Over the years there has been significant development in all aspects of reconstruction ranging from advanced techniques in trauma to arthroplasty. Although trauma surgeons have understood the importance of the soft-tissue envelope to promote adequate bone healing by exploring various techniques of wound closure and developing sophisticated systems, such as wound vacuums to enhance healing, little attention has been paid to methods of enhancing wound closure after elective procedures. This raises several fundamental questions regarding wound closure. First and foremost, can we improve upon current techniques? Second, in this growing era of cost containment where time is money, can we make wound closure more rapid? Third, is it more beneficial to have a watertight seal when closing an arthrotomy or fascia? Finally, and most importantly, will this lead to improved outcome?

In traditional methods of wound closure surgeons have used either interrupted sutures or continuous sutures, and the skin has been closed with surgical staples (Fig. 1). Suture material is classified by size, tensile strength, absorbable versus nonabsorbable, multifilament versus monofilament, flexibility, and smooth versus barbed. A new type of suture, a bidirectional barbed material, was introduced in January 2007 (Quill Self-Retaining Suture; Angiotech, Vancouver, British Columbia). The suture material is relatively standard, namely polydioxanone (PDO), nylon, and polypropylene. The uniqueness of this suture comes in its design. Traditionally, sutures have been a smooth monofilament or braided thread with a needle on one end. This new suture consists of the PDO material with tiny barbs cut into the length of the filament in a helical array set facing in opposite directions from an unbarbed midsegment, with a needle attached to each end. Tissues can be approximated without surgical knots, providing a more uniform distribution of tension, reducing closure time and wound tissue reactions. At our practice, closure with bidirectional, barbed absorbable Quill suture (Angiotech, Vancouver, British Columbia) has been the standard of care for all primary arthroplasty procedures since 2007. We present results from a preliminary review of 7191 primary hip and knee arthroplasties performed from July 2007 to February 2011.

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port and cosmesis are enhanced. A similar self-anchoring barbed suture material, the V-Loc advanced wound closure device (Covidien, Mansfield, MA), is also available.

The barbed suture material was initially used in plastic surgery procedures which required an even tension across the length of the repair to minimize scar formation.1-8 Its use has been expanded to urological and gynecologic procedures, with early reports documenting satisfactory results.9-13 Basic science research has elicited continued advances in this material.14,15 Finite element analysis has demonstrated that the flexibility of the barb can be increased or decreased by changing the barb geometry. Furthermore, barb geometry and design need to be modified for use with different types of tissue. It has been determined that to achieve the best mechanical anchoring within skin tissue, the barb should be more flexible compared with one designed to work with tendon tissue.

Preliminary evaluations in orthopedics both in the laboratory and intraoperatively have shown that this barbed suture can effectively produce a watertight seal and speed the closure of the wound. The authors of a recent meta-analysis of 194 studies evaluating suture versus staples for skin closure in orthopedic surgery identified 6 manuscripts which included 683 wounds.16 Three hundred thirty-two patients underwent suture closure, and 351 underwent staple closure. The risk of developing a superficial wound infection after orthopedic procedures was 3 times greater after staple closure than suture closure.

A recent study compared knee arthrotomy closure in 8 cadaveric lower extremity pairs using interrupted biodegradable sutures versus running bidirectional barbed sutures, subjected to cyclic loading.17 Although both groups maintained closure without rupture during 2000 initial cycles, barbed sutures performed better when suture...
throws were sequentially cut to weaken the repairs, and knees were cyclically flexed after each cut. In the interrupted suture group, no knee repairs survived more than 3 cuts, whereas in the barbed group severing of as many as 7 throws were required for the repair to fail.

The authors of a retrospective analysis of 178 total knee arthroplasty performed by a single surgeon between January 2007 and September 2008 compared 88 procedures closed with conventional, absorbable interrupted sutures for the retinacular and subcutaneous layers with 90 procedures closed with running, bidirectional, barbed absorbable sutures for all layers. Surgeries performed with the barbed suture were significantly faster by an average of 11.3 minutes \((P < 0.001)\) than those performed with conventional sutures, and no detrimental clinical effects were observed.

At our practice, closure with bidirectional, barbed absorbable Quill suture has been the standard of care for all primary arthroplasty procedures since 2007. We conducted a preliminary review of 7191 primary hip and knee arthroplasties performed from July 2007 to February 2011. There were 2243 primary hip and 4948 primary knee arthroplasties. Minimally or less invasive approaches were used in all cases. For all primary knees, wound closure was accomplished with the knee in 45 degrees of flexion. In all cases, the retinacular layer was closed with running stitches of size 2 PDO barbed suture, size 0 PDO barbed suture in running stitches was used to close the subcutaneous layer (Figs. 2 and 3), and 2-0 or 3-0 PDO barbed suture in running stitches was used to close the subcuticular layer (Fig. 4). At each end of the arthrotomy, a reverse last stitch was applied to lock the suture in place.

Tissue adhesive (Dermabond; Ethicon, Somerville, NJ) was applied over the closed wound (Fig. 5).

In our series there were 6 hip cases (0.3%) and 22 knee cases (0.4%) that required an incision and debridement of an aseptic nonhealing wound, of which 1 hip (0.04%) and 13 knees (0.3%) were attributed to an adverse reaction to the suture material.

In summary, early work in the fields of plastic surgery, urology, gynecology, and orthopedic surgery has demonstrated that a barbed knotless suture system can effectively enhance wound closure. Furthermore, it appears that this type of closure is cost-effective not only by virtue of speeding closure in the operating room but also by decreasing the potential for postoperative wound infections.

References