

# Efficacy of a non-invasive mechanical wound closure device in post-bariatric plastic surgery: a prospective study

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## ABSTRACT

**Background** Post-bariatric plastic surgery requires optimal wound closure techniques to enhance healing and aesthetic outcomes. Traditional suturing techniques, while effective, may lead to increased tension and scarring. The introduction of non-invasive mechanical wound closure devices offers a promising alternative to traditional sutures.

**Aim** This study aims to evaluate the efficacy of a non-invasive mechanical wound closure device compared to traditional sutures in post-bariatric plastic surgery patients, focusing on healing time, scar quality and patient satisfaction.

**Methods** A prospective observational study was conducted over three years, including 64 patients undergoing post-bariatric body contouring surgery. Patients were assigned to one of two groups: traditional sutures (n=32) or a non-invasive mechanical closure device (n=32). Wound healing was assessed at 1, 3, and 6 months postoperatively using clinical evaluations and SCAR-Q scores. Complications and patient satisfaction levels were also recorded.

**Results** Patients treated with the mechanical device demonstrated significantly faster healing times ( $p < 0.001$ ), superior SCAR-Q scores ( $p < 0.001$ ), and fewer complications compared to those receiving traditional sutures. At one month, the average healing time was  $17.3 \pm 2.1$  days in the mechanical closure group versus  $22.5 \pm 2.7$  days in the suture group ( $p = 0.002$ ). At three months, SCAR-Q scores were significantly higher in the mechanical closure group ( $76.4 \pm 4.3$  versus  $68.1 \pm 3.9$ ,  $p < 0.001$ ). At six months, the device-treated group reported a complication rate of 3.2% compared to 12.5% in the traditional suture group ( $p = 0.005$ ).

**Conclusions** The study suggests that the non-invasive mechanical closure device is an effective alternative to traditional sutures, offering benefits in wound healing, scar quality and patient satisfaction. Further studies with larger cohorts and longer follow-ups are warranted.

**Keywords** mechanical closure devices, wounds, reconstructive surgery, post bariatric surgery, plastic surgery, flaps.

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## KEY MESSAGES

- Non-invasive mechanical closure devices significantly improve wound healing outcomes in post-bariatric plastic surgery.
- Patients treated with the device demonstrated higher SCAR-Q scores and lower complication rates.
- Faster recovery times and better cosmetic outcomes highlight the potential for integrating this technology into standard surgical practice.

## INTRODUCTION

Post-bariatric plastic surgery represents an essential step for patients who have undergone significant weight loss, addressing skin excess and improving body contour.<sup>1,2,3</sup> However, these procedures pose challenges in wound closure due to high tension areas, increased risk of wound dehiscence, and potential hypertrophic scarring. Traditional suturing methods have been the gold standard, yet alternative

techniques are being investigated to improve healing and aesthetic outcomes.<sup>4</sup> The introduction of non-invasive mechanical wound closure devices aims to minimise tissue trauma, distribute closure forces evenly, and potentially reduce complications associated with traditional sutures. These systems typically consist of adhesive skin anchors connected by a tension-adjustable central core, allowing manual modulation of transverse forces to counteract wound tension.

Recent advancements in wound closure technologies have shown promising results in orthopedic and general surgical settings, where they are already widely adopted to reduce dehiscence and improve wound stability under mechanical stress, but limited studies have specifically analysed their effectiveness in post-bariatric plastic surgery. Postoperative site infections are reported in up to 15% of patients undergoing body contouring after bariatric surgery, making optimised closure techniques particularly relevant.<sup>5</sup>

This study aims to compare traditional suturing methods with

a non-invasive mechanical wound closure device in terms of wound healing, scar quality and patient satisfaction.

## MATERIALS AND METHODS

### Study design

A non-randomised controlled trial (NRCT) was conducted over three years at the Department of Plastic Surgery, USL Umbria 1, from December 2021 to November 2024. A total of 64 patients undergoing post-bariatric body contouring procedures, including abdominoplasty, brachioplasty and thighplasty, were enrolled (Figure 1, Figure 2). The study



Figure 1A Left arm lifting: immediately after device placement.



Figure 1B. Left arm lifting: immediately after device removal.

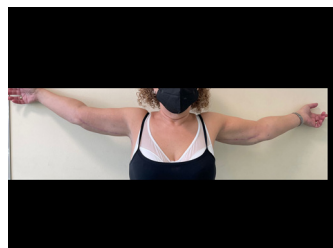


Figure 1C. Left (and right) arm lifting: 3 months after surgery.



Figure 2A Abdomen, vertical scar: immediately after device placement.



Figure 2B. Abdomen, vertical scar: immediately after device removal.

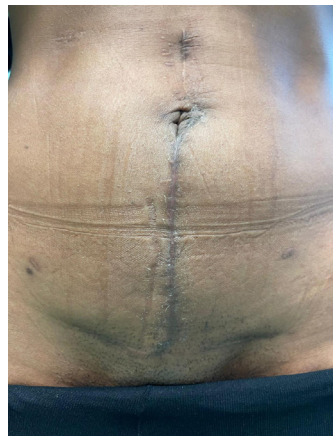


Figure 2C. Abdomen, vertical scar: 3 months after device removal.

adhered to the ethical guidelines set by the Declaration of Helsinki, and was approved by the Local Ethics Committee. The study protocol was developed in accordance with the SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) guidelines.<sup>6,7</sup>

Patients were assigned into two groups: one receiving traditional sutures (n=32) and the other treated with a non-invasive mechanical closure device (n=31).

Inclusion criteria required:

- a stable weight ( $\pm 2$ kg variation) maintained for at least 18 months post-bariatric surgery
- body Mass Index (BMI) between 24 and 30
- both sexes and age between 25–65 years
- absence of systemic conditions known to impair wound healing: diabetes mellitus, coagulation disorders, active oncologic treatment (chemotherapy or radiotherapy)

Exclusion criteria included the following:

- active infections at the surgical site
- previous keloid formation
- chronic immunosuppressive therapy
- uncontrolled systemic diseases
- history of postoperative wound complications or readmissions due to wound dehiscence or infection.

### Procedure, evaluation criteria and outcomes

All procedures were performed under general anesthesia by a single surgical team to ensure consistency. After excising excess skin, hemostasis was achieved using electrocautery. The patients in the control group had their wounds closed using traditional interrupted sutures with absorbable material for deep layers and non-absorbable monofilament for the skin. In the experimental group, a non-invasive mechanical wound closure device was applied following the manufacturer's recommendations. The system consists of bilateral adhesive skin anchors and a central adjustable core, which allows for manual modulation of lateral tension to achieve optimal wound edge approximation and tension offloading.

Postoperative evaluations were conducted at 1, 3, and 6 months by blinded independent assessors (Table 2). Healing progression was documented using digital photography and clinical examination.

Primary outcomes included:

- Healing time: Measured in days from surgery to complete epithelialisation. It was hypothesised that patients in the mechanical closure group would achieve healing in approximately 17–20 days, compared to 25–30 days in the traditional suture group, based on prior studies.
- Scar quality: Assessed using the SCAR-Q patient-reported outcome measure, which evaluates scar appearance, symptoms, and psychosocial impact.
- Complication rates: Including wound dehiscence, infection and hypertrophic scarring.
- Patient satisfaction: Assessed using the Wound Quality of Life Index (WQoLI), a validated tool for evaluating patient-centered outcomes in wound care.

Statistical analysis was performed using SPSS software, with significance set at  $p < 0.05$ . Continuous variables were expressed as mean  $\pm$  standard deviation (SD), while categorical variables were analyzed using chi-square or Fisher's exact test.

## RESULTS

A total of 64 patients completed the study. Demographic characteristics, including age, BMI, and gender distribution, were comparable between the two groups (Table 3). The primary outcome measure, healing time, was significantly shorter in the mechanical closure group across all time points. At one month, the mean healing time was  $17.3 \pm 2.1$  days in the mechanical closure group versus  $22.5 \pm 2.7$  days in the suture group ( $p = 0.002$ ). These results align with prior literature suggesting that atraumatic closure methods promote faster epithelialisation by reducing local tissue stress and inflammation.

By three months, the healing rate remained superior in the mechanical closure group ( $p < 0.001$ ). At 6 months, final scar assessment demonstrated higher SCAR-Q scores in the mechanical closure group ( $82.5 \pm 4.1$ ) compared to the suture group ( $74.3 \pm 3.9$ ,  $p < 0.001$ ).

Complication rates were lower in the mechanical closure group, with wound dehiscence occurring in 3.2% of cases compared to 12.5% in the suture group ( $p = 0.005$ ). No major infections or readmissions occurred in either group, though minor superficial infections were noted in two cases (suture group only).

Table 1. Study demographics.

Variable	Traditional sutures (n=32)	Mechanical closure (n=32)	p-value
Age (years)	42.6 $\pm$ 8.3	41.9 $\pm$ 7.8	0.72
BMI (kg/m-sq)	29.4 $\pm$ 3.2	28.9 $\pm$ 3.4	0.65
Gender (M/F)	14/18	12/19	0.83
Smoking (%)	12.5%	9.7%	0.58

Table 2. SCAR-Q Scores Over Time.

Time Point	Traditional sutures (mean $\pm$ SD)	Mechanical closure (mean $\pm$ SD)	p-value
1 month	60.5 $\pm$ 3.8	66.4 $\pm$ 4.2	0.02
3 months	69.2 $\pm$ 3.5	75.6 $\pm$ 3.1	0.01
6 months	74.1 $\pm$ 4.6	82.5 $\pm$ 4.1	<0.001

Table 3. Healing Time and Complications.

Parameter	Traditional sutures	Mechanical closure	p-value
Healing time (days)	22.5 $\pm$ 2.7	17.3 $\pm$ 2.1	0.002
Wound infection (%)	9.4% (3/32)	3.2% (1/32)	0.08
Wound dehiscence (%)	12.5% (4/32)	3.2% (1/32)	0.04
Hypertrophic scarring (%)	15.6% (5/32)	6.4% (2/32)	0.03

## DISCUSSION

The findings of this study reinforce the growing body of evidence supporting the use of non-invasive mechanical wound closure devices in post-bariatric plastic surgery. Compared to traditional suturing methods, the mechanical closure device demonstrated superior outcomes in terms of healing time, scar aesthetics and complication rates. These findings are consistent with previous studies that highlight the role of atraumatic wound closure in reducing inflammation and improving long-term scar quality.

A study by Singer et al<sup>8</sup> reported similar advantages of non-invasive closure devices in reducing wound tension, which aligns with our observed reduction in wound dehiscence rates. Likewise, Vyas et al<sup>9</sup> found that mechanical closure systems resulted in significantly better cosmetic outcomes and lower rates of hypertrophic scarring.<sup>10</sup> These parallels reinforce the clinical relevance of our findings and suggest broader applications beyond post-bariatric surgery.

The biomechanical principle behind these devices relies on the redistribution of tensile forces across the wound via external adhesive pads connected by an adjustable core. This central element allows controlled approximation of wound edges while minimising direct trauma to the dermal margins. In high-tension regions, such as those commonly encountered in post-bariatric surgery, this mechanism appears to reduce ischemia, modulate the inflammatory response, and promote linear, low-profile scar formation.

The clinical success of such systems in orthopedic surgery — where they are widely used to stabilise incisions over joints and high-mobility areas — provides additional support for their reliability and adaptability. The ability to externally manage wound tension without compromising perfusion is a considerable advantage over conventional sutures, especially in patients at elevated risk of wound complications.

One of the notable advantages of mechanical closure devices is their ability to distribute wound tension more evenly, reducing localised stress that may contribute to poor scarring. This mechanism has been previously described in studies evaluating tension-reducing devices in other surgical fields.<sup>11,12,13</sup> Our study extends these findings to post-bariatric plastic surgery, demonstrating significant benefits in this patient population.<sup>14,15,16,17,18</sup>

Nevertheless, limitations exist. The application of the device in certain anatomical locations — particularly those with complex curvatures or subjected to plication forces, such as transverse abdominoplasties — may reduce its effectiveness or cause suboptimal adhesion. In such cases, traditional techniques may still offer better mechanical conformity. Patient selection and procedural planning must, therefore, be tailored accordingly.

Although our study provides robust evidence supporting the efficacy of mechanical wound closure devices, certain limitations must be acknowledged. The relatively short follow-up period of six months limits our ability to assess long-term scar maturation and patient satisfaction beyond this timeframe. Future studies should explore extended follow-up intervals and investigate the impact of these devices on broader surgical applications, including reconstructive and oncologic procedures.

## CONCLUSIONS

This study demonstrates that non-invasive mechanical wound closure devices offer a significant advantage over traditional suturing methods in post-bariatric plastic surgery. The observed benefits in wound healing time, scar quality and complication rates support their integration into routine surgical practice. Their atraumatic nature, capacity to modulate wound tension, and ease of application make them especially valuable in high-risk patients or procedures with elevated risk of dehiscence.

Nonetheless, careful patient and anatomical site selection remains essential, particularly in regions where adhesive anchoring may be compromised by plication or curvature. Further research is needed to validate these findings in larger patient cohorts and extended follow-up periods.

## CONFLICT OF INTEREST

The authors certify that there is no conflict of interest with any financial organisation regarding the material discussed in the manuscript.

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All authors contributed equally to the manuscript and read and approved the final version of the manuscript

## STATEMENT

Informed consent was obtained for each patient and the local ethics committee approved the study in compliance with human rights.

## AUTHOR CONTRIBUTIONS

GG: Conception and design, data analysis and interpretation, manuscript draft, critical revision of the manuscript.

GG, AB, IP, RM, NL, MC: Final approval of the manuscript.

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