Progressive Tension Sutures: A Technique to Reduce Local Complications in Abdominoplasty

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Abdominoplasty has evolved as a very effective and satisfactory procedure, especially when combined with liposuction and the repair of diastasis recti. However, local complications, including hematoma and seroma formation, flap necrosis, and hypertrophic scars, continue to plague this procedure. The authors present a relatively simple and reproducible technique that allows extensive liposuction in conjunction with abdominoplasty; they think this technique reduces the incidence of local complications. This technique, the use of progressive tension sutures, has been used in their practice for more than 15 years. A retrospective review of 65 consecutive abdominoplasty patients demonstrates a very low local complication rate when compared with historical controls. In this series of both full and modified abdominoplasty patients who were followed for an average of 18 months, the authors had no hematomas, seromas, or skin flap necrosis. (*Plast. Reconstr. Surg.* 105: 2583, 2000.)

Abdominoplasty has evolved as a very effective body contouring procedure. However, local complications are a major risk of this surgery; these complications include skin flap necrosis, hypertrophic scarring, and seroma and hematoma formation. In a review of studies that was performed by Matarasso,[1] the incidence of skin flap necrosis was 5 percent, on average, whereas the incidence of seroma formation was 10 percent. Hypertrophic scarring was reported as high, but the incidence was rarely quantitated in the studies he examined.

Adjunctive procedures such as liposuction have added considerably to the overall aesthetic results of abdominoplasty. However, combining liposuction with the extensive undermining typical of abdominoplasty has been implicated in increasing local complication rates.[2] Mechanical injury to the abdominal wall vasculature is the reported mechanism for skin flap necrosis, and recommendations for limiting or avoiding the liposuction of certain areas have been espoused. Furthermore, the incidence of seroma formation reportedly increases in direct proportion to the extent of undermining and the volume of liposuction performed.

It has been our experience that full or modified abdominoplasty procedures, combined with extensive liposuction in all areas of the abdomen and hips, can be performed without local complications when the technique of progressive tension suturing is included. This technique, which has been used successfully for the past 15 years, is a simple adjunct to standard abdominoplasty procedures. The progressive tension sutures are placed from the superficial fascia to the deep fascia as the flap is advanced. Dead space is tightly closed to prevent hematoma and seroma formation, without the use of drains. Additionally, tension is transferred to the strong superficial fascial system, and no tension is placed on the distal skin flap. Distal flap perfusion is not impaired by tension, which significantly lowers the risk of flap necrosis and hypertrophic scaring.

The use of progressive tension sutures is simple; the sutures add minimal time to the procedure and eliminate the need for suction drains. Furthermore, their use has allowed virtually unrestricted liposuction of the abdomen

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and hips in conjunction with abdominoplasty, with a minimum of local complications.

Operative Technique

The technique is relatively simple and is applicable to both modified and full abdominoplasties. It has been performed using both general anesthesia and local anesthesia with intravenous sedation. The introduction of the superwet infiltration technique has minimized blood loss and has facilitated performing the procedure under local anesthesia with intravenous sedation.

The patient is marked in an upright position; all areas appropriate for liposuction are noted. Suctioning is performed before the abdominoplasty using a standard superwet technique. We use a 3.7-mm, Mercedes-type cannula, with either a syringe or vacuum pump method. Suctioning is limited to a plane deep to the superficial fascia. All areas of the abdomen, hips, and flanks are addressed strictly on the basis of the patient's needs. Only the upper flanks are treated less aggressively to protect the segmental thoracic and lumbar vessels.

When liposuction is completed, the appropriate abdominoplasty incision is performed. Undermining for both the modified and full abdominoplasty is fairly extensive in the lower abdomen. Undermining of the epigastrium in the full procedure is limited to the area that is necessary to allow for the repair of the rectus diastasis and to allow the untethered advancement of the abdominal flap. The midline rectus plication is performed with interrupted 0 Mersilene sutures in the usual fashion.

The patient is then placed in a moderate flexed position, and the progressive tension sutures are placed. The surgeon advances the flap while placing 3-0 Vicryl sutures from the superficial to the deep fascia (Fig. 1, *above*). The suture is tied while the assistant maintains the flap in the advanced position (Fig. 1, *below*). The advancement and suturing are repeated in the midline at intervals of approximately 1.0 cm. Lateral areas of the undermined flap are sutured as needed to close the dead space and to secure the advanced flap. This suture advancement is continued to the level of the inferior wound edge (Fig. 2). It should be noted that sutures placed too superficially and sutures that too aggressively advance the flap will leave a dimple in the skin. Inspection of the skin surface is done after the placement and tying of each suture. If deep dimpling is observed, the suture is removed and replaced. Minor dimpling is acceptable, and it completely resolves in about 6 weeks. This is the only aspect of the technique with a learning curve.

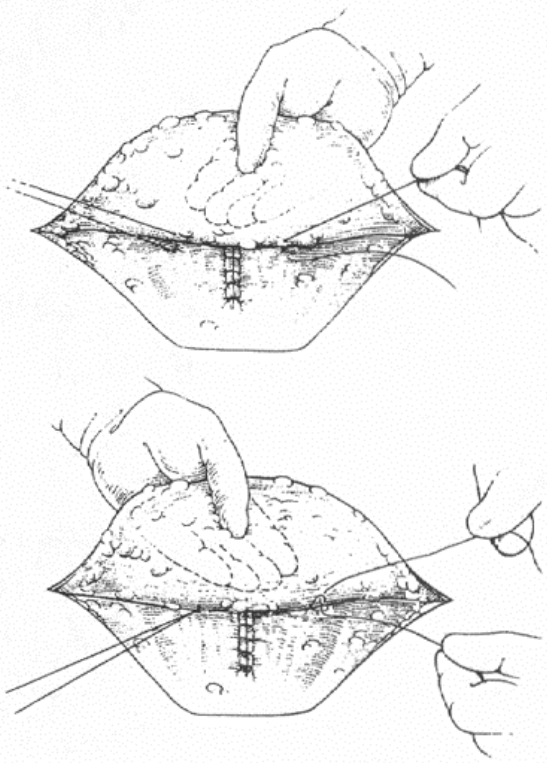

Fig. 1. (*Above*) The surgeon places progressive tension suture from the superficial to the deep fascia. (*Below*) The assistant maintains the flap in the advanced position while the surgeon ties down the suture.

The excess skin is excised, and the superficial fascia of the superior and inferior wound edges is approximated. The wound edges lie together in the advanced position under no tension. The skin is closed with buried, interrupted sutures in the deep dermis, and a running subcuticular suture is used to close the skin.

No drains are required because the flap is tightly coapted to the deep fascia, and minimal dead space remains. The placement of Steristrips, dressings, and a compressive garment completes the procedure. An overnight stay in the hospital is recommended for the full abdominoplasty, but it is not required. The modified abdominoplasty is usually performed as an outpatient procedure. The patient is directed to wear a compressive garment for at least 2 weeks. The use of the garment should

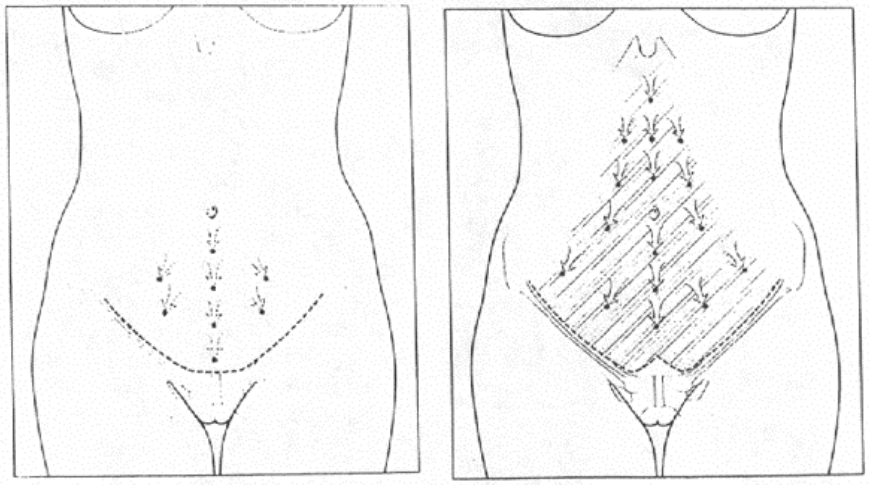

FIG. 2. Cross-hatched area depicts extent of flap elevation, and arrows demonstrate the vector of flap advancement and the location of sutures in both full (*left*) and modified (*right*) abdominoplasties.

be continued beyond this period as required for support and patient comfort.

METHOD

A retrospective chart review was undertaken, and 65 consecutive abdominoplasty cases were reviewed. These cases included 40 modified and 25 full abdominoplasties performed by the two authors.

RESULTS

A total of 56 of the 65 abdominoplasties (86 percent) were performed using general anesthesia, although there was a trend toward performing more procedures under local anesthesia with intravenous sedation. Patients ranged in age from 22 to 70 years, with mean age of 42 years. Follow-up ranged from 3 months to 8 years, with a mean of 15 months. The total suction lipectomy volume varied from 300 to 5000 cc, with a mean of 1800 cc. Of the 65 patients who underwent this procedure, none had seromas, hematomas or skin necrosis. A liberal revision policy resulted in 10 cases (15 percent) of minor revisions; these mostly consisted of touch-up liposuction or dog-ear revisions. The only local complication was a small area of localized drainage in a 70-year-old diabetic that was thought to be a liquefaction of an area of fat necrosis. The wound healed rapidly and did not compromise the final result.

DISCUSSION

Two major factors are responsible for local complications in abdominoplasty, and both are addressed by the use of progressive tension sutures. The first is the dead space created by the extensive undermining and mobilization of the abdominal flaps. When combined with liposuction, additional dead space is created. Preventative measures that have been suggested include the routine use of drains, the use of compressive garments with foam dressings, and even body casts. Others recommend limiting both the extent and location of the concomitant liposuction to reduce the dead space. However, this can compromise the final aesthetic result. Progressive tension sutures effectively eliminate dead space, preventing fluid collection both acutely and chronically. Postoperative drains are unnecessary, and early ambulation is possible.

Wound tension is another major factor contributing to local complications. Tension compromises the circulation to the distal flap, which can lead to necrosis. Additionally, tension on the closure can lead to widening or hypertrophy of the scar. Finally, excessive tension can produce a superior displacement of the mons pubis. Progressive tension sutures transfer the tension to the fascial system. Tension is distributed over the entire deep surface of the abdominal flap, leaving minimal tension on the skin closure.

Progressive tension sutures should be differentiated from the "quilting sutures" described by Baroudi and Ferreira.[3] The suturing technique they describe approximates the full-thickness flap and deep fascia to close the dead

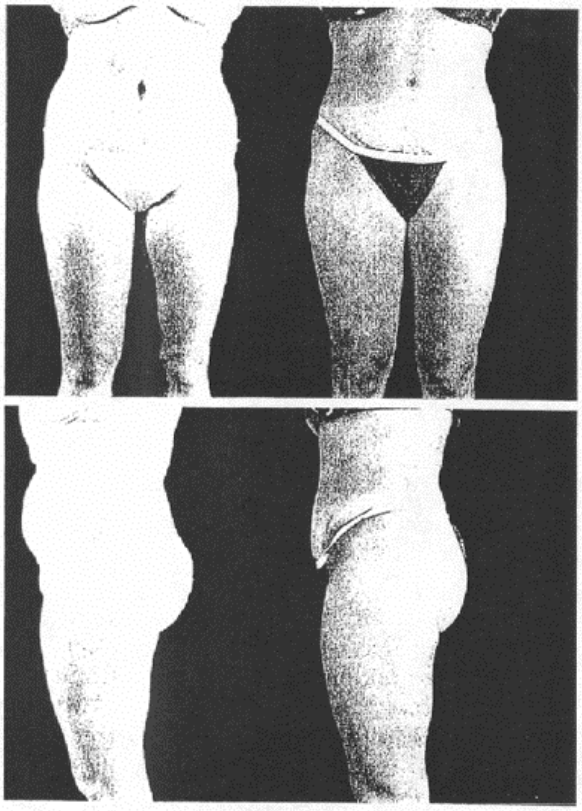

FIG. 3. (*Above*) Frontal and (*below*) lateral views of a full abdominoplasty patient taken preoperatively (*left*) and 3 months postoperatively (*right*).

space. The progressive tension sutures are placed while advancing the flap, yielding "progressive" tension on each suture. Further, because the deep fat has been removed or significantly reduced, the progressive tension sutures are placed from the superficial to the deep fascia. These sutures anchor the flap in the advanced position, distributing the tension over the flap and eliminating dead space.

Huger[4] describes three vascular zones of the abdominal wall. Two of these zones are partially or completely divided in most abdominoplasty procedures. Matarasso[5] recommends limiting or avoiding liposuction in the "arc" areas to avoid damage to the remaining vasculature. It cannot be disputed that the blood supply to the abdominoplasty flap is limited and that protecting the remaining vessels is important. However, rarely is the blood supply to the axial portion of the flap ever compromised. Rather, it is the random circulation at the distal flap that is jeopardized. Tension on the flap at the level of the skin impairs perfusion through the subdermal plexus and compromises the circulation of the distal flap. By redistributing the tension on the flap to the deeper fascia, the flow in the subdermal plexus is not hindered, allowing for more complete suctioning without worrying about further devascularization of the flaps.

Thus, another benefit of the progressive tension suture is the ability to use liposuction more liberally in combination with abdominoplasty, thereby reducing the need for multiple staged procedures. The safety of concomitant liposuction has been demonstrated (Fig. 3).

SUMMARY

A simple suturing technique significantly reduces the local complications of abdominoplasty; this technique enhances the results and seems to ease convalescence. Progressive tension sutures may be used in other procedures when skin flap advancement is involved.

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