following parameters - degree of necrosis, coagulative necrosis, floccular degeneration, inflammation, neutrophils, lymphocytes, plasma cells, macrophages, fibroendothelial proliferation, fibrosis, giant cells, and fatty infiltration.

Cosmesis Evaluation: Each wound was evaluated by a blinded plastic surgeon using the visual analog scale (VAS) [0 (worst) to 100 (best)], and the modified Hollander scale [the sum of individual scores of 0 (absent) or 1 (present) for stepoff of borders, contour irregularities, margin separation, edge inversion, excessive distortion, and unacceptable overall appearance].⁴

Results and Discussion

Wound Security: Wound strengths with each suture in skin and abdominal wall tissues were equivalent over 4-6 weeks:



Histological Evaluation: Tissue reactions to each suture were mild. Rat abdomen scores were 0.39 (2 weeks) and 0.40 (4 weeks) for barbed suture vs. 0.36 and 0.36 for PDS II suture, respectively. Porcine dermis scores were 0.62 (2 weeks) and 0.35 (6 weeks) for barbed suture vs. 0.44 and 0.21 for PDS II suture, respectively.

Cosmesis Evaluation: All wounds closed with barbed PDO had acceptable cosmesis. One wound closed with PDS II developed a suture granuloma (resulting in poor cosmesis) and was not included in the VAS calculation. The scores were 92 ± 5 (VAS) and 0.6 ± 0.5 (Hollander) for barbed suture vs. 89 ± 6 and 1.3 ± 1.3 for PDS II suture, respectively.

Conclusions

This study demonstrated that knotless barbed sutures provide the same *in vivo* wound security in dermal and abdominal wall tissues as conventional sutures that are one size smaller. Tissue reactions to both barbed and conventional sutures were mild. By eliminating a large foreign-body knot, barbed sutures may further afford improved cosmetic outcomes.

References

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