

# A Novel Approach to Incision Marking in Abdominoplasty Using 3D Printing Technology: A Description of Technique

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**Summary:** Abdominoplasty is one of the most common plastic surgery procedures used to improve the appearance and contour of the abdominal region. Despite advances in surgical techniques, achieving optimal aesthetic results with minimal scarring remains a challenge. In this study, we describe a feasible approach to incision marking in abdominoplasty using a three-dimensional-printed incision marking tool. This technique with open source nature has the potential to revolutionize the field of plastic surgery and enhance patient satisfaction. Further studies are needed to confirm our findings and explore the potential applications of three-dimensional printing technology in other aesthetic procedures. (*Plast Reconstr Surg Glob Open* 2024; 12:e6038; doi: [10.1097/GOX.00000000000006038](https://doi.org/10.1097/GOX.00000000000006038); Published online 15 August 2024.)

## INTRODUCTION

Abdominoplasty is a popular plastic surgery procedure that involves removing excess skin and fat and tightening abdominal muscles.<sup>1-3</sup> Despite potential complications, it is sometimes combined with other procedures to reduce costs and recovery time.<sup>4-6</sup> Three-dimensional (3D) printing has transformed plastic surgery by enabling surgical planning, medical education, and the creation of custom biological implants. As the technology evolves, 3D printing has become an increasingly important tool, allowing practices to visualize procedures in advance, educate future doctors, and create patient-specific implants. Implementing 3D printing in abdominoplasties effectively reduces unintentional deviations from initial marking, intraoperative time, and surgical planning time, showing great promise to enhance plastic surgery outcomes.<sup>7</sup> Multiple methods have been

described for marking abdominoplasty incisions,<sup>8-10</sup> but 3D templates have not been used. Although 3D printing transformed plastic surgery, its application to incision marking is undiscovered. Given 3D printing's accuracy and precision, further study is warranted.<sup>11</sup> In this technical article, we outline our experience and novel technique using a 3D-printed tool designed for incision marking in abdominoplasty.

## TECHNIQUE DESCRIPTION

This tool is designed to optimize incision placement through precise anatomical alignment, tailored to each patient's unique body contours. This method contrasts with traditional freehand techniques, which can vary significantly between surgeons and even for the same surgeon under different circumstances. Our technique uses a generic 3D-printed incision marking tool for abdominoplasty, which incorporates the advantages of previously described tools.<sup>8-10</sup> However, we have further refined and enhanced this approach by designing an optimized 3D-printed tool specifically for precise incision planning and execution. This includes manufacturing quality control and ensuring shareability through open access. The tool is intended solely for use in preoperative planning and will not be used intraoperatively. The development of our 3D-printed incision marking tool involves a two-stage process. Initially, the template is digitally designed with precision to ensure it meets the specific requirements of the surgical procedure. After the design phase, the digital model is sent to a 3D printing specialist for production. The manufacturing cost of a template ranges from \$150 to \$300, varying according

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to the type of material selected and the printer's capabilities. Given its use in preoperative planning without direct application during surgery, the template does not require sterilization, simplifying its handling and use.

### Preoperative Marking

The 3D-printed tool can be customized to match each patient's specific anatomical needs. The expandable tool has an initial lower incision width of 5 cm from the midline, extendable up to 9 cm on each side. The upper incision is marked above the umbilicus with side arms extended. After lifting the skin apron, lateral skin recruitment medially compresses the width (Figs. 1, 2). The tool's midline indentation is placed over the root of the penis in men and the vulvar commissure in women, with a height of 6 cm to mark the lower incision extent. An attached oil-based inclinometer ensures perfect horizontal orientation of both incision lines. This method provides a quantifiable, individualized approach to incision marking, offering a tailored surgical experience and promising improved aesthetic outcomes. As shown in Figure 3, the use of our 3D-printed surgical template enabled precise and symmetrical incision marking and planning, resulting in an evenly positioned postoperative scar without distortion, lateralization, or tilt.

## DISCUSSION

This study aimed to demonstrate the feasibility of using 3D-printed tool technology for incision marking in abdominoplasty and contribute to the literature on its potential advantages and limitations, informing future clinical practice. The final scar's shape and location in



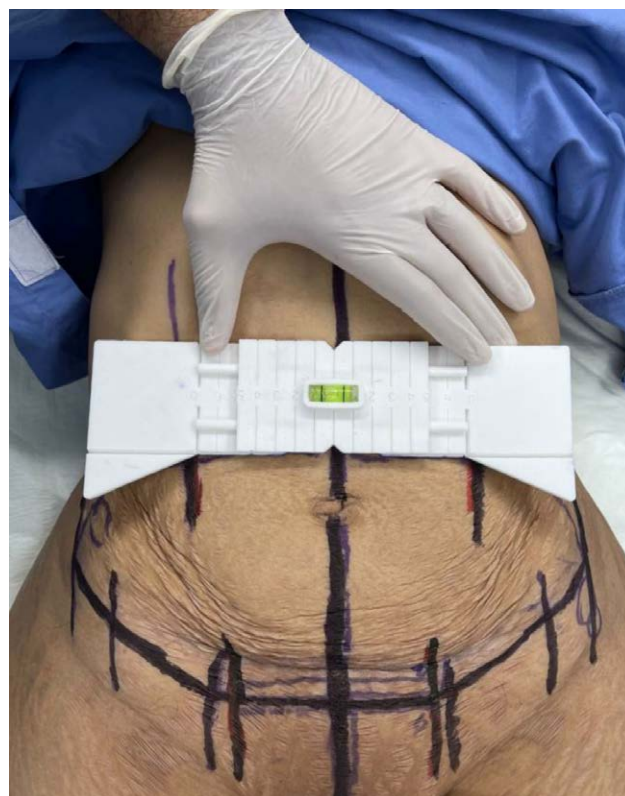
**Fig. 1.** Use of the 3D-printed surgical template for incision marking in an abdominoplasty procedure. The template is shown here marking the lower abdominal incision.

## Takeaways

**Question:** What novel incision marking approach using three-dimensional printing technology can help plastic surgeons achieve optimal aesthetic results and minimal scarring in abdominoplasty procedures?

**Findings:** In this study, we describe a feasible approach to incision marking in abdominoplasty using a three-dimensional-printed incision marking tool.

**Meaning:** This technique with open source nature has the potential to revolutionize the field of plastic surgery and enhance patient satisfaction.



**Fig. 2.** The 3D-printed surgical template assisting with preoperative planning by marking the upper abdominal incision location.

abdominoplasty are influenced by factors such as preoperative marking, dermoadipose undermining, and the size and shape of the resection.<sup>7</sup> Even with well-planned cutaneous marking, the scar may be asymmetrical, distorted, or poorly positioned due to insufficient or inadequate undermining, asymmetrical traction, varying resection of dermoadipose portions, and improper marking.<sup>10</sup>

The use of 3D-printed surgical templates is a promising innovation compared with conventional incision marking techniques.<sup>11</sup> Three-dimensional printing allows for customized tools that match each patient's unique anatomy, potentially reducing human error, improving consistency, mitigating asymmetry or distortion, and enabling ease of shareability and open access. Precise preoperative





**Fig. 3.** Postoperative scar after abdominoplasty using the 3D-printed surgical template for incision planning and marking.

planning may also decrease complications, shorten operating times, and reduce recovery needs. However, robust clinical studies are needed to confirm the concrete impacts on outcomes. Our initial observations are promising, but additional research is necessary to substantiate the efficacy and quantify the benefits. Further validation is required to support its adoption in mainstream surgical practice. We hope future studies with a control arm will facilitate direct comparisons and robustly evaluate our technique's outcomes against established methods.

Although 3D printing shows promise for abdominoplasty, limitations such as costs, production time, print quality, and the need for specialized training must be considered. Three-dimensional-printed tools cannot replace surgeon experience and judgment, and caution is essential to ensure optimal outcomes. Our proposed tool offers advantages over traditional methods, including precision, reducing asymmetry risk, enhancing results, standardizing the marking process, reducing operative time, and serving as a visual guide. Cost-effectiveness is anticipated due to reusability and reduced operative time, but further analyses and comparisons are necessary to substantiate these claims. We recommend future projects extend 3D printing to procedures such as breast augmentation, integrating augmented/virtual reality for comprehensive evaluation. Randomized controlled trials are crucial to validate its effectiveness and safety over traditional methods, potentially enhancing outcomes and satisfaction. As 3D printing evolves, its plastic surgery application offers vast potential. Future publications will include extensive visual evidence to showcase our technique's effectiveness and aesthetic benefits. Exploring patient positioning and anatomical variations will refine our tool's precision. This

research promises to significantly improve surgical outcomes, patient experiences, and healthcare efficiency.

## CONCLUSIONS

Our experience using a 3D-printed tool for abdominoplasty incision marking demonstrated its feasibility and potential to improve surgical planning accuracy and precision. Despite limitations, we believe the benefits outweigh the drawbacks and hope our study encourages further research and clinical application of 3D printing in plastic surgery to enhance outcomes and satisfaction.

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## DISCLOSURE

*The authors have no financial interest to declare in relation to the content of this article.*

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