Use of Quilting Sutures During Abdominoplasty to Prevent Seroma Formation: Are They Really Effective?

Marcos Sforza, MD; Rodwan Husein; Katarina Andjelkov, MD, PhD; Paulo Cesar Rozental-Fernandes, MD; Renato Zaccheddu, MD; and Milan Jovanovic, MD, PhD

Abstract

Background: Abdominoplasty surgery is one of the most popular cosmetic procedures performed in plastic surgery. As with any surgical procedure, it is associated with risks and complications, primarily that of seroma formation. Quilting sutures are a recent development in abdominoplasty surgery that aim to prevent the incidence of seroma.

Objectives: The aim of this article was to assess the effectiveness of quilting suturing in the prevention of seroma formation.

Methods: In our retrospective clinical study, 414 female patients underwent abdominoplasty surgery with liposculpture contouring. The patients were divided into three groups. The first group, comprising of 100 patients, were fitted with two drains postoperatively and no quilting sutures. The second group of 226 patients underwent quilting suturing in addition to receiving two drains. And the final group of 88 patients also underwent quilting suturing, but received only one drain. Post-operative seroma diagnosis was confirmed with the presence of clinical signs and symptoms.

Results: The data was analysed using Fisher's exact test. With P < .000, we rejected our null hypothesis that there is no difference in results between the procedure with sutures and that without sutures. We calculated that the probability of having seroma with sutures to be <0.02. In contrast, abstinence from quilting sutures resulted in a 12% risk of seroma formation.

Conclusions: The use of quilting sutures is a significantly effective measure for the prevention of seroma formation.

Level of Evidence: 4

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With over 160,000 procedures performed annually in the United States, abdominoplasty has become one of the most popular and sought after surgeries within the plastic and reconstructive field.\(^1\) As with any surgery, abdominoplasty is associated with a variety of different complications including seroma, hematoma, cellulitis, deep venous thrombosis (DVT) and pulmonary embolism (PE).\(^2\) Of these, seroma formation is the most commonly occurring with an incidence rate of 10%-15%\(^3\) amongst all other complications. Seroma development is highly problematic for both the patient and surgeon, resulting in further treatment, prolonged recovery time and increased costs. Despite usually being self-limiting, seromas can cause wound dehiscence, flap necrosis and predispose to infection. In addition, it can induce scar tissue formation and increase tissue pressure and effecting contour. Some authors have described capsular formation after seromas leading to asymmetries and poor aesthetic outcome.\(^4\)

So what can be done to prevent the incidence of abdominoplasty associated seroma? One proposed method aimed at tackling seroma is quilting sutures placement. These are sutures used to attach an undermined flap to the abdominal wall fascia. Quilting sutures were first developed by Titley et al. in the mid 90’s, who discovered their ability to reduce seroma formation in latissimus dorsi harvest.\(^5\) Baroudi and Ferreira later applied this technique to abdominoplasty surgery, achieving good clinical results and advocating the use of quilting sutures for seroma prevention.\(^6\) However, current quilting suture practice involves the prolongation of operating time by up to 50 minutes. This is a significant time span, too long and risky for most surgeons and anaesthetists alike. As such, in this study we assess the effectiveness of quilting sutures in reducing abdominoplasty associated seroma, using a new time-efficient operating technique that uses less than one-third of the original number of sutures described by Baroudi.

**METHODS**

In order to assess the effectiveness of quilting sutures, we performed a retrospective clinical study involving 414 female patients, undergoing abdominoplasty surgery with flank lipo-contouring between January 2007 and December 2011. In our practice we have very little demand for abdominoplasties from the male population and we did not have male requests in that period. All surgeries were performed in a private UK hospital. Combined abdominoplasty and lipo-contour patients were selected due to their increased risk of seroma formation compared to abdominoplasty only patients, allowing us to extensively evaluate quilting suture efficacy.\(^7\) Prior to participation in the study, written informed consent was acquired from all patients included in the study.

**Patients**

The selected patients were divided into three groups:

Group 1 comprised of 100 patients who underwent surgery between January 2007 and June 2008. These patients did not have quilting sutures, but had two size 14 pubic drains positioned internally supra and infraumbilically. Group 2, comprised of 226 patients undergoing abdominoplasty surgery with quilting sutures in addition to the drains used in group 1, between the period of July 2008 and December 2010. Our third and final group of 88 patients underwent surgery between January 2010 and December 2011. This group of individuals were operated on using quilting sutures and one drain, positioned internally infraumbilically. Our hospital policy states that all abdominoplasties must be drained to guarantee proper monitoring of the bleeding during the night. Therefore all groups had 2 drains placed, except for group 3 who only received 1.

A preoperative 45-day smoking cessation period was imposed on all patients with all surgeries being performed under general anesthesia by the same surgical team. All patients undergoing abdominoplasty were included in this study except for active smokers who failed to commit to the cessation period. No other exclusion criteria were included in the study. Patients were systematically reviewed at 7-, 14-, and 28-day intervals and whenever necessary for up to one year. Seroma diagnosis was confirmed clinically, with syringe aspiration performed bi-weekly to treat the complication when necessary. The smoking habits of all patients were also recorded. Our aftercare scheme covers up to 3 years and entitles any free revisions. The patients need to return after one year to renew for the next 2 years, otherwise the aftercare is voided. All 414 have returned.

**Surgical Technique**

All abdominoplasties performed involved a transverse lower abdominal incision and wide undermining of the skin and subcutaneous tissue to the costal margins and 2 cm below the xiphoid appendix. Tightening of the abdominal musculature with correction of rectus muscle diastasis with Prolene 1 sutures was then completed, followed by resection of redundant abdominal skin and subcutaneous tissue.

The umbilicus was then repositioned using Avelar’s technique before final skin closure.\(^8\) Liposuction was employed in the lateral regions of the abdomen and hips. Liposculpture was executed to improve the contouring result, but no liposculpture of the dorsum and/or abdominal flap or any other additional areas was performed in any of these cases. All patients were administered compression socks (Preventex, UK) and underwent surgery using a prophylactic pneumatic DVT system (Flowtron, UK). All
participants also received prophylactic enoxaparin. Patients with BMIs of up to 30 were administered 20 mg whilst those with BMIs over 30 were given 40 mg. Enoxaparin was delivered as a single dose at the end of the procedure.

Group 2 and 3 patients had 9 to 15 Monocryl 2.0 single sutures inserted depending on the extension of the area undermined with at least 2 inches between each suture (Figures 1 and 2, and Supplementary Video S1). The sutures were distributed equally at the surgeon’s discretion and used to attach the undermined flap to the abdominal wall fascia. Equality and proportion of the sutures position was determined by the operating surgeon’s observation following hemostasis. In general small patients would only require the minimum of 9 sutures were as very large patient would require the maximum of 15 The average time spent per suture was less than 30 seconds, cumulating to a maximal 5-minute increase on general operative time (Supplementary Video S1). All surgical procedures were completed within one and a half to two hours.

Drains were introduced through the pubic area in all three groups, using size 14 vacuum system drains (Medinorm, Germany). Drains were subsequently removed 48 hours postoperatively, providing that drainage was less than 30 mL in 24 hours. Drains were used in all groups according to hospital policy in abdominoplasties. All patients had compressive garments dressed in the operative room, remaining in situ for 6 weeks in all patients. Hospital stay was 2 nights in all cases with early ambulation encouraged from the first postoperative day.

**RESULTS**

The mean age was 41.2 years (range, 28-57 years) for Group 1, 40.2 years (range, 29-56 years) for Group 2, and 41.5 years (range, 25-57 years) for Group 3. All 414 patients were followed up for a 1-year period. In addition, we gathered information regarding the smoking habits of the patients. The data was analyzed using Fisher’s exact test. Exact logistic regression was also applied in order to control for possible confounding in our sample.

We applied one-sided Fisher’s exact test to determine the efficacy of sutures in reducing the clinical appearance of seroma. The result, at \( P < .001 \), indicated the need to reject our null hypothesis; that there is no difference between the procedure with sutures and without sutures. We calculated that the upper 95% confidence level of the probability of having seroma with sutures is \(< 0.02\). No cases of seroma were recorded in any patient with quilting sutures. In

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<th>Table 1. Demographic and complication information for all groups</th>
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<tr>
<td><strong>Group 1</strong></td>
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were followed up for a 1-year period. In addition, we gathered information regarding the smoking habits of the patients. The data was analyzed using Fisher’s exact test. Exact logistic regression was also applied in order to control for possible confounding in our sample.
contrast, we found that 12% of the patients without sutures developed seroma. Additional information about patient demographics and complications can be found on Table 1.

We also analyzed the effect of smoking on seroma formation. It was found that 15% of smokers developed seroma in comparison to only 1.6% of non-smokers. One sided Fisher’s exact test also gave a value of $P = .013$, further indicting smoking as a significant contributor to abdominoplasty associated seroma. Exact logistic regression was used to control for possible confounding in our sample. We found that sutures decrease the probability of developing seroma at $P = .0007$ and smoking increases the probability of developing seroma when sutures were not present at $P = .0585$ (Figures 3 and 4).

Two incidents of hematoma were also recorded in Group 1, in contrast to Groups 2 and 3 where no patients developed hematoma. However, due to the fact that drains were used in all groups we cannot conclude that their implementation can be significantly associated with hematoma prevention. Future studies should be powered to address this finding. Typical clinical results are shown Supplementary Figures S1 and S2.

**DISCUSSION**

The abdomen plays a central role in defining the body’s contours. It’s composition alongside the flanks form the central defining silhouette of the body. Many individuals experience superficial distortion of the abdomen naturally as they age and following pregnancy and weight loss. The main causes of abdominal contour deformities are obesity, flaccidity of the muscles, localized lipodystrophy and events of trauma or previous surgery that result in scars, hernias, and eventrations. Such distortion can greatly alter a figure and create a perceived undesirable body image. It is for these reasons that many thousands of women choose to undergo corrective body contouring procedures, primarily that of abdominoplasty and liposuction.

Despite its popularity and advancements, abdominoplasty, as with any surgical procedure, is associated with a variety of complications. Immediate complications can include deep vein thrombosis, pulmonary emboli and hematoma. Early complications include infection, skin necrosis, umbilical necrosis and seroma. The incidence of each complication varies in literature, however seroma formation is reported to be one of the most commonly occurring with an incidence of 10%-15%. The most significant factors predisposing patients to post-abdominoplasty seroma are body mass index, the extent of flap undermining and the combination of liposuction or other procedures. Seroma formation is highly problematic for both the surgeon and patient. It results in both patient anxiety and discomfort, succeeded by frequent outpatient visits, follow-up treatment and potentially increased costs. Occasionally seroma formation can also cause more significant problems including wound dehiscence, flap necrosis, infection and pseudocyst formation. The pathophysiology of seroma is not utterly discovered and not well understood but by definition it has been described as a subcutaneous non-infective exudate fluid. Mechanisms postulated for its formation include disruptions of vascular and lymphatic channels, dead space creation, shearing forces between the flap and fascia and release of inflammatory mediators. The main cause of seroma is thought to be inflammation, a normal physiological response to the trauma of surgery. However, given the high levels of seroma incidence in abdominoplasty procedures, disruption of lymphatic systems and dead space creation are thought to be highly relevant and aggravating factors. Patients undergoing abdominoplasty surgery tend to possess thick enlarged skin flaps with an engorged lymphatic system. This hypertrophic lymphatic system has an extensive network of vessels severed during undermining, allowing fluid drainage and collection in the dead space

**Figure 3.** Graphic with the distribution of patients from the original studied groups who did not develop seroma, according to the smoking and non-smoking variable.

**Figure 4.** Graphic with the distribution of patients from the original studied groups who developed seroma, according to the smoking and non-smoking variable.
created by dissection. Dead space volume is not only created by surgical undermining but also by the process of liposuction, what increases fluid drainage to the cavity. This accounts for the significantly higher seroma incidence rates in combined abdominoplasty/liposuction procedures compared to abdominoplasty alone.7 Matarasso states that the incidence of seroma increases in relation to the volume of associate liposuction and the extent of flap undermining.15 The combination of causative factors presents surgeons with a problem. Given that seroma will always form to some extent in any surgical procedure due to physiological inflammation we may never be able to prevent its formation. So if we are unable to prevent seroma development then we can at least reduce the volume formed by minimizing lymphatic trauma and decreasing dead space creation.

Attempts have been made to address this issue by introducing additional measures to the classic abdominoplasty. Pitanguy describes a method involving the use of a plaster shield molded over a thick soft dressing to avoid seroma.16 This handmade 2 kg plate lies on top of the anterior abdominal wall and is thought to reduce seroma development by providing a firm and even pressure over the dissected abdominal flap, guaranteeing the adhesion of undermined tissues. Minimal handling of the skin flap, thromboembolism prophylaxis and the application of compression garments are similarly thought to help reduce seroma formation.15 Current literature indicates that drains may also be effective seroma deterrents.18 However, drain placement has been shown to be a source of infection and even discomfort for patients.19 Nonetheless, un-drained small collections of blood under the abdominal flap can eventually sediment as plasma.13 This plasma, if not drained or reabsorbed, will help maintain dead space volume aiding seroma formation. From our results we found no statistical difference in seroma and/or hematoma incidence when compared with the number of drains used. But, this was only true in patients who underwent quilting suture abdominoplasty. We cannot confirm or deny that drains are a necessary measure to be implemented on a singular basis. Our current hospital policy on drain implementation is under review with the prospect of eliminating their use in such procedures. Further studies exploring the technique without drains are encouraged. Nevertheless, taking all our variables into consideration, we can conclude that one drain was more than sufficient to monitor and/or remove any excess of fluids, when our technique was used.

One of the other proposed measures aimed at reducing seroma formation is quilting suture placement. Quilting sutures are a relatively new concept. Tittley et al was the first to implement their use in latissimus dorsi harvest in 1997.7 The authors describe a 27 patient case-control study, involving 11 individuals undergoing surgery with quilting sutures. The results achieved were astonishing, with 56% of the control group developing seroma in comparison to 0% of the suture group (P = .003). These results were echoed by Daltrey20 and later Rios21 who found that quilting sutures reduced overall seroma volume in latissimus dorsi harvest. Despite the positive press, one study found that seroma formation was not reduced as a result of quilting sutures in TRAM flap reconstruction (P = 1.00).22 However the authors describe a technique involving only 11 sutures in comparison to other studies that use approximately 30. This indicates the possibility of a fault in suturing methodology rather than the quilting suture concept.

Baroudi and Ferreira were the first to describe the use of quilting sutures in cosmetic abdominoplasty surgery.6 They found that applying over 40 quilting sutures per patient resulted in a 0% rate of seroma incidence. Pollock & Pollock later described their 12-year experience of progressive tension sutures in a 597-patient series.23 Progressive tension sutures vary slightly from quilting sutures, in that they are thought to allow tension free advancement of the abdominal flap in a proximal to distal direction. They aim not only to reduce seroma formation but also to provide a tension free abdominal border that prevents skin suffering. Despite the difference, the study further supported the case for sutured abdominoplasties as no incidence of seroma was recorded over the entire period. The authors even advocate that quilting sutures may in fact also help reduce the incidence of other complications such as hematoma and skin necrosis as the flap tension was distributed among the sutures, leaving a tension free wound to be closed.

More recently, Di Martino et al also showed the benefits of progressive tension sutures in abdominoplasty in their 58-patient study.24 The authors found that seroma formation was absent in patients who had had suture placement compared to 38% of those who had not. These results held true for both short and long term follow up. Conversely, Andrades et al’s study found no significant difference in seroma incidence when comparing sutures to drain implementation.25 The results on this single study contradict the findings of many other authors, which have led us to stipulate that this Chilean study may have involved a misuse or error in technique.

Pollock et al’s detailed study allowed us to appreciate the effectiveness of quilting sutures in reducing seroma incidence in abdominoplasty.23 However, it also highlighted a problem with current procedures. Present-day techniques involve the placement of 30-40 sutures over an average of 50 minutes. 50 minutes is a significant addition to surgical time that very few surgeons would be willing to introduce to their practice. The longer a surgical procedure is, the higher the risk of surgical site infection, DVT and PE. Other potential complications of prolonged surgery are hypothermia, fluid shifts, nerve compression injuries, compartment syndromes and rhabdomyolysis.26 Our study on the other hand has shown that with only 9-15 quilting sutures, seroma accumulation can be significantly reduced. The key point, however, is that placement of these sutures only
requires an additional 5 minutes. The use of barbed sutures has also been highlighted in recent years. Warner et al clearly demonstrated that barbed sutures are also an efficient alternative to progressive tension suturing requiring only 9 minutes. However the reported seroma rates with this technique ranged between 1.7%-8.3% in the few small available studies in comparison to our 0% incidence. Also, the higher cost of the proposed suture brand in these papers may become impetuous to surgeons in less fortunate areas to perform this technique.27,28

It is also important to highlight the power of our study in comparison to previous publications. We evaluated the effectiveness of quilting sutures in 414 patients, a cohort 7-8 times larger than most other studies. Criticism may be due in the fact that seroma diagnosis was established clinically and without ultrasound which may have lead to a certain degree of observer bias in detection. Di Martino et al’s study illustrated the potential of this and showed that 23.8% of seromas are diagnosed clinically compared to 38.1% using ultrasound.24 Nevertheless, as mentioned before, seroma formation will always occur to a certain degree following surgery, with small fluid collections being reabsorbed by the body without pathological consequence. The presence of fluid collections is not a complication but a natural process that occurs following abdominoplasty; the fact that fluid is present does not necessarily mean that a problem will occur. Ultrasound is therefore more effective in detecting fluid collection, but not in the diagnosis of pathological seroma.

We also looked into the effect of smoking on seroma formation in this study. We found that a past history of smoking was associated with a significantly higher risk of developing seroma, even after a 45-day cessation period. Smoking has long been known to have long-term negative affects on the human body, predisposing individuals to cancer, cardiovascular, cerebral and pulmonary diseases to name but a few. In addition to this, smokers have been shown to have worse outcomes when undergoing surgery in a variety of fields including plastic and reconstructive surgery.29 A 2008 British study found that infection rates were significantly higher in smokers in comparison to non-smokers (14 vs 1, respectively) in patients undergoing abdominoplasty surgery. Similarly, Manassa et al showed that 47.9% of smokers experienced wound healing problems or dehiscence compared to only 14.8% of non-smokers.30 Conversely, Momeni et al describe results that show no significant difference in both major and minor complications between smokers and non-smokers.2 We can only assume that the small sample size may not have allowed for full assessment of the risk factor. Tobacco smoke has been found to contain over 4000 different toxic substances, including nicotine and carbon monoxide. Smoking primarily causes hypoxia, impaired wound epithelisation, thrombogenesis, diminished oxygen utilization, microvascular injury and leukocyte, macrophage, fibroblast and platelet dysfunction.29 The increased incidence of seroma in smokers can be attributed to tobacco’s general impairing effect on wound healing and vasculature repair. We believe that a long cessation period of smoking is necessary to revert the damaging effects of tobacco. The 45-day cessation period is only effective enough to reduce the immediate perioperative and postoperative period effects of smoking. We do not believe that this small time period is holistic in reversing the entirety of tobacco’s effects. Our results only highlight the existence of a relationship between smoking and seroma formation. It would be difficult to scientifically infer from our study that smoking increases the chance of seroma without further investigation.

CONCLUSION

The use of quilting sutures in abdominoplasty surgery has completely changed the outlook and practice of a single surgeon. Following our study on over 400 patients we have come to conclude that quilting sutures in a reduced number are an effective measure in diminishing the clinical manifestation of seroma. In addition to which we can also conclude that smoking is a major risk factor for seroma development. Finally, we believe that the use of drains will eventually become obsolete in the presence of any type of fixation sutures, but further studies are necessary to fully validate this.

Supplementary Material

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REFERENCES