Lapra-Ty Holding Strength and Slippage with Various Suture Types and Sizes

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OBJECTIVES To investigate the holding strength and slippage of Lapra-Ty clips on various suture types and sizes.

METHODS Using an automated materials testing system with the Lapra-Ty in a fixed position, Lapra-Ty holding strength and displacement were determined with 0, 2-0, 3-0, and 4-0 Vicryl, Monocryl, and polydioxanone suture (PDS). To simulate clinical application, Lapra-Tys were also tested by applying a load to these sutures after being passed through a full-thickness layer of tautly suspended fresh porcine bladder tissue. Three trials were performed with each suture type and size.

RESULTS The Lapra-Ty holding strength with Vicryl suture was significantly higher than with Monocryl or PDS of the same suture size in bladder tissue trials. Monocryl suture had a significantly higher displacement than Vicryl or PDS of the same suture size in bladder tissue trials (except for 4-0 Monocryl and PDS having insignificantly different displacements). Lapra-Tys slipped off Vicryl, Monocryl, and PDS in 25%, 67%, and 67% of their respective trials. Lapra-Tys did not slip during any of the trials with 2-0 suture of any type or 3-0 Vicryl. Lapra-Tys with holding strengths on suture less than approximately 8 Newtons (N) slipped and greater than 8 N pulled through the bladder tissue without slipping.

CONCLUSIONS The optimal suture type and size to maximize Lapra-Ty holding strength and minimize slippage was determined to be 2-0 and 3-0 Vicryl, 2-0 Monocryl, and 2-0 PDS. Monocryl suture stretches more than Vicryl and PDS at higher loads. UROLOGY 71: 32–35, 2008. © 2008 Elsevier Inc.

Urologic procedures such as partial nephrectomy, pyeloplasty, and vesicourethral anastomosis during prostatectomy rely on accurate suture approximation of tissue to prevent urinary extravasation. Intracorporeal knot tying during reconstructive laparoscopic surgery is difficult for many surgeons and time-consuming at best for expert laparoscopists. To improve efficiency many laparoscopic surgeons use a Lapra-Ty clip (Ethicon Endosurgery, Cincinnati, Ohio) as a substitute for knot tying.[1–3] The polydioxanone Lapra-Ty clip is absorbable and maintains tensile strength for at least 14 days.[4]

The manufacturer's Lapra-Ty package insert states that the product is intended "for use with single strands of coated Vicryl (polyglactin 910) suture coated with polyglactin 370 and calcium stearate dyed (violet) braided synthetic absorbable sutures (sizes 2-0, 3-0, and 4-0)." However, some laparoscopic surgeons are applying Lapra-Ty clips to monofilament suture during vesicourethral anastomosis during laparoscopic radical prostatectomy.[1,3]

We investigated the holding strength and slippage of Lapra-Ty clips on various sutures to determine the optimal suture type and size. Ex vivo studies involving fresh porcine bladder tissue increase the clinical applicability of the data. To our knowledge, we report the first study that compares the performance of Lapra-Ty clips on braided and monofilament sutures.

MATERIAL AND METHODS

Mechanical testing to determine Lapra-Ty holding strength was performed with a Series IX Automated Materials Testing System (AMTS) from the Instron Corporation (Norwood, Mass). First, holding strength was determined with the Lapra-Ty in a fixed position. A Lapra-Ty applier was used to place the clip exactly 1 cm from the end of a 15-cm section of suture. The suture and Lapra-Ty were submerged in sterile saline just before testing to simulate clinical conditions after suture passage through healthy tissue. The opposite end of the suture was threaded through a 2-mm hole in a specially designed metal stand before securing it to the arm of the AMTS that would apply the load (Fig. 1). The 2-mm hole allowed the suture to easily slide through the plate but restrained the Lapra-Ty at a fixed position under the metal plate while the load was applied upward on the suture. The arm was carefully raised until the

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Figure 1. The Lapra-Ty clip (small arrow) was applied to the distal 1 cm of suture. The proximal end of suture (large arrow) was passed through a 2-mm hole in the metal stand and secured to the AMTS arm.

Lapra-Ty cinched up to the metal plate with a 0.03-Newton (N) preload as measured on the AMTS to pull the suture taut. The load was applied at a constant speed of 12 mm/min. The AMTS recorded raw data and computed the load over time. The holding strength was defined as the maximum load recorded at the instant just before failure. Displacement was defined as the distance traveled by the AMTS arm until failure. With the Lapra-Ty in a fixed position in this phase of the study, all failures occurred by the Lapra-Ty slipping on the suture, and displacement was a direct measure of suture stretch under increasing loads. Testing was performed on 0, 2-0, 3-0, and 4-0 Vicryl, Monocryl, and polydioxanone suture (PDS) (Ethicon, Somerville, NJ). Three trials were performed with each suture size and type.

To more closely simulate clinical application, Lapra-Tys were also tested by applying a load to the suture after being passed through a full-thickness layer of tautly suspended fresh porcine bladder tissue. In these trials, the porcine bladders were bivalved, spread flat, and sandwiched between two rigid platforms. The matching platforms had overlapping holes 1 cm in diameter. With the platforms secured to each other with C-clamps, the 1-cm openings provided a tautly suspended diaphragm of bladder tissue ready for testing. The 1-cm holes were large enough to easily allow passage of the Lapra-Ty through the opening and tested the holding strength of the Lapra-Ty against the resistance provided by the tissue. A moistened 15-cm section of suture with a Lapra-Ty clip 1 cm from the end was prepared as described above. Then the end opposite the Lapra-Ty was passed through the center of the diaphragm of bladder tissue with a tapered needle. Again, a 0.03-N preload was applied to cinch the Lapra-Ty up to the tissue and pull the suture taut. In addition to recording the holding strength and displacement, one of two modes of failure was also recorded by direct observation in the trials incorporating bladder tissue. First, Lapra-Ty slippage was defined as the Lapra-Ty slipping on the suture. Second, tissue failure without slippage was defined as the clip holding to the suture as it pulled through the tissue with increasing load. Three trials were performed with each suture size and type.

Given that suture size is a clinical decision based on the type of tissue and anastomosis being performed, single-factor analysis

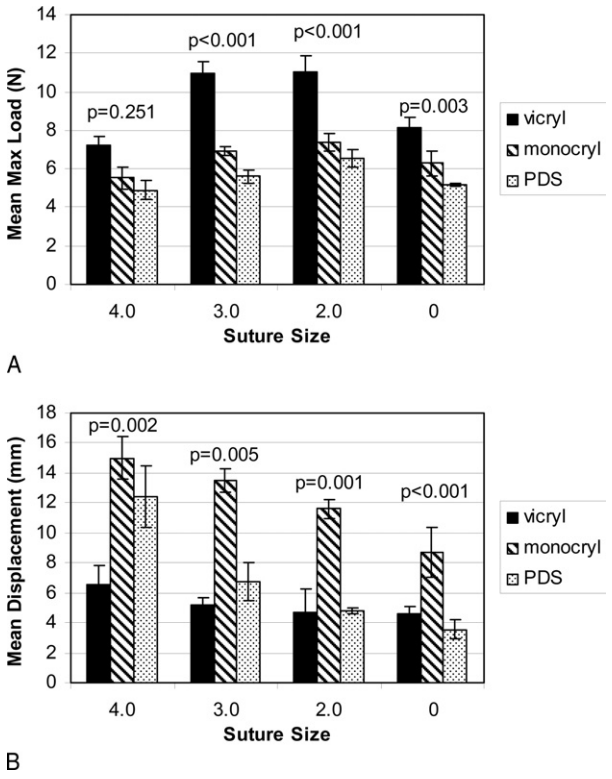

Figure 2. Mean Lapra-Ty holding strength **(A)** and displacement **(B)** for the various sutures with the Lapra-Ty fixed in position beneath the metal stand. Error bars represent ±1 standard deviation.

of variance was performed for holding strength and displacement, with suture type as the main effect. Because of multiple comparisons a Bonferroni correction was applied, such that significance was reached with an alpha level less than 0.01. Subsequent post hoc tests using Tukey honestly significant difference analyses were performed.

RESULTS

Figures 2A and 2B show the mean Lapra-Ty holding strength and displacement for the various sutures with the Lapra-Ty fixed in position beneath the metal stand. Figure 2A shows a significant difference in holding strength among the suture types for 0, 2-0, and 3-0 suture sizes. Post hoc analyses showed that the holding strength for 0 Vicryl and Monocryl was significantly greater than for 0 PDS, for 2-0 Vicryl was significantly greater than for 2-0 Monocryl and PDS, and for 3-0 Vicryl was significantly greater than for 3-0 Monocryl and PDS. Figure 2B shows a significant difference in displacement among the suture types for all suture sizes. Post hoc analyses showed that the displacement for 0 Monocryl was significantly greater than for 0 Vicryl and PDS, for 2-0 Monocryl was greater than for 2-0 Vicryl and PDS, for 3-0 Monocryl and PDS was greater than for 3-0 Vicryl, and for 4-0 Monocryl and PDS was greater than for 4-0 Vicryl. In all cases with the Lapra-Ty fixed beneath the metal stand, the Lapra-Ty slipped off the suture, and no suture breakage was observed.