

# Abdominal Flap-based Breast Reconstruction versus Abdominoplasty: The Impact of Surgical Procedure on Scar Location

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**Background:** Autologous breast reconstruction has been demonstrated to be associated with superior patient-reported outcomes, and hence is regarded as the gold standard reconstructive modality. A common drawback of this procedure, however, is related to a high abdominal scar. Recently, hybrid breast reconstruction (ie, the combination of autologous and implant-based reconstruction) was presented as an approach that would combine the benefits of both reconstructive modalities. In this study, we sought to assess abdominal aesthetic outcomes associated with this approach.

**Methods:** Thirty-two blinded reviewers evaluated standardized pre- and postoperative abdominal images of patients following autologous reconstruction with free abdominal flap (Group 1; N = 10), hybrid reconstruction (Group 2; N = 5), and abdominoplasty (Group 3; N = 10). Aesthetic abdominal appearance, including overall result, scar position, skin redundancy, and lateral abdominal contour, was rated on a 5-point Likert scale and a comparative analysis was performed.

**Results:** Hybrid reconstruction was associated with significantly lower abdominal scars compared with Group 1 ( $P = 0.01$ ), nearing results of patients in Group 3 ( $P = 0.39$ ). Significantly higher aesthetic ratings were ascribed to Groups 2 and 3 when compared with Group 1 ( $P < 0.001$ ) with regard to scar positioning ( $P < 0.001$ ), skin redundancy ( $P < 0.001$ ), and lateral abdominal contour ( $P < 0.001$ ). No significant difference in aesthetic ratings was noted between Groups 2 and 3.

**Conclusions:** When applied to the appropriate patient population, hybrid breast reconstruction is a powerful method to achieve reconstructive goals while optimizing abdominal aesthetics. A significantly lower scar position was noted and higher abdominal aesthetic ratings were given following abdominoplasty and hybrid reconstruction compared with conventional abdominal flap-based reconstruction. (*Plast Reconstr Surg Glob Open* 2020;8:e3112; doi: [10.1097/GOX.0000000000003112](https://doi.org/10.1097/GOX.0000000000003112); Published online 24 September 2020.)

## INTRODUCTION

The incidence of breast cancer is increasing, with an estimated 276,480 new cases of invasive disease being expected in 2020.<sup>1</sup> Importantly, however, improvements in breast cancer care have resulted in a 40% decline in breast cancer deaths between 1989 and 2016, thus resulting in almost 4 million breast cancer survivors in the United States.<sup>2</sup> The importance of health-related quality

of life becomes quite evident in light of the ever-increasing number of breast cancer survivors, for whom patient satisfaction and a return to normalcy take center stage. Postmastectomy reconstruction is, therefore, a critical component of contemporary breast cancer care and has been demonstrated to favorably impact patient satisfaction with breast cancer procedures.<sup>3</sup> Of the various reconstructive options, autologous reconstruction has been demonstrated to be associated with the most superior long-term patient-reported outcomes.<sup>4-7</sup>

A central component of the initial patient consultation is a clear communication regarding realistic postoperative outcomes following the respective reconstructive modalities. While the abdomen is often considered the

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most ideal donor site from a surgical perspective due to the amount and quality of available tissue,<sup>8,9</sup> one of the main appeals for patients is the possibility of an “abdominoplasty”-like improvement of their abdomen. To this point, abdominally based autologous reconstruction has commonly been marketed as a “tummy-tuck” breast reconstruction.<sup>10</sup>

However, the surgical goals of abdominoplasty and autologous breast reconstruction are quite different. In planning an abdominoplasty, the primary focus is on correcting the existing abdominal skin and myofascial laxity, while placing a low-lying scar.<sup>11</sup> In contrast, scar placement following abdominal flap harvest is ordinarily determined by the desired breast size and perforator anatomy, thus, typically resulting in a higher scar location.

The senior author (A.M.) has previously described a hybrid approach to autologous breast reconstruction involving free abdominal tissue transfer with concurrent placement of a breast implant to supplement volume.<sup>12,13</sup> Abdominal tissue is harvested only to a degree that corrects abdominal skin laxity while permitting placement of a low abdominal scar, knowing that the difference in required volume for satisfactory breast reconstruction is compensated by placement of an implant. For patients with inadequate abdominal tissue to meet reconstructive needs, particularly in cases of bilateral reconstruction, this approach aims to take advantage of the benefits of free tissue transfer while enhancing the aesthetics of the donor site.<sup>14,15</sup> The effects of hybrid breast reconstruction on abdominal scar location, however, have not been previously studied.

In this study, we aimed to objectively quantify differences in abdominal scar positioning between 3 distinct cohorts—conventional free abdominal flap, hybrid reconstruction, and abdominoplasty. We hypothesized that implementation of the hybrid technique would be associated with a lower abdominal scar location more similar to an abdominoplasty, and thereby be associated with an improved aesthetic appearance of the abdomen postoperatively.

## PATIENTS AND METHODS

Institutional Review Board approval was obtained before conducting this study. Adult (>18 years of age) female patients who underwent postmastectomy autologous breast reconstruction with free abdominal flaps (Group 1), postmastectomy hybrid breast reconstruction with free abdominal flaps and simultaneous implant placement (Group 2), or full abdominoplasty (Group 3) were considered for inclusion in the study. Representative cases by a single surgeon across procedure types were used to limit inter-operator variability. Of note, all patients in Groups 1 and 2 underwent bilateral breast reconstruction.

Only patients with complete pre- and postoperative abdominal photographs were included in the study. All photographs were taken by a single surgeon to limit inconsistencies with postoperative images being obtained at least 6 months following surgery. In each image, the

relationship between abdominal scar and umbilicus was evaluated. In all three groups, we attempted to maintain the preoperative position of the umbilicus during abdominal closure. Using a ruler tool on a photograph editing software (Image J v1.52; NIH), the length of a straight line drawn from the umbilicus to scar ( $u - s$ ) and the xiphoid to umbilicus ( $x - u$ ) was measured. (See figure, Supplemental Digital Content 1, which displays the normalized umbilicus-to-scar-distance ratio is significantly lower in conventional free abdominal flap reconstruction compared with cosmetic abdominoplasty or hybrid reconstruction. A–C, representative photographs from patients undergoing conventional free abdominal flap reconstruction (A), hybrid reconstruction (B), and cosmetic abdominoplasty (C). Ratio is calculated as the distance from the umbilicus to transverse scar ( $u-s$ ) relative to the distance from the umbilicus to xiphoid ( $x - u$ ), ie  $(u - s) / (x - u)$ . \* $P < 0.05$ , <http://links.lww.com/PRSGO/B471>.) Scar position relative to the umbilicus was subsequently normalized by dividing the distance to the xiphoid by the distance to the umbilicus  $[(u - s) / (x - u)]$ , thereby correcting for varying distances between subject and camera lens. Of note, the breast region on all images was blurred using image editing software to ensure that reviewers were blinded to the type of procedure performed and to limit bias (See figure, Supplemental Digital Content 1, <http://links.lww.com/PRSGO/B471>).

Pairs of pre- and postoperative abdominal photographs were then randomized and shown to 32 blinded reviewers—that is, 21 laypersons and 11 medical professionals (ie, plastic surgery residents/nurse practitioners)—who were asked to rate the aesthetic appearance of each image with respect to the overall aesthetic appearance, as well as skin redundancy, lateral abdominal contour, and scar position. Aesthetic rating was provided using a Likert scale ranging from 1 to 5, where 1 indicated a poor outcome and 5 indicated an excellent outcome. All data are presented in the form of means and SDs. Statistical analysis was conducted with analysis of variance and 2-tailed  $t$  tests between groups. A value of  $P < 0.05$  was considered to be statistically significant. All statistical analysis was performed using R (v. 3.6.0).

## RESULTS

Standardized pre- and postoperative abdominal photographs of 25 patients were utilized. Group 1 consisted of 10 patients undergoing autologous breast reconstruction with free abdominal flaps with a mean age and body mass index (BMI) of  $49.8 \pm 9.6$  years (range, 31–62 years) and  $28.4 \pm 5.5$  kg/m<sup>2</sup> (range, 19.1–34.3 kg/m<sup>2</sup>), respectively. Group 2 consisted of 5 patients undergoing postmastectomy hybrid breast reconstruction with a mean age of  $48.6 \pm 2.6$  years (range, 45–53 years) and mean BMI of  $24.6 \pm 1.5$  kg/m<sup>2</sup> (range, 22.2–26.4 kg/m<sup>2</sup>). Finally, Group 3 consisted of 10 patients undergoing abdominoplasty with a mean age and BMI of  $46.9 \pm 5.4$  years (range, 40–60 years) and  $26.9 \pm 4.7$  kg/m<sup>2</sup> (range, 20–33.4 kg/m<sup>2</sup>), respectively. There were no significant differences between groups in terms of age or BMI (Table 1).

**Table 1. Patient Demographics**

	Group 1: Conventional Free Abdominal Flap (N = 10)	Group 2: Hybrid Reconstruction (N = 5)	Group 3: Cosmetic Abdominoplasty (N = 10)	P
Age, y				0.69
Mean $\pm$ SD	49.8 $\pm$ 9.6	48.6 $\pm$ 2.6	46.9 $\pm$ 5.4	
Range	31–62	45–53	40–60	
BMI, kg/m <sup>2</sup>				0.40
Mean $\pm$ SD	28.4 $\pm$ 5.5	24.6 $\pm$ 1.5	26.9 $\pm$ 4.7	
Range	19.1–34.3	22.2–26.4	20–33.4	

**Scar Placement**

Patients in Group 3 demonstrated the lowest scar location averaging a normalized scar distance ratio of  $0.56 \pm 0.11$ . In comparison, patients in Group 1 had the highest abdominal scar with the average ratio of  $0.32 \pm 0.08$  ( $P = 0.01$ ). Mean scar location in patients in Group 2 was found to be significantly lower than Group 1 ( $P = 0.01$ ), while approaching that of Group 3 patients with a mean ratio of  $0.50 \pm 0.07$  ( $P = 0.39$ ) (Table 2). Supplemental Digital Content 1 demonstrates representative patient images per study group (<http://links.lww.com/PRSGO/B471>).

**Overall Aesthetic Rating**

Layperson reviewers ascribed the highest overall abdominal aesthetic rating to patients in Group 3 with a mean value of  $3.7 \pm 1.0$ . Conventional free abdominal flap harvest (Group 1) received a significantly lower aesthetic rating than Groups 2 and 3 [ $3.1 \pm 1.0$  versus  $3.6 \pm 0.9$  ( $P < 0.001$ ) and  $3.1 \pm 1.0$  versus  $3.7 \pm 1.0$  ( $P < 0.001$ )], respectively. Of note, the overall aesthetic rating of Groups 2 and 3 did not display a significant difference ( $P = 0.29$ ) (Fig. 1).

Assessment by medical professionals (ie, plastic surgery residents and nurse practitioners) demonstrated a similar pattern. Abdominoplasty patients received the highest overall aesthetic rating ( $4.1 \pm 0.9$ ), with significantly higher scores than those following conventional abdominal flap harvest (Group 1) ( $4.1 \pm 0.9$  versus  $3.7 \pm 0.9$ ,  $P = 0.02$ ). In contrast, no difference was noted in aesthetic rating between patients in Group 2 and 3 ( $4.1 \pm 0.9$  versus  $3.9 \pm 0.8$ ,  $P = 0.18$ ).

**Subdivision Aesthetic Rating (Skin Redundancy, Lateral Abdominal Contour, and Scar Position)**

Group 3 patients were found to have the highest aesthetic ratings for skin redundancy ( $3.8 \pm 1.0$ ), lateral contour ( $3.6 \pm 1.1$ ), and scar position ( $3.7 \pm 0.9$ ) by layperson reviewers, with significantly lower ratings for skin redundancy ( $3.2 \pm 1.1$ ;  $P < 0.001$ ), lateral abdominal contour ( $3.0 \pm 1.2$ ;  $P < 0.001$ ), and scar position ( $3.3 \pm 1.0$ ;

$P < 0.001$ ) being ascribed to patients in Group 1 (Fig. 2). Of note, patients in Group 2 received significantly higher aesthetic ratings than those in Group 1 for skin redundancy ( $3.8 \pm 1.0$  versus  $3.2 \pm 1.1$ ,  $P < 0.001$ ), and lateral abdominal contour ( $3.6 \pm 1.1$  versus  $3.0 \pm 1.2$ ,  $P < 0.001$ ). Scar position was improved but did not reach statistical significance ( $3.5 \pm 1.0$  versus  $3.3 \pm 1.0$ ,  $P = 0.17$ ). No significant differences were noted between Groups 2 and 3 (skin redundancy,  $P = 0.69$ ; lateral contour,  $P = 0.80$ ; scar position,  $P = 0.13$ ) (Fig. 2).

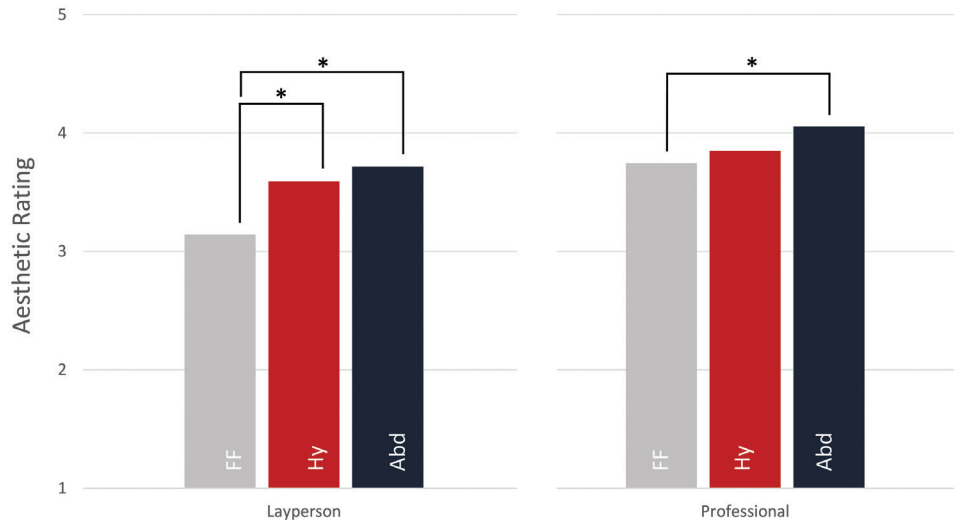
Review by medical professionals demonstrated a similar pattern, with patients in Group 3 receiving higher aesthetic ratings compared with Group 1 with regard to skin redundancy ( $4.1 \pm 0.9$  versus  $3.5 \pm 1.2$ ;  $P < 0.001$ ) and lateral abdominal contour ( $3.7 \pm 1.1$  versus  $3.2 \pm 1.0$ ;  $P = 0.007$ ). Similarly, patients in Group 2 received higher aesthetic ratings compared with patients in Group 1, approaching the level of Group 3 patients for skin redundancy ( $3.9 \pm 0.9$  versus  $3.5 \pm 1.2$ ;  $P = 0.03$ ) and lateral contour ( $3.7 \pm 1.0$  versus  $3.2 \pm 1.0$ ;  $P = 0.01$ ) (Fig. 2).

**DISCUSSION**

The goals for modern breast reconstruction are best summarized by the eponym “5S,” that is, reconstruction of breasts of adequate size, shape, symmetry, softness, and sensation.<sup>16,17</sup> As techniques in the field continue to advance, we find increasing success in achieving these reconstructive goals, especially in autologous reconstruction.<sup>18</sup> However, a commonly overlooked element is the aesthetic appearance of the abdomen following surgery. Historically, we have been concerned with donor site morbidity, as expressed by abdominal bulge/hernia rates. However, advances in surgical technique and the introduction of mesh have reduced these rates to low single digit percentages.<sup>19</sup> In contrast, all women will have an abdominal scar postoperatively. Hence, exploring approaches that place the inevitable scar in a more favorable location seems prudent. For many patients, especially thin patients with inadequate abdominal tissue, framing a preoperative

**Table 2. Differences in Scar Placement and Overall Aesthetic Rating**

	Group 1: Conventional Free Abdominal Flap (N = 10)	Group 2: Hybrid Reconstruction (N = 5)	Group 3: Cosmetic Abdominoplasty (N = 10)	P
Normalized scar distance ratio (mean $\pm$ SD)	0.32 $\pm$ 0.08	0.50 $\pm$ 0.07	0.56 $\pm$ 0.11	0.01
Overall layperson aesthetic rating (mean $\pm$ SD)	3.1 $\pm$ 1.0	3.6 $\pm$ 0.9	3.7 $\pm$ 1.0	<0.001
Overall professional aesthetic rating (mean $\pm$ SD)	3.7 $\pm$ 0.9	3.9 $\pm$ 0.8	4.1 $\pm$ 0.9	0.06



**Fig. 1.** Mean overall aesthetic ratings between blinded layperson and professional reviewers for differing patient cohorts. Abd, cosmetic abdominoplasty; FF, conventional abdominal free flap; Hy, hybrid reconstruction. \* $P < 0.05$ .

discussion regarding donor site harvest as an ‘abdominoplasty-type’ procedure misrepresents actual outcomes.

In this study, we demonstrate the impact of three different surgical procedures, ie conventional breast reconstruction with free abdominal flaps (Group 1), hybrid breast reconstruction (Group 2), and abdominoplasty (Group 3), on postoperative scar location and unmask clinically meaningful differences. Patients in Groups 2 and 3 were found to have significantly lower abdominal scars. Additionally, this observation correlated with superior aesthetic ratings being ascribed to these procedures when compared to Group 1.

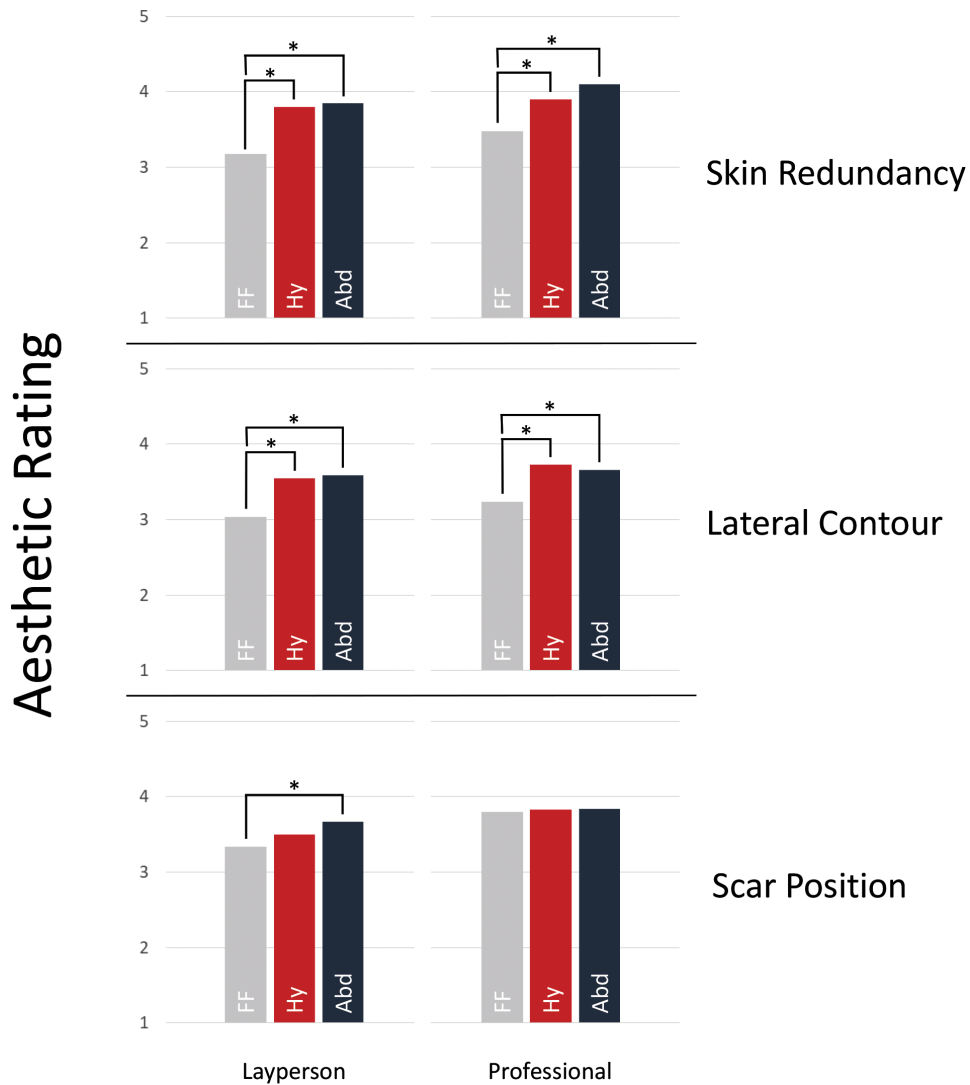
Postoperative scar location can more easily be controlled when planning an abdominoplasty, as the primary objective is to correct abdominal skin laxity with freedom to excise excess tissue without limitations by underlying perforator anatomy. The challenge in autologous breast reconstruction is related to the need for recruitment of sufficient abdominal soft tissue volume to create a breast mound while respecting underlying dominant perforator branching patterns. Thus, the abdominal scar is commonly positioned higher than following abdominoplasty, as more technical constraints are present. This difference in scar placement does not go unnoticed and is apparent when aesthetic outcomes are evaluated.<sup>20</sup> In this study, higher scars in Group 1 patients were associated with inferior aesthetic ratings when compared with Group 3 patients. As such, patients expecting an abdominoplasty in the process of abdominal flap harvest could be disappointed by their abdominal appearance.

The issue of a high abdominal scar following abdominal flap harvest is well known and has resulted in the introduction of technical modifications to lower the abdominal scar. Examples include the introduction of the low Deep inferior epigastric perforator (DIEP) flap for breast reconstruction.<sup>21,22</sup> Importantly, however, “the volume of the low DIEP flap tends to be smaller than the conventional DIEP flap.”<sup>22</sup> It is in this patient population (ie, patients who do not have

sufficient abdominal flap volume if a low abdominal flap is planned) that the hybrid approach is particularly useful.<sup>14</sup>

One of the advantages of hybrid breast reconstruction is the fact that abdominal tissue is harvested only to a degree that corrects abdominal skin laxity, knowing that the difference in required volume for satisfactory breast reconstruction is compensated by placement of an implant. This compensation in turn permits for placement of a lower abdominal scar as the entire volume of reconstructed breast need not come from the abdomen alone. This concept translated into blinded reviewers composed of laypersons as well as medical professionals in the present study to rate the aesthetic appearance of the abdomen of patients who underwent hybrid reconstruction (Group 2) significantly higher than following conventional reconstruction (Group 1). Importantly, no difference in aesthetic rating was noted in Groups 2 and 3.

Modern breast reconstruction options are no longer binary (ie, implant vs. autologous reconstruction), but rather are characterized by an individualized approach that takes into account the patient’s individual anatomy as well as preferences. The importance of shared decision-making cannot be overstated and mandates a thorough discussion of all reconstructive options during the initial consultation.<sup>23</sup> In our practice, utilization of hybrid reconstruction has enhanced our ability to offer patients individualized reconstructive solutions in line with their personal preferences. To be clear, not all patients are suitable candidates for hybrid reconstruction. If the abdominal donor site is adequate to achieve the desired breast size and shape and the patient wishes autologous reconstruction, then conventional microsurgical reconstruction is offered. However, the findings of this study have changed our practice in that our default is the design of a low abdominal flap with the upper border of the abdominal flap being located below the umbilicus. The reconstructive algorithm we adhered to is displayed in [Figure 3](#). If adequate abdominal skin/soft tissue laxity and volume is present and the patient desires



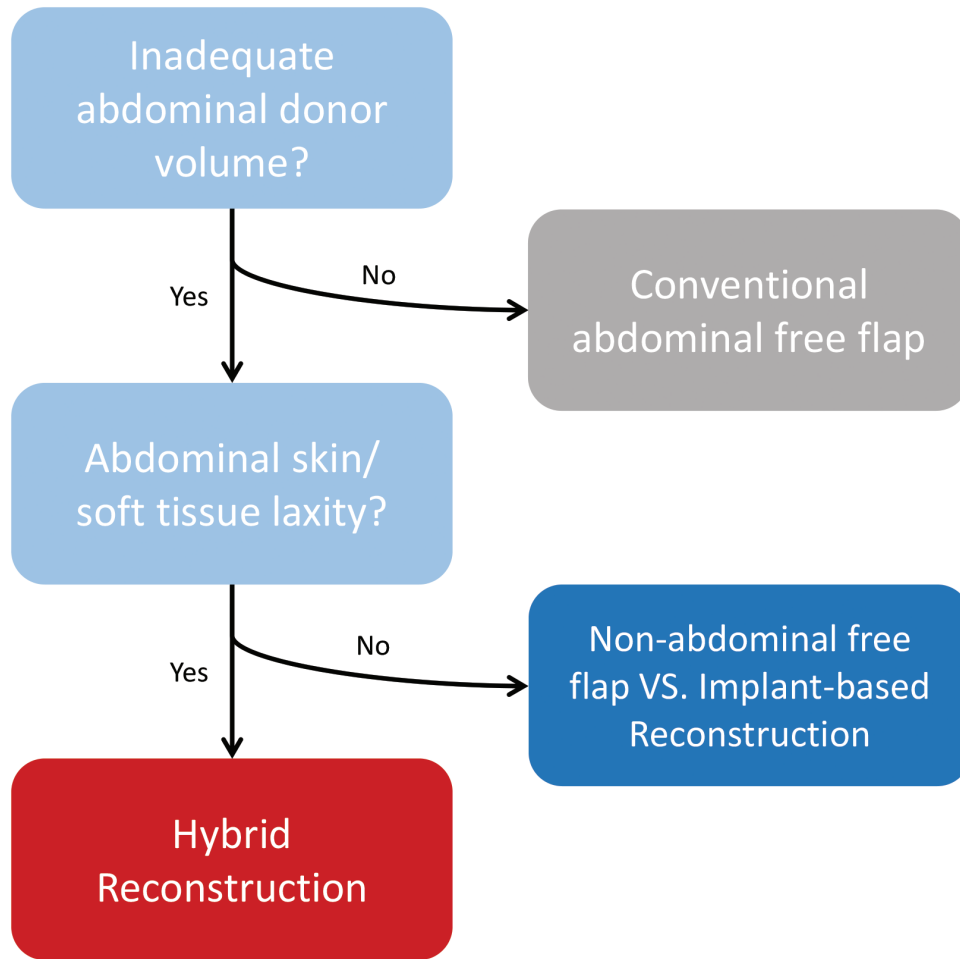
**Fig. 2.** Mean aesthetic ratings in subcategories of skin redundancy, lateral contour, and scar position between blinded layperson and professional reviewers for differing patient cohorts. Abd, cosmetic abdominoplasty; FF, conventional abdominal free flap; Hy, hybrid reconstruction. \* $P < 0.05$ .

autologous reconstruction, then conventional free abdominal-flap-based reconstruction is performed. In patients with abdominal skin/soft tissue laxity, however, with inadequate volume, hybrid reconstruction is discussed. The absence of abdominal skin/soft tissue laxity is addressed by autologous reconstruction using thigh-based flaps, with our preference being the profunda artery perforator flap, or by implant-based reconstruction.

Hybrid breast reconstruction, thus, provides a solution for many of the traditional limitations of implant and autologous reconstruction. It expands the indications for microsurgical reconstruction, thus, offering the advantages of autologous reconstruction to a larger group of patients. Importantly, it is a technically simple procedure (eg when compared with bilateral breast reconstruction with stacked flaps), which represents an alternative approach in patients who have insufficient tissue volume at a single donor site.<sup>14,24–26</sup>

Limitations of the present study include the small number of patients included in the study. However, increasing the number of patients beyond 25 would have potentially limited the number of reviewers willing to participate in the study. Importantly, no significant differences in BMI were present between the respective study groups. Photographic angles for patient pre- and postoperative images were standardized and taken by a single operative surgeon to limit bias. However, distance-to-camera was not standardized between groups. As such, a normalized-distance measurement was used based on fixed anatomic landmarks within each patient to correct for this. A strength of the study was the fact that all patients in Groups 1 and 2 underwent bilateral breast reconstruction, thus creating homogeneity in the patient population included in the study. Importantly, the reviewers were blinded to the procedure performed by randomization of photographs and concealment of breast incisions.





**Fig. 3.** Patient selection algorithm for hybrid reconstruction.

In conclusion, when applied to the correct patient population, hybrid breast reconstruction is a powerful method to achieve reconstructive goals while optimizing abdominal aesthetics. As demonstrated in this study, a significantly lower scar position was noted and higher abdominal aesthetic ratings were given following abdominoplasty and hybrid reconstruction compared with conventional abdominal flap-based reconstructions.

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