Repair of the Midline Fascial Defect in Abdominoplasty With Long-Acting Barbed and Smooth Absorbable Sutures

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Abstract

Background: Traditionally, repair of the midline fascial defect has been performed with interrupted or running permanent sutures during abdominoplasty. Barbed suture devices, however, eliminate the need for knot tying and potentially are equally effective at maintaining the repair while allowing for faster deployment and elimination of a potential nidus for infection.

Objective: The authors report their experience with long-acting absorbable barbed and smooth sutures.

Methods: A retrospective chart review was conducted on 34 consecutive patients who underwent abdominoplasty, alone or in conjunction with other procedures, between August 2006 and December 2009. Seventeen patients had repair of the midline abdominal wall rectus diastasis performed with a smooth running absorbable polydioxanone suture, and 17 underwent repair with a barbed suture.

Results: All 34 patients were women; their mean age was 43.6 years, and their mean body mass index was 23.0 kg/m². Sixty-eight percent of the patients elected to undergo concurrent procedures. Patients were followed for a mean of 34 months (27 months barbed; 42 months smooth). No cases of recurrent diastasis were observed. Complications included minor seroma (two cases in the barbed suture group, one in the smooth group) and infected hematoma (one in the barbed suture group).

Conclusions: Based on the data from this series of patients, long-acting absorbable barbed or smooth sutures appear to be equally effective in maintaining rectus diastasis repair. Barbed sutures therefore hold promise as a useful alternative to permanent sutures for the plication of the rectus fascia during abdominoplasty.

Keywords
abdominoplasty, midline fascial defect, barbed sutures, absorbable sutures, smooth sutures, Quill

Over the past 40 years, a wide variety of suture materials and techniques has been employed by plastic surgeons for the repair of rectus diastasis during abdominoplasty.1,2 Although the ideal technique has yet to be determined, the best method for repair should be fast, easy, cost-effective, and have a low incidence of complications. Although permanent sutures have been widely utilized historically for this purpose, the availability and adoption of absorbable material for fascial repair have grown in recent years.

The placement of absorbable suture material for plication of the rectus fascia during abdominoplasty was first described by Birdsell and colleagues3 in 1981; they placed fast-acting, polyglycolic acid sutures. Their data showed that equivalent correction was achieved with absorbable and nonabsorbable materials at six months follow-up. Van Uchelen and colleagues4 studied materials that were...
resorbed within 90 days (mostly polyglactin 910) and found that standard plication of the abdominal wall with fast-acting absorbable sutures led to residual or recurrent diastasis in 40% of subjects followed up to five years. More recently, Nahas and colleagues, in placing long-acting polydioxanone sutures (180-day resorption), found that diastasis correction was as reliable as permanent sutures. Based on the evidence from meta-analyses of studies on midline abdominal incision closures, it appears that long-term equivalence between permanent and absorbable sutures in correction of rectus diastasis can be achieved with polydioxanone but not with faster-acting absorbable materials.

Many plastic surgeons hold a longstanding clinical belief that permanent sutures should be placed to repair fascial defects in order to provide lasting support to tissues that undergo dynamic tension forces. These beliefs are usually based on tradition, familiarity, prejudice, and anecdotal experience rather than on scientific studies. On the contrary, permanent palpable knots and the potential for a permanent nidus for infection and sinus tract formation have been uncommon but bothersome consequences of non-absorbable material. Advances in surgical techniques and materials have allowed us to reexamine previously accepted techniques of rectus fascia plication during abdominoplasty.

In our own practices, we have successfully placed slow-absorbing polydioxanone (PDO) sutures (PDS II; Ethicon, Inc., Somerville, New Jersey) for five years in patients without recurrent diastasis, which stimulated our interest evaluating a barbed suture equivalent. The knotless bidirectional-barbed self-anchoring suture (Quill SRS; Angiotech, Reading, Pennsylvania) incorporates tiny barbs spaced evenly in a helical array on both sides of a non-barbed segment, with a needle cramped onto each suture end. Compared to standard sutures, these barbed devices allow even distribution of wound tension across multiple barbs running the length of the suture, rather than just at the knotted end. The Quill suture was designed to allow faster, more efficient tissue approximation during wound closure and is available in absorbable and nonabsorbable formulations. With the absorbable variety, absorption of the polydioxanone is essentially complete by 180 days.

**METHODS**

We conducted a retrospective review of 34 consecutive patients who underwent abdominoplasty between August 2006 and December 2009 and had midline fascial defects. The midline abdominal wall rectus diastasis repair for these patients was performed with either long-acting polydioxanone smooth (PDS II; 17 patients) or slow-absorbing barbed (Quill SRS; 17 patients) sutures. From 2003 to 2007, the senior author (AR) was placing long-acting running absorbable smooth sutures but began using barbed sutures in 2008, with the hypothesis that the barbed device, which eliminates the need for knot tying, might prove equally effective in maintaining the repair while allowing for faster deployment and elimination of a potential nidus for infection. The 17 patients in the smooth suture group in this study underwent abdominoplasty between August 2006 and February 2008; the 17 patients in the barbed suture group underwent abdominoplasty between February 2008 and December 2009. The last repair in the smooth suture group and the first repair in the barbed suture group were each performed in February 2008. All patients were women with a body mass index (BMI) of less than 30; 23 (68%) had undergone previous abdominal surgery, with C-section procedures noted in approximately half. Patients underwent abdominoplasty either alone or in conjunction with various other plastic surgery procedures.

The fascial defects were noted on physical exam during the initial consultation. Rectus diastasis was determined by visualization and palpation of a midline “bulge” both in the standing “diver’s” (half-flexed) pose and in a supine midpoint sit-up (crunch) position. All procedures were performed under general anesthesia by the same surgeon (AR) at an accredited outpatient surgery center. Rectus repair width was measured at 8 to 10 cm, with 4 to 5 cm measured out lateral to the umbilicus on each side. Jackson-Pratt drains were placed in all patients in the smooth suture group; progressive tension sutures without drains were utilized in the barbed suture group.

The fascial repair of the midline rectus diastasis was performed during abdominoplasty by reapproximation of the medial borders of the rectus muscles with a double-layer closure of either #2-PDO Quill or 0-PDS Quill for patients in the barbed suture group or 0-PDS for patients in the smooth suture group. The choice of PDO was prompted solely by the availability of the material at the time of surgery. Sutures were run continuously from the xiphoid (Figure 1) to the superior umbilical region (Figure 2) and also from the inferior umbilical region to the pubis (Figure 3). Although not demonstrated in the figures, knots were tied for the PDS smooth group at the xiphoid, umbilical, and suprapubic regions. For the PDO barbed suture group, no knots were necessary. Figure 4 depicts the completed two-layer closure with PDO sutures; a technique video is also available at www.aestheticsurgeryjournal.com. In the smooth suture group, all wound closures were performed with PDS for Scarpa’s layer, and a running 3-0 Monocryl (Ethicon, Inc.) was placed for deep dermal and subcuticular layers. For the barbed suture group, 0-PDS was inserted for Scarpa’s layer, and 3-0 Monoderm (Angiotech) was inserted for the subcuticular layers. Postoperative diastasis was assessed as described above with visual exam and palpation by two separate examiners (AR, TH) at three months, six months, and one year postoperatively.

**RESULTS**

The 34 patients in this series had a mean age of 43.6 years (range, 33 to 67) and a mean BMI 23.0 kg/m\(^2\) (range, 18.7 to 29.1 kg/m\(^2\); Table 1). Eleven patients (32.4%) underwent abdominoplasty alone, whereas 23 patients (67.6%) underwent concurrent procedures, of which liposuction was the most common (Table 2). The midline rectus diastasis fascial repair in the barbed suture group was performed with #2-PDO Quill in 12 cases (70.6%); five cases...
were performed with 0-PDO (29.4%). All repairs in the smooth suture group were performed with 0-PDS.

Patients were followed for a mean of 34 months: 27 months in the barbed suture group (range, 12-34 months) and 42 months in the smooth suture group (range, 34-51 months). No evidence of diastasis recurrence was seen on physical exam in any patients treated with absorbable sutures for midline fascial plication. There was one case of infected hematoma in the barbed suture group, which occurred in a patient who presented following previous complicated abdominal lipoplasty and required additional localized lipoplasty of the cutaneous flap after

Figure 1. (A) Intraoperative deployment of the double-ended barbed #2-PDO suture at the subxiphoid region to begin the midline diastasis repair. (B) Diagrammatic representation of two double-armed barbed sutures deployed to their respective transition zones and ready for running the two-layer closure above and below the umbilicus. Reprinted with permission of Angiotech Pharmaceuticals, Inc. © 2009 Angiotech Pharmaceuticals, Inc.

Figure 2. (A) The first running layer is complete to the umbilicus and ready for the back throw. The second arm of the suture is ready for deployment at the xiphoid. (B) This diagram shows the first running layer being completed and cut after the backstitch inferiorly. No knots are required for barbed suture closure. Reprinted with permission of Angiotech Pharmaceuticals, Inc. © 2009 Angiotech Pharmaceuticals, Inc.
advancement. She was also given Lovenox (sanofi-aventis US, Bridgewater, New Jersey) for postoperative deep venous thrombosis (DVT) prophylaxis. Incision and drainage did not reveal any association of the hematoma with the fascial repair, and we suspect that it was related to lipoplasty on the previously scarred flap in this patient who had been given anticoagulants. The only other complications observed were three cases of minor seroma formation, each requiring a single tap: two in the barbed suture group and one in the smooth suture group. In total, 17.6% of patients in the barbed suture group experienced complications; these included two minor seromas (11.8%) and one infected hematoma (5.8%). In the smooth suture group, one minor seroma (5.8%) was observed. Overall, 30 of the 34 patients (88.2%) in this series experienced no complications.

DISCUSSION

Despite a longstanding and widespread belief among plastic surgeons that permanent sutures are required for midline fascial plication of rectus diastasis during abdominoplasty, our data shows that long-acting absorbable sutures (barbed or smooth) are an effective alternative. This supports previous reports in the literature, as well. With a maximum follow-up of 4.5 years and a mean of 2.8 years, no evidence of recurrent diastasis was observed in any of the 34 patients who underwent this procedure. Recent studies also confirm successful placement of absorbable barbed sutures for fascial repair in other plastic surgery applications, including mastopexy and brachioplasty.13

In this series of 34 patients, more postoperative complications were evident in the barbed suture group, although all were minor in nature. There was no evidence of wound dehiscence, skin necrosis, or prolonged edema in either group. Similarly, there was no evidence of any major complications such as DVT or pulmonary embolism, both of which have been observed in larger patient series. The complication rates observed in this series were within the range reported in the literature for patient groups of similar mean BMI: 5% to 17.4% for seroma and 3% to 5.8% for hematoma.14,15

The elimination of permanent suture material that may act as a nidus for infection makes absorbable sutures an excellent alternative for midline fascia plication in abdominoplasty patients. The knotless technique for bidirectional barbed sutures also decreases excessive suture

Figure 3. The final back throw of the second arm completes the supraumbilical repair; it is cut at the level of the fascia without knotting.

Figure 4. (A) The same process shown in Figures 1, 2, and 3 begins again below the umbilicus. (B) In this diagram, the second running layer is complete above and below the umbilicus. Reprinted with permission of Angiotech Pharmaceuticals, Inc. © 2009 Angiotech Pharmaceuticals, Inc.
material in the wound bed, which is a source of infection or sinus tract formation. Visible or palpable suture knots are also eliminated; this is occasionally a problem with knotted sutures in patients who present with thin abdominal walls. The technique for placing barbed sutures is simple, has a short learning curve, and does not require an assistant to “follow” the suture since there is constant, evenly-distributed tension along the length of the repair.

Unfortunately, early adopters of barbed sutures for wound closure only had large-bore, long-acting polydioxanone at their disposal and placed it in the subcuticular areas. Like any other firm implant placed too close to the skin, cases of exposure and extrusion were prevalent. We now only utilize PDO on deep tissues and have replaced it with Monoderm (short-acting polyglactin) for superficial applications. It has also become apparent that barbed sutures require gentleness when setting the tension on the running suture line, with much less “pull” needed for approximation when compared to smooth sutures. In fact, it is unnecessary to have an assistant “follow” at all during deployment. When used properly with good suture selection and technique, we see no disadvantage to barbed sutures, except the increase in cost per suture. We believe the time savings and reduced morbidity associated with knot-free applications offset the cost.

This study is limited by the relatively small sample size and single-center retrospective design, which precludes definitive statistical analysis. This report is also restricted to a series of midline rectus plications during abdominoplasty. Although the authors have also successfully placed barbed absorbable sutures for the repair of the anterior rectus sheath and to secure onlay and interpositional mesh placements in TRAM flaps, it would be desirable to assess the results in a randomized, double-blinded study of other fascial repair sites using absorbable and permanent sutures.

Table 1. Baseline Patient Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Smooth (n = 17)</th>
<th>Barbed (n = 17)</th>
<th>All (n = 34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, years (range)</td>
<td>45.2 (33-57)</td>
<td>41.9 (33-67)</td>
<td>43.6 (33-67)</td>
</tr>
<tr>
<td>Mean BMI, kg/m² (range)</td>
<td>23.1 (18.7-29.1)</td>
<td>22.9 (19.2-27.8)</td>
<td>23.0 (18.7-29.1)</td>
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<tr>
<td>Women, No. (%)</td>
<td>17 (100)</td>
<td>17 (100)</td>
<td>34 (100)</td>
</tr>
<tr>
<td>PTS, No. (%)</td>
<td>17 (100)</td>
<td>17 (100)</td>
<td>34 (100)</td>
</tr>
<tr>
<td>Abdominoplasty, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>6 (35.3)</td>
<td>5 (29.4)</td>
<td>11 (32.4)</td>
</tr>
<tr>
<td>In conjunction</td>
<td>11 (64.7)</td>
<td>12 (70.6)</td>
<td>23 (67.6)</td>
</tr>
</tbody>
</table>

BMI, body mass index; PTS, progressive tension sutures.

Table 2. Other Procedures Performed Concurrently With Abdominoplasty

<table>
<thead>
<tr>
<th>Additional Procedure</th>
<th>Smooth (n = 17), No. (%)</th>
<th>Barbed (n = 17), No. (%)</th>
<th>All (n = 34), No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any additional procedure</td>
<td>11 (64.7)</td>
<td>12 (70.6)</td>
<td>23 (67.6)</td>
</tr>
<tr>
<td>Liposuction</td>
<td>3 (17.6)</td>
<td>4 (23.5)</td>
<td>7 (20.6)</td>
</tr>
<tr>
<td>One area</td>
<td>3 (17.6)</td>
<td>2 (11.8)</td>
<td>5 (14.7)</td>
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<tr>
<td>Two or more areas</td>
<td>0</td>
<td>2 (11.8)</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Mastopexy</td>
<td>1 (5.9)</td>
<td>0</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Mastopexy with nipple reduction</td>
<td>0</td>
<td>1 (5.9)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Mastopexy with implant exchange</td>
<td>1 (5.9)</td>
<td>0</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Mastopexy with breast augmentation</td>
<td>1 (5.9)</td>
<td>2 (11.8)</td>
<td>3 (12.5)</td>
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<tr>
<td>Mastopexy, breast augmentation, or implant exchange</td>
<td>0</td>
<td>1 (5.9)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Breast augmentation</td>
<td>1 (5.9)</td>
<td>1 (5.9)</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td>Breast augmentation, hernia repair</td>
<td>1 (5.9)</td>
<td>0</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Implant exchange</td>
<td>0</td>
<td>1 (5.9)</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Hernia repair</td>
<td>1 (5.9)</td>
<td>1 (5.9)</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Blepharoplasty</td>
<td>2 (11.8)</td>
<td>1 (5.9)</td>
<td>3 (8.8)</td>
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</table>

CONCLUSIONS

This study adds to the body of evidence supporting the use of absorbable sutures for rectus diastasis in abdominoplasty. Smooth and barbed absorbable sutures have been shown to be an effective alternative to the use of permanent sutures for plication of the midline fascial defect. Barbed absorbable sutures have the additional advantage of eliminating knots. As other specialties begin to adopt this new material for fascial repair, we believe that forthcoming studies from plastic surgeons will lead the way in developing new techniques for applying barbed suture technology in other types of procedures.

Disclosures

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REFERENCES