

Efficiency Literature Summary

Barbed sutures represent an efficient, safe, and effective technology that may offer multiple time-saving benefits over conventional suture techniques for patients undergoing various surgical procedures, such as gastric bypass, hip and knee arthroplasties, plastic surgery, robotic hysterectomy, and laparoscopic prostatectomy, partial nephrectomy, and myomectomy.



Key takeaways

- There is a growing body of evidence supporting the efficiency of using barbed sutures compared with conventional sutures for patients undergoing various surgical procedures, including gastric bypass, hip and knee arthroplasties, plastic surgery, robotic hysterectomy, and laparoscopic prostatectomy, partial nephrectomy, and myomectomy
 - Shorter total operative times,^{1,7,9-13,15,16,18} reaching statistical significance in many instances^{6,9-12,16}
 - Significantly shorter closure/anastomosis/reconstruction time^{1-6,14}
 - Significantly shorter warm ischemia time^{7,15}
 - Significantly shorter nurse set-up time⁴
 - Significantly shorter anesthesia time¹⁰
- Barbed sutures also provide additional benefits over conventional suture techniques,^{1,4,5,9,10,14} with similar complication rates^{12,5,8,9,11,15-17}
 - Significant cost reduction^{14,10}
 - Significantly shorter duration of hospital stay^{9,14}
 - Significantly less bleeding⁵
 - Significantly less need for suture tension readjustment⁴
- Preclinical studies also support the efficiency and safety of barbed sutures compared with conventional suture techniques²⁰⁻²²

Prospective studies

- Milone M, Di Minno MN, Galloro G, Maietta P, Bianco P, Milone F, Musella M. Safety and efficacy of barbed suture for gastrointestinal suture: a prospective and randomized study on obese patients undergoing gastric bypass. *J Laparoendosc Adv Surg Tech A*. 2013;23:756-759. PMID: 23859743.

 - In this prospective, randomized study of 60 patients undergoing gastric bypass, anastomosis time was significantly shorter with knotless V-Loc™ Wound Closure Device vs knot-tying running Polysorb™ Braided Absorbable Suture (12.8 vs 24.1 minutes, respectively; $P < 0.001$), as knotless anastomosis used a single suture while knot-tying anastomosis used up to 7 sutures, but total operative time was not significantly different between groups (122.7 vs 134.4 minutes; $P = 0.151$); multivariate logistic regression analysis showed that a shorter time needed for anastomosis was significantly predicted by use of knotless anastomosis ($P < 0.001$)
 - Complication rates were similar between groups; there was 1 leak in each group, 1 bleeding in the V-Loc™ Wound Closure Device group, and no stenosis in either group
 - V-Loc™ Wound Closure Device was significantly cheaper than Polysorb™ sutures (26 vs 39.9 Euros; $P < 0.001$)
- Ting NT, Moric MM, Della Valle CJ, Levine BR. Use of knotless suture for closure of total hip and knee arthroplasties: a prospective, randomized clinical trial. *J Arthroplasty*. 2012;27:1783-1788. PMID: 23146366.

 - Three-layer closure in primary total hip (deep fascia, subcutaneous fat layer, and subdermal layer) and knee (arthrotomy, intermediate layer, and subdermal layer) arthroplasty was faster with a device of similar material and anchor design to STRATAFIX™ Spiral Knotless Tissue Control Device with standard interrupted suture technique (Coated VICRYL® (polyglactin 910) Suture, 2-0 MONOCRYL® (poliglecaprone 25) Suture, and staples) (9.3 vs 13.6 minutes, respectively; $P < 0.005$), but total operative duration was not significantly different (85.1 vs 96.5 minutes; $P = 0.05$)
 - Overall complication rates ($P = 0.7737$), time to complication ($P = 0.3925$), and wound-related complication rates ($P = 0.6198$) were not significantly different between groups; no patient developed active drainage in the inpatient setting or deep periprosthetic joint infection after discharge in either group, but 2 patients with a device of similar material and anchor design to STRATAFIX Spiral Device and 3 patients with standard sutures developed peri-incisional erythema
 - While direct cost per patient was higher with a device of similar material and anchor design to STRATAFIX Spiral Device compared with standard interrupted sutures (THAs: \$52.75 vs \$12.79, $P = 0.008$; TKAs: \$52.84 vs \$9.43; $P = 0.002$), overall cost savings were potentially realized by reductions in operative time (THAs: \$614.72; TKAs: \$364.62)
- Williams SB, Alemozaffar M, Lei Y, Hevelone N, Lipsitz SR, Plaster BA, Hu JC. Randomized controlled trial of barbed polyglyconate versus polyglactin suture for robot-assisted laparoscopic prostatectomy anastomosis: technique and outcomes. *Eur Urol*. 2010;58:875-881. PMID: 20708331.

 - In this prospective, randomized, controlled, single-surgeon study of robot-assisted laparoscopic prostatectomy, mean anastomosis time was statistically shorter (9.7 vs 9.8 minutes; $P = 0.014$), but overall operative times were similar (103.8 vs 110.4 minutes; $P = 0.163$) using V-Loc™ Wound Closure Device compared with traditional Coated VICRYL Suture
 - Compared with traditional sutures, use of V-Loc™ Wound Closure Device was associated with more frequent cystogram extravasation 8 days postoperatively, longer mean catheterization times, and greater cost

Prospective randomized study

(N = 60; V-Loc™ Wound Closure Device, n = 30; Polysorb™ running suture, n = 30)

Prospective randomized study vs standard interrupted suture technique

(THAs: N = 25; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 14; standard interrupted suture, n = 11)

(TKAs: N = 35; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 18; standard interrupted suture, n = 17)

Prospective, randomized, controlled, single-surgeon study

(N = 81; V-Loc™ Wound Closure Device, n = 45; Coated VICRYL Suture, n = 36)

4. Zorn KC, Trinh QD, Jeldres C, Schmitges J, Widmer H, Lattouf JB, Sammon J, Liberman D, Sun M, Bianchi M, Karakiewicz PI, Denis R, Gautam G, El-Hakim A. Prospective randomized trial of barbed polyglyconate suture to facilitate vesico-urethral anastomosis during robot-assisted radical prostatectomy: time reduction and cost benefit. *BJU Int*. 2012;109:1526-1532. PMID: 22221566.

- In this prospective, randomized study of patients undergoing robot-assisted radical prostatectomy, use of V-Loc™ Wound Closure Device significantly reduced mean nurse set-up time (31 vs 294 seconds; $P < 0.01$) and total reconstruction time (13.1 vs 20.8 minutes; $P < 0.01$) vs standard monofilament suture ((MONOCRYL® (poliglecaprone 25) Suture, but overall procedure time was not significantly different between groups (166 vs 174 minutes; $P = 0.11$)
- More patients in the standard monofilament group required suture tension readjustment or additional suture clips for watertight closure than in the V-Loc™ Wound Closure Device group (24% vs 6%; $P = 0.03$)
- No complications were reported in either group

5. Angioli R, Plotti F, Montera R, Damiani P, Terranova C, Oronzi I, Luvero D, Scaletta G, Muzii L, Panici PB. A new type of absorbable barbed suture for use in laparoscopic myomectomy. *Int J Gynaecol Obstet*. 2012;117:220-223. PMID: 22445426.

- In this comparison of V-Loc™ Wound Closure Device (prospective) and classic continuous suture with intracorporeal knots (retrospective) during laparoscopic myomectomy, mean operative time for the whole surgical procedure (51.0 ± 18.1 vs 58.0 ± 17.8 minutes; $P = 0.0616$) and mean time required for uterine suture (9.9 ± 4.3 vs 15.8 ± 4.7 minutes; $P = 0.0004$) were lower in the V-Loc™ Wound Closure Device group vs control
- Intraoperative bleeding was significantly lower with V-Loc™ Wound Closure Device vs control, both in terms of estimated blood loss ($P = 0.0076$) and hemoglobin drop ($P = 0.0176$)
- There were no laparotomic conversions or intraoperative complications in either group, and postoperative complication rates were similar between groups

6. Tewari AK, Srivastava A, Sooriakumaran P, Slevin A, Grover S, Waldman O, Rajan S, Herman M, Berryhill R Jr, Leung R. Use of a novel absorbable barbed plastic surgical suture enables a "self-cinching" technique of vesicourethral anastomosis during robot-assisted prostatectomy and improves anastomotic times. *J Endourol*. 2010;24:1645-1650. PMID: 20818988.

- In this prospective cohort study of V-Loc™ Wound Closure Device after robot-assisted radical prostatectomy (RARP) vs a control group of patients who also underwent RARP by the same surgeon using poliglecaprone 25 3-0 sutures (before this new technique was available), posterior reconstruction (40 vs 60 seconds; $P < 0.001$) and vesicourethral anastomotic times (7 vs 12 minutes; $P < 0.001$) were significantly shorter with V-Loc™ Wound Closure Device vs control
- The authors inferred that total reconstruction times (8 vs 13.5 minutes; $P < 0.001$) and operative times (106 vs 114.5 minutes; $P < 0.001$) were also significantly shorter with V-Loc™ Wound Closure Device vs control

Prospective, randomized, controlled study by a single surgeon

(N = 66; V-Loc™ Wound Closure Device, n = 33; 4-0 MONOCRYL Suture, n = 33)

Prospective, single-center study of V-Loc™ Wound Closure Device (n = 19) vs control group of classic continuous suture with intracorporeal knots (n = 20)

Prospective cohort study of V-Loc™ Wound Closure Device (n = 50) vs control group using poliglecaprone 25 3-0 sutures (n = 50)

7. Sammon J, Petros F, Sukumar S, Bhandari A, Kaul S, Menon M, Rogers C. Barbed suture for renorrhaphy during robot-assisted partial nephrectomy. *J Endourol.* 2011;25:529-533. PMID: 21351886.
- In this study of 30 consecutive patients undergoing robot-assisted partial nephrectomy by a single experienced surgeon, median operative time (227.5 vs 275 minutes; $P = 0.49$) and mean console time (179.9 vs 195.9 minutes; $P = 0.47$) were not significantly different using V-Loc™ Wound Closure Device vs Coated VICRYL® (polyglactin 910) Suture, but warm ischemia time was significantly shorter with V-Loc™ Wound Closure Device (18.5 vs 24.7 minutes; $P = 0.008$)
 - There was no suture slippage or tearing in the V-Loc™ Wound Closure Device group
8. Murtha AP, Kaplan AL, Paglia MJ, Mills BB, Feldstein ML, Ruff GL. Evaluation of a novel technique for wound closure using a barbed suture. *Plast Reconstr Surg.* 2006;117:1769-1780. PMID: 16651950.
- Results from this blinded, prospective, randomized study showed that cosmesis scores were not significantly different using a device of similar material and anchor design to STRATAFIX™ Spiral Knotless Tissue Control Device vs running PDS® II (polydioxanone) Suture for dermal closure during nonemergent cesarean delivery
 - Secondary endpoints were also similar between groups, including rates of infection, dehiscence, and other adverse events; closure time; and pain scores
 - With a cosmesis and safety profile similar to that of conventional suture technique, a device of similar material and anchor design to STRATAFIX Spiral Device avoids the drawbacks inherent to suture knots

Retrospective studies

9. Einarsson JI, Chavan NR, Suzuki Y, Jonsdottir G, Vellinga TT, Greenberg JA. Use of bidirectional barbed suture in laparoscopic myomectomy: evaluation of perioperative outcomes, safety, and efficacy. *J Minim Invasive Gynecol.* 2011;18:92-95. PMID: 21094097.
- In a retrospective analysis of 138 consecutive laparoscopic myomectomies performed by a single surgeon, a device of similar material and anchor design to STRATAFIX Spiral Device significantly shortened mean duration of surgery (118 vs 161 minutes; $P = 0.003$) and reduced duration of hospital stay (0.58 vs 0.97 days; $P = 0.001$) compared with conventional smooth 2-0 polydioxanone sutures, with no significant differences in complication rates
10. Hashemi L, Hart S, Morseon M. Comparison of surgery time and cost in using barbed suture versus the traditional suture in robotic hysterectomy: a retrospective cohort study. *J Minim Invasive Gynecol.* 2012;19(6 Suppl 1):S6.
- In a matched cohort study of patients undergoing robotic-assistance hysterectomies, use of a device of similar material and anchor design to STRATAFIX Spiral Device significantly shortened mean operating room time by 24 minutes ($P < 0.001$) and mean anesthesia time by 25 minutes ($P < 0.001$) compared to traditional suture
 - Mean overall surgery costs were \$715 less with use of a device of similar material and anchor design to STRATAFIX Spiral Device in addition to traditional suture alone (\$3,701 vs \$4,415; $P < 0.001$)

Prospective study by a single surgeon

(N = 30; Coated VICRYL Suture, n = 15; V-Loc™ Wound Closure Device, n = 15)

Prospective, randomized, controlled non-inferiority trial

(N = 188; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 127; PDS II Suture, n = 61)

Retrospective cohort study vs conventional smooth sutures

(N = 138; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 107; running 2-0 polydioxanone suture, n = 31)

Retrospective cohort study vs "traditional" sutures

(N = 740; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 370; traditional suture, n = 370)

11. Eickmann T, Quane E. Total knee arthroplasty closure with barbed sutures. *J Knee Surg.* 2010;23:163-167. PMID: 21329257.

- In the retrospective review of 178 total knee arthroplasties performed by 1 primary surgeon, overall mean surgical time was significantly faster with a device of similar material and anchor design to STRATAFIX™ Spiral PDO Knotless Tissue Control Device than conventional Coated VICRYL® (polyglactin 910) Suture interrupted stitch/ MONOCRYL® (poliglecaprone 25) Suture running stitch (74.3 vs 85.8 minutes; $P < 0.001$), with an average savings of 11.5 minutes per procedure
- Extension and flexion and complication rates were similar between groups

12. Jandali S, Nelson JA, Bergey MR, Sonnad SS, Serletti JM. Evaluating the use of a barbed suture for skin closure during autologous breast reconstruction. *J Reconstr Microsurg.* 2011;27:277-286. PMID: 21437863.

- For closure of the incision following free flap breast reconstruction, use of a device of similar material and anchor design to STRATAFIX Spiral PDO Device decreased the average operative time for unilateral (360 vs 405 minutes, $P = 0.02$) and bilateral cases (500 vs 510 minutes; $P = 0.44$) compared with traditional interrupted Biosyn™ Synthetic Absorbable Sutures and was more cost-effective; possible explanations for the lack of significant time savings in bilateral cases are the inherently longer operation times, more intraoperative variables and variations, greater likelihood of using mesh for closure, and greater proportion of time dedicated to tedious pedicle dissection and microvascular anastomoses (ie, the rate-limiting factor is not the actual closure of the incisions)
- Delayed wound healing was more common with a device of similar material and anchor design to STRATAFIX Spiral PDO Device compared with traditional sutures in women undergoing bilateral reconstruction (72% vs 48%; $P = 0.04$). No significant difference was observed in the unilateral cases. The authors suggest this difference may be related to the “viability of the mastectomy skin flaps” rather than the suture used for closure

13. Rosen AD. Use of absorbable running barbed suture and progressive tension technique in abdominoplasty: a novel approach. *Plast Reconstr Surg.* 2010;125:1024-1027. PMID: 20195129.

- Based on this series of patients undergoing abdominoplasty, use of a device of similar material and anchor design to STRATAFIX Spiral Device and a progressive tension technique was a satisfactory alternative to standard PDS® II (polydioxanone) Suture, reducing average surgical time by 15 minutes
- Note: no drains were used in the cohort of a device of similar material and anchor design to STRATAFIX Spiral Device as opposed to 2-3 drains in the standard suture group

Retrospective study vs conventional interrupted suture technique

(N = 178; a device of similar material and anchor design to STRATAFIX Spiral PDO Device, n = 90; Coated VICRYL Suture interrupted stitch/ MONOCRYL Suture running stitch, n = 88)

Comparative study using a historical cohort comparing interrupted Biosyn sutures (n = 60) to a device of similar material and anchor design to STRATAFIX Spiral PDO Device (n = 76)

Retrospective case series vs historical standard sutures

(N = 24; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 12; running PDS II Suture, n = 12)

14. Hemal AK, Agarwal MM, Babbar P. Impact of newer unidirectional and bidirectional barbed suture on vesicourethral anastomosis during robot-assisted radical prostatectomy and its comparison with polyglecaprone-25 suture: an initial experience. *Int Urol Nephrol.* 2012;44:125-132. PMID: 21523325.

- In this comparative study of unidirectional and bidirectional barbed sutures (prospective data) with MONOCRYL® (poliglecaprone 25) Suture (retrospective data) for vesicourethral anastomosis (VUA), after the first 5 cases, investigators determined that the needle characteristics of a device of similar material and anchor design to STRATAFIX™ Spiral Knotless Tissue Control Device (3/8 circle and diamond tip) were not appropriate for the VUA so this arm of the study was closed (despite successful VUA in all 5 cases)
- When compared with MONOCRYL Suture (using retrospective data), prospective data with V-Loc™ Wound Closure Device showed significantly shorter anastomosis time (8.4 ± 1.7 vs 14.3 ± 4.8 minutes; $P = 0.0001$) and hospital stay (1.9 ± 0.8 vs 2.7 ± 1.1 days; $P = 0.023$)
- Study results should be interpreted with caution as they are based on a comparison of prospectively collected versus retrospectively collected data

15. Olweny EO, Park SK, Seideman CA, Best SL, Cadeddu JA. Self-retaining barbed suture for parenchymal repair during laparoscopic partial nephrectomy; initial clinical experience. *BJU Int.* 2012;109:906-909. PMID: 21991931.

- In this retrospective analysis of consecutive patients undergoing laparoscopic partial nephrectomy for tumor by a single surgeon, mean warm ischemia time was significantly shorter with V-Loc™ Wound Closure Device than with running 2-0 polyglactin sutures (26.4 vs 32.8 minutes; $P < 0.001$), but mean operative time was similar between groups (174 vs 178 minutes; $P = 0.7$)
- Estimated blood loss ($P = 0.34$), length of stay ($P = 0.4$), and overall complication rates ($P = 0.13$) were all lower with V-Loc™ Wound Closure Device vs polyglactin sutures, but differences were not statistically significant
- Incidence of bleeding requiring clinical intervention (option conversion or transfusion \pm embolization) was lower with V-Loc™ Wound Closure Device than with polyglactin sutures (3.4% vs 18.4%; $P = 0.06$); the authors suggest that the lack of statistical significance is likely the result of the low overall transfusion rate (7.7%) and small retrospective sample size, which was probably underpowered to detect a significant difference

16. Aoki Y, Kikuchi I, Kumakiri J, Kitade M, Shinjo A, Ozaki R, Kawasaki Y, Takeda S. Long unidirectional barbed suturing technique with extracorporeal traction in laparoscopic myomectomy. *BMC Surg.* 2014;14:84. PMID: 25345546.

- In this retrospective study of women who underwent laparoscopic myomectomy, mean total operation time was significantly shorter with V-Loc™ Wound Closure Device vs standard continuous Polysorb™ Braided Absorbable Suture (71.2 ± 22.9 vs 94.4 ± 27.2 minutes; $P < 0.001$)
- No significant differences between groups were observed for intraoperative blood loss or postoperative hospital stay; there were no complications in either group

17. Levine BR, Ting N, Della Valle CJ. Use of a barbed suture in the closure of hip and knee arthroplasty wounds. *Orthopedics.* 2011;34:e473-e475. PMID: 21902135.

- Review of 940 cases of total knee or hip arthroplasty shows no change in complication and wound healing rates since the introduction of a device of similar material and anchor design to STRATAFIX Spiral Devices to this institution

Prospective evaluation of unidirectional V-Loc™ Wound Closure Device (n = 25) and a device of similar material and anchor design to STRATAFIX Spiral Device (n = 5) compared with retrospective data with 3-0 MONOCRYL Sutures (n = 25)

Retrospective cohort study

(N = 78; running 2-0 absorbable polyglactin sutures with LAPRA-TY® Suture Clip, n = 49; V-Loc™ Wound Closure Device with LAPRA-TY Suture Clip, n = 29)

Retrospective cohort study

(N = 78; running 2-0 absorbable polyglactin sutures with LAPRA-TY Suture Clip, n = 49; V-Loc™ Wound Closure Device with LAPRA-TY Suture Clip, n = 29)

Retrospective institutional case review

(N = 940)

Meta-analysis

- 18.** Bogliolo S, Musacchi V, Dominoni M, Cassani C, Gaggero C, De Silvestri A, Gardella B, Spinillo A. Barbed suture in minimally invasive hysterectomy: a systematic review and meta-analysis. *Arch Gynecol Obstet.* 2015; 292:489-497.
- In vaginal cuff closure, barbed suture was found to significantly reduce operative time of laparoscopic vaginal vault closure (SMD = -0.96, 95 % CI 1.26-0.70; $P < 0.001$) and to be as safe and well tolerated as traditional sutures

Newsletter

- 19.** Jancin B. Knotless wound closure saves time, money. *Skin & Allergy News.* March 2009:48.
- In this newsletter, the author describes results from a comparative study presented at the annual meeting of the American Academy of Cosmetic Surgery involving 40 patients undergoing abdominoplasty or bilateral breast reduction using a device of similar material and anchor design to STRATAFIX™ Spiral Knotless Tissue Control Device or traditional techniques (mostly multilayered interrupted individual absorbable sutures with 3-0 Coated VICRYL® (polyglactin 910) Suture or 3-0/4-0 MONOCRYL® (poliglecaprone 25) Suture
 - Using a device of similar material and anchor design to STRATAFIX Spiral Device decreased total operating time by 20 minutes, with additional benefits of cost savings and better tissue approximation compared with traditional suture techniques

Review articles

- 20.** Chamsy D, Lee T. The use of barbed suture in bladder and bowel surgery. *Surg Technol Int.* 2013;23:153-159. PMID: 23965906.
- This article discusses the characteristics that make barbed sutures attractive for bladder and bowel repair and illustrates the authors' surgical approach for cystotomy and enterotomy repair using this novel suture material
 - Based on their experience, the authors conclude that use of unidirectional barbed suture in bladder and bowel repair procedures is safe and effective if proper surgical technique is utilized and improves the efficiency of laparoscopic suturing when closing bladder or bowel defects
- 21.** Kassir R, Blanc P, Breton C, Tiffet O, Iannelli A, Amor I, Debs T, Lointier P, Gugenheim J. Laparoscopic Roux-en-Y Gastric Bypass with the Absorbable Bidirectional Monofilament Barbed Suture Stratafix®: the Hand-Sewn Technique. *Obes Surg.* 2015; 25:325-326.
- The authors discuss the surgical technique to perform the gastrojejunal anastomosis (GJA) in a laparoscopic Roux-en-Y gastric bypass (LRYGBP) by using the STRATAFIX Spiral Device
 - The authors discuss STRATAFIX Spiral Device's ease of handling within the abdomen, greater distribution of tensile strength along the GJA, and lack of need for a third hand to facilitate laparoscopic suturing. Therefore, the use of STRATAFIX Spiral Device was found to reduce operative time, allow for a shorter learning curve, and prevent complications that might arise from loose knots

Meta-analysis of 11 retrospective studies of barbed sutures in laparoscopic or robotic-assisted hysterectomy in vaginal cuff closure

Newsletter reporting meeting results

(N = 40; a device of similar material and anchor design to STRATAFIX Spiral Device, n = 20; traditional suture techniques, n = 20)

Review article

Review article

22. Mitchell RTM, Bengtson BP. Clinical Applications of Barbed Suture in Aesthetic Breast Surgery. *Clinics in Plastic Surgery*. 2015; 42:595-604.

- The authors describe the use of barb suture in primary and revisional breast surgery where incisional space is limited. They find barbed suture technology to be useful here through its ability to facilitate suturing internally in limited spaces without the need for tying knots
- These authors further conclude that limited access application and increased speed and efficiency of incisional closures using barbed sutures are the main applications and benefits of using this technology

Preclinical studies

23. Moran ME, Marsh C, Perrotti M. Bidirectional-barbed sutured knotless running anastomosis v Classic van Velthoven in a model system. *J Endourol*. 2007;21:1175-1177. PMID: 17949320.

- Using an in vitro model of microfiber synthetic material, a single surgeon performed 10 vesicourethral anastomoses using running MONOCRYL® (poliglecaprone 25) Suture or a device of similar material and anchor design to STRATAFIX™ Spiral PDO Knotless Tissue Control Device and the da Vinci® Surgical System and found that a device of similar material and anchor design to STRATAFIX Spiral Device was faster to deploy (17.3 vs 19.2 minutes) and resulted in a greater security score by the surgeon
- Accuracy with the 2 types of suture closures was similar

24. Omotosho P, Yurcisin B, Ceppa E, Miller J, Kirsch D, Portenier DD. In vivo assessment of an absorbable and nonabsorbable knotless barbed suture for laparoscopic single-layer enterotomy closure: a clinical and biomechanical comparison against nonbarbed suture. *J Laparoendosc Adv Surg Tech A*. 2011;21:893-897. PMID: 22129144.

- In this in vivo study in which viscerotomies in the stomach, jejunum, and colon (3 each for each dog) were closed with the Endo Stitch™ Automatic Endoscopic Suturing Device using absorbable or nonabsorbable barbed suture or conventional suture, barbed suture with the Endo Stitch™ device was associated with significantly faster closure times than the control suture with Endo Stitch™ device ($P < 0.05$), resulting in reduction in closure time between 35% and 42%
- Closure leak rate was 0%; there was no difference in adhesion levels between viscerotomies closed with barbed sutures vs control sutures at any of the survival intervals

25. Demyttenaere SV, Nau P, Henn M, Beck C, Zaruby J, Primavera M, Kirsch D, Miller J, Liu JJ, Bellizzi A, Melvin WS. Barbed suture for gastrointestinal closure: a randomized controlled trial. *Surg Innov*. 2009;16:237-242. PMID: 19783567.

- In this porcine study of enterotomy closure, use of V-Loc™ Wound Closure Device significantly reduced suturing time in the stomach, jejunum, and colon vs continuous 3-0 Maxon™ Monofilament Absorbable Sutures; adhesion scores, burst strength pressures, and histology scores were similar between groups

Review article

Preclinical study

(N = 10)

Preclinical study to test in vivo efficacy of 2 knotless barbed monofilament sutures (absorbable and nonabsorbable) for use with the Endo Stitch™ device vs conventional suture (Endo Stitch™ device with Polysorb™ Braided Absorbable Suture) in 24 purpose-bred mongrel dogs

Preclinical randomized study with V-Loc™ Wound Closure Device vs continuous 3-0 Maxon™ suture in 12 nonparous female pigs

26. Shikanov S, Wille M, Large M, Lifshitz DA, Zorn KC, Shalhav AL, Eggener SE. Knotless closure of the collecting system and renal parenchyma with a novel barbed suture during laparoscopic porcine partial nephrectomy. *J Endourol.* 2009;23:1157-1160. PMID: 19530906.

- In this porcine model of kidney and collecting system closure following laparoscopic partial nephrectomy, mean weight of resected tissue (barbed: 34 ± 13 vs clips: 34 ± 11 grams), mean ischemia time (barbed: 34 ± 8 vs clips: 34 ± 10 minutes), and mean suturing time (barbed: 21 ± 4 vs clips: 22 ± 7 minutes) were similar with a device of similar material and anchor design to STRATAFIX™ Spiral Knotless Tissue Control Device vs Coated VICRYL® (polyglactin 910) Suture with absorbable LAPRA-TY® Suture Clips
- No animal had visible hematoma or urinoma at necropsy

27. Weld KJ, Ames CD, Hrubby G, Humphrey PA, Landman J. Evaluation of a novel knotless self-anchoring suture material for urinary tract reconstruction. *Urology.* 2006;67:1133-1137. PMID: 16750256.

- During the in vitro part of the study, a device of similar material and anchor design to STRATAFIX Spiral Device showed similar strength, but mode of failure was different vs standard ligated suture. The only type of failure for standard suture technique (running or interrupted) was tissue fracture. Type of failure for a device of similar material and anchor design to STRATAFIX Spiral Device was suture slippage to allow tissue separation (66.7% total; 44.4% thin tissue, 22.2% thick tissue) and tissue fracture (33.3%); however, the slippage events occurred at failure forces equivalent to tissue fracture for standard suturing technique
- In the in vivo study, there were no differences in operative times during pyeloplasties or bladder neck anastomoses for a device of similar material and anchor design to STRATAFIX Spiral Device compared with Coated VICRYL Suture running or interrupted suture technique
- A device of similar material and anchor design to STRATAFIX Spiral Device was associated with more fibrotic reactions compared with Coated VICRYL Suture running or interrupted suture during bladder neck anastomoses ($P < 0.01$). The authors suggested this might be caused by the relatively traumatic mechanism of tissue gripping in the perianastomotic tissue or by the higher surface area produced by the barbing process; however, the clinical significance of increased fibrosis is unknown and requires longer-term follow-up study

Preclinical study

(N = 10; bilateral nephrectomy closure using a device of similar material and anchor design to STRATAFIX Spiral Device for 1 kidney and Coated VICRYL Suture with absorbable LAPRA-TY Suture Clips for the other kidney)

Preclinical study

(N = 12; pyeloplasties, n = 3 [bilateral, a device of similar material and anchor design to STRATAFIX Spiral Device vs standard 2-0 Coated VICRYL Suture]; bladder neck anastomoses, n = 9 [3 each for a device of similar material and anchor design to STRATAFIX Spiral Device, running Coated VICRYL Suture and interrupted Coated VICRYL Suture])