

Video-assisted submuscular breast reconstruction: evaluating a novel technique in high-risk patients

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Background: Breast cancer is one of the most prevalent oncological diseases worldwide, with mastectomy often necessary for treatment. Post-mastectomy breast reconstruction is essential for restoring physical integrity and improving patients' quality of life, especially in high-risk individuals with advanced age, obesity, diabetes, smoking habits, or a history of radiotherapy. Traditional submuscular reconstruction techniques are effective but often associated with higher rates of complications in this patient population. This study aimed to evaluate the efficacy and safety of a novel video-assisted procedure (VAP) for submuscular breast reconstruction, focusing on its ability to reduce complications and enhance outcomes.

Methods: A retrospective analysis compared 17 high-risk patients who underwent VAP with 127 patients treated using traditional non-video-assisted procedures (NVAP) between September 2022 and June 2024. Both groups were comparable in age, body mass index (BMI), and risk factors. Data on postoperative complications, including bleeding, wound dehiscence, and infections, were collected and analyzed. Statistical significance was determined using appropriate tests, with a P value <0.05 considered significant.

Results: The VAP group demonstrated significant reductions in complications compared to the NVAP group. No cases of postoperative bleeding were reported in the VAP group, while 8.66% of NVAP patients experienced bleeding. Wound dehiscence rates were also lower in the VAP group (5.88%) compared to the NVAP group (10.24%). The minimally invasive nature of VAP allowed for precise dissection and reduced tissue trauma without prolonging surgical times.

Conclusions: The findings suggest that VAP is a safer and more effective alternative for high-risk patients requiring submuscular breast reconstruction. By minimizing complications and enhancing both functional and aesthetic outcomes, VAP offers a promising innovation in reconstructive surgery. Larger, randomized trials are necessary to validate these results and establish VAP as a standard of care in diverse clinical settings.

Keywords: Video-assisted breast reconstruction; submuscular breast reconstruction; post-mastectomy techniques; minimally invasive surgery; high-risk patient surgery

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Introduction

Breast cancer remains one of the most prevalent oncological diseases globally, significantly impacting women's health. Its incidence continues to rise, underscoring the urgency for effective treatments and advanced surgical techniques that not only address the disease but also enhance patients' quality of life. Mastectomy, often necessary for tumor removal, can have profound physical and psychological effects on women (1,2).

Post-mastectomy breast reconstruction is a crucial intervention designed to restore physical integrity and support the psychological well-being of patients. This procedure mitigates the visual consequences of breast removal and plays a vital role in improving self-esteem and body image, facilitating recovery and reintegration into social and personal life (2).

Among the various techniques available, submuscular prosthetic reconstruction stands out for its ability to reduce the risk of severe complications, such as mastectomy flap necrosis and prosthetic infections (3). This technique is

Highlight box

Key findings

 This study evaluates a novel video-assisted procedure (VAP) for submuscular breast reconstruction in high-risk patients. Compared to the traditional non-video-assisted procedure, VAP significantly reduced postoperative complications, such as bleeding and wound dehiscence, without prolonging surgical time. The results indicate that VAP may offer enhanced safety and precision in challenging cases.

What is known and what is new?

- Submuscular breast reconstruction is effective for high-risk patients but is often associated with complications due to tissue fragility and stress during dissection. Minimally invasive, videoassisted techniques in other surgical fields have shown promise in improving outcomes.
- This study introduces the application of video assistance in submuscular breast reconstruction, highlighting its potential to minimize trauma and complications in anatomically complex or compromised cases.

What is the implication, and what should change now?

The findings suggest that VAP could become a safer and more
effective standard of care for high-risk patients requiring
submuscular breast reconstruction. Its precision and minimally
invasive nature may reduce complications, enhancing functional
and aesthetic outcomes. Future research should focus on larger,
randomized trials to validate these results and explore the broader
applicability of the technique in diverse clinical settings.

particularly suitable for patients with elevated risk factors, including advanced age, extreme body mass index (BMI >35 or <20 kg/m²), smoking habits, diabetes, and a history of radiotherapy treatments. These factors contribute to surgical risks and challenges in post-operative management, necessitating optimized surgical techniques for such conditions (4).

Our preliminary study introduces an innovative videoassisted technique, video-assisted reconstruction (VR), for creating the submuscular pocket. This methodology leverages advanced imaging technologies and minimally invasive surgical instrumentation, enabling significant improvements in precision and management of interventions in anatomically challenging areas (5).

The adoption of skin preservation techniques, such as conservative mastectomy of the breast and areola, further emphasizes the need to tailor the surgical approach to the specific needs of each patient. The VR technique aims to overcome the limitations of traditional methodologies, offering a potentially safer and less invasive solution for breast reconstruction, particularly in patients with unique anatomical or clinical challenges.

This innovative approach represents a significant advancement in breast reconstruction techniques, aiming to optimize patient outcomes and minimize discomfort and post-operative complications. With VR, we seek to explore and establish new standards in reconstructive treatment, thereby improving access to more effective and personalized surgical solutions that better meet the needs of each patient. This study's primary objectives are to evaluate the potential of the video-assisted procedure (VAP) in reducing postoperative complications, assess its impact on improving clinical outcomes for high-risk patients, and explore the role of technological innovation in advancing submuscular breast reconstruction techniques. We present this article in accordance with the SUPER reporting checklist (available at https://gs.amegroups.com/article/view/10.21037/gs-2024-485/rc).

Methods

We collected data from two groups of patients who underwent submuscular breast reconstruction. The VAP group consisted of 17 patients who received video-assisted submuscular breast reconstruction between September 2023 and June 2024. The patient data were obtained from the Breast Surgery Unit at Livorno Hospital, Livorno, Italy.

The non-video-assisted procedure (NVAP) group



Video 1 Demonstration of breast reconstruction video-assisted procedure.

included 127 patients who underwent submuscular breast reconstruction without video assistance between September 2022 and June 2024. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). No institutional ethics were required, as there were no human or animal participants. This study involved a retrospective analysis of anonymized data collected from patient records. No identifying personal information was included, and only demographic data and surgical outcomes were analyzed. Since the data were anonymized and did not involve direct patient participation or intervention, obtaining individual informed consent was not deemed necessary.

Patient demographic data, including age and BMI, were recorded for both groups to ensure comparability and establish a consistent baseline for evaluating the surgical interventions' outcomes. In both groups, the surgical technique followed the standard approach for submuscular breast reconstruction. For the VAP group, advanced imaging technologies and minimally invasive surgical instruments were employed to facilitate the precise formation of the submuscular pocket. In contrast, the NVAP group underwent the conventional procedure without video-assisted technologies. These two distinct approaches provided a basis for evaluating the effectiveness, safety, and complication rates of the new video-assisted technique compared to traditional methods.

Surgical equipment and visualization

For intraoperative visualization, a Storz light source was used in combination with a Stryker HD camera equipped with a 5-mm, 30° optic. This system provided a clear and detailed view of the surgical field, essential for navigating tight spaces

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and ensuring accurate dissection and implant placement. A PlumePen Ultra electrosurgical unit (Conmed[®]) was used for cutting and coagulation, connected to a ViroVac (Buffalo Filter[®]) suction system, which effectively removed surgical smoke and aerosols, maintaining a clear visual field.

Mastectomy and pocket formation

The surgical procedure began with a skin-sparing mastectomy (SSM), employing a radial incision in nipplesparing cases and an elliptical incision including the areolanipple complex in skin-sparing cases. This approach preserves as much skin envelope as possible, crucial for achieving natural-looking reconstruction results. After the mastectomy, the focus shifted to creating a submuscular pocket for the implant. Dissection started at the inframammary fold and extended superiorly beneath the major pectoral muscle, which serves as the primary cover for the implant, providing protection and support.

Submuscular dissection

The dissection involved the meticulous separation of the fibres of the major pectoral muscle without compromising their attachment to the sternum to prevent the medial displacement of the implant. Additional muscle layers, including the serratus anterior and external oblique muscles, were also dissected to ensure adequate coverage and stabilization of the implant. These steps are critical to prevent the implant from being too superficial, which could compromise aesthetic results and increase the risk of complications (*Video 1; Figure 1*).

Implant placement

After the submuscular pocket was prepared, the pocket dimensions were measured to proceed with the expander selection. Once the size was confirmed, the actual implant was placed in this pocket. The implant placement was meticulously adjusted to fit correctly within the newly created anatomical boundaries.

Closure techniques

The muscle incisions were sutured with absorbable sutures. The skin was then closed in layers over the muscle, ensuring no tension on the wound edges, which could impede healing or lead to necrosis. Prophylactic antibiotics were



Figure 1 Schematic diagram showing breast reconstruction videoassisted procedure.

administered during and after the procedure to prevent infections.

Drainage and postoperative care

Drains were placed in the submuscular and subcutaneous layers to prevent fluid accumulation and facilitate healing. As part of standard postoperative care, these were generally removed within the first week after the operation.

Statistical analysis

P values were calculated using appropriate tests based on the nature of the variables to compare the outcomes between the two groups (VAP and NVAP). Categorical variables were compared using the Chi-squared test or Fisher's exact test. In contrast, continuous variables, such as age and BMI, were analyzed with non-parametric tests like the Mann-Whitney test, depending on the data distribution. A P value of less than 0.05 was considered statistically significant.

Results

The VAP group included 17 patients, while the non-video assisted procedure group included 127 patients. The median age was 62 in the VAP group and 64 in the NVAP group. The median BMI was 29 kg/m² in the VAP group and 28 kg/m² in the NVAP group. The percentage of smokers was 23.53% in the VAP group and 16.54% in the NVAP group (P=0.50). The percentage of diabetic patients was 11.76% in the VAP group and 3.15% in the NVAP group

(P=0.15). In the VAP group, 41.18% of patients (7 cases) had a history of breast radiotherapy compared to 9.45% (12 cases) in the NVAP group (P=0.002). Nipple-sparing mastectomy (NSM) was performed in 88.24% of patients in the VAP group and in 76.38% of patients in the NVAP group (P=0.36). SSM was performed in 11.76% of cases in the VAP group and 23.62% in the NVAP group (P=0.36). Lipofilling was performed in 17.65% of patients in the VAP group and in 12.60% in the NVAP group (P=0.70).

Postoperative complications were classified as major or minor and managed accordingly.

In the VAP group, no major bleeding complications were reported. However, a small percentage of wound dehiscence cases (5.88%) were classified as major complications, requiring a return to the operating room for necrotic tissue removal and re-advancement of the wound margins. The remaining complications, including minor bleeding and wound dehiscence, were managed on an outpatient basis. In 5.88% of patients, infections were classified as minor complications and treated with outpatient antibiotic therapy. Postoperative pain, nausea, and vomiting were reported in 5.88% of patients and were successfully managed in the outpatient setting without the need for hospitalization.

In the NVAP group, 8.66% of patients experienced postoperative bleeding, with 1.18% classified as major complications that required surgical intervention to achieve proper hemostasis.

Additionally, 10.24% of patients experienced wound dehiscence, with 1.57% necessitating surgical revision to remove necrotic tissue and reapproximate the wound margins. Most of the complications, including minor bleeding and wound dehiscence, were managed on an outpatient basis. In 11.81% of patients, infections were classified as minor complications and treated with outpatient antibiotic therapy. Similarly, postoperative pain (11.02%) and nausea and vomiting (7.09%) were managed in an outpatient setting without further surgical intervention. We reviewed the intraoperative filling data and confirmed no significant differences in the filling volumes between the VAP and NVAP groups. These findings suggest that the observed differences in wound dehiscence rates may be attributed to other factors, such as patient selection and tissue quality, rather than intraoperative expansion techniques (Table 1).

Discussion

Our study's objective was to evaluate the efficacy and safety

Table 1 VAP vs. NVAP (N=144)

Variables	VAP (n=17)	NVAP (n=127)	P value
Age (years)	62 [52–64]	64 [42–84]	-
BMI (kg/m ²)	29 [26–31]	28 [25–32]	-
Previous radiation therapy	7 (41.18)	12 (9.45)	0.002
Smokers	4 (23.53)	21 (16.54)	0.50
Diabetics	2 (11.76)	4 (3.15)	0.15
NSM	15 (88.24)	97 (76.38)	0.36
SSM	2 (11.76)	30 (23.62)	0.36
Lipofilling	3 (17.65)	16 (12.60)	0.70
I POD	14 (82.35)	98 (77.17)	>0.99
II POD	2 (11.76)	21 (16.54)	>0.99
III POD	1 (5.88)	8 (6.30)	>0.99
Asthenia	1 (5.88)	23 (18.1)	0.31
Pain	1 (5.88)	14 (11.02)	>0.99
PONV	1 (5.88)	9 (7.09)	>0.99
Infection	1 (5.88)	15 (11.81)	0.69
Bleeding	0	11 (8.66)	0.36
Wound dehiscence	1 (5.88)	13 (10.24)	>0.99

Data are presented as median [range] or n (%). VAP, videoassisted procedure; NVAP, non-video-assisted procedure; BMI, body mass index; NSM, nipple-sparing mastectomy; SSM, skinsparing mastectomy; POD, postoperative day (I POD, II POD, and III POD indicating the first, second, and third postoperative days, respectively); PONV, postoperative nausea and vomiting.

of video-assisted submuscular breast reconstruction in a group of high-risk patients. The results suggest that the VAP approach may represent a beneficial strategy compared to traditional reconstruction, particularly in patients with risk factors that compromise tissue quality and the elasticity of the pectoralis major muscle.

Patients in the VAP group were selected based on the presence of specific risk factors, such as a history of breast radiotherapy, obesity, diabetes, or smoking. These factors make the pectoralis major muscle more fragile and less elastic, increasing the risk of intra- and postoperative complications (3,4). To minimize stress on the muscle during dissection and creation of the submuscular pocket, we opted for a video-assisted technique, which allowed for more precise and less traumatic dissection compared to the traditional approach. This technical choice was

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crucial for preserving muscle integrity in patients with compromised tissues (5). Although the mastectomy incision remains unchanged, the video-assisted technique differs from other approaches by enabling a minimally invasive procedure that reduces traumatic muscle manipulation, thus preserving structural integrity and optimizing dissection. This is particularly advantageous for high-risk patients with compromised tissue quality, addressing functional and aesthetic outcomes.

Our data clearly show that the VAP group had a higher prevalence of risk factors than the NVAP group. Specifically, 41.18% of patients in the VAP group had a history of breast radiotherapy, 11.76% were diabetic, and 23.53% were smokers. These data support our decision to opt for VR in this group to minimize the risk of complications from manipulating compromised tissues.

The comparison of outcomes between the two groups reveals that the VAP approach reduced postoperative complications, particularly in controlling bleeding and reducing wound dehiscence. Specifically, the postoperative bleeding rate in the NVAP group was 8.66%, whereas no cases of bleeding were reported in the VAP group. Similarly, wound dehiscence was less frequent in the VAP group (5.87%) compared to the NVAP group (10.24%). These findings indicate that the video-assisted technique can improve surgical outcomes in high-risk patients.

The current literature, as highlighted in the work of Franceschini et al. and Kappos et al., predominantly focuses on techniques that improve aesthetic outcomes, such as skin preservation and endoscopic approaches (2,6). However, these studies do not fully address the need to reduce tension on muscle tissues, a critical factor in patients with preexisting conditions like diabetes or radiotherapy. While the submuscular technique is often considered outdated due to its association with increased pain and animation deformities, our findings suggest it remains a valuable option for high-risk patients. Incorporating video-assisted technology mitigates many of these limitations by allowing precise dissection and minimizing trauma to the muscle. This evolution of the technique may redefine its role in reconstructive surgery, particularly in complex cases where muscle coverage provides essential support and reduces the risk of complications. Our study, by contrast, emphasizes the importance of minimizing stress on the pectoralis major muscle, demonstrating that the videoassisted technique can be a safer option for patients with compromised tissue (7-10).

In our preliminary experience, using videoendoscopy

during muscle pocket creation proved effective in enhancing visual control and precision in dissection. The enhanced visualization provided by the endoscope allowed for more accurate identification and coagulation of bleeding vessels, significantly reducing the risk of hematomas. This advantage aligns with findings in the literature, which highlight the importance of improved intraoperative visualization in minimizing complications. In the initial cases, we employed a SSM with elliptical excision, achieving optimal visibility through endoscopic imaging. In subsequent cases involving NSM, we maintained the incision in the lateral portion of the inframammary fold, minimizing tension on the pectoralis major muscle. This approach facilitated minimally invasive tissue manipulation and optimized muscle pocket formation, contrasting with existing literature, which often overlooks the issue of postoperative muscle tension.

Regarding operative times and complications, our technique proved effective without prolonging the duration of surgery. The average operative time in our study was consistent with those reported by other authors, such as Kappos *et al.*, with an average of approximately 140 minutes (2,11-13). Additionally, no immediate complications, such as postoperative bleeding or infections, were observed in the VAP group. These results are significantly better than the NVAP group, where infections occurred in 11.81% of cases and bleeding in 8.66%.

In conclusion, although our study is limited by the relatively small sample size in the VAP group, the preliminary findings suggest that video-assisted submuscular reconstruction may offer several advantages over the traditional approach, particularly in reducing postoperative complications in high-risk patients. Further studies with larger cohorts are needed to confirm these results and to further explore the potential of this innovative technique. We acknowledge that the smaller sample size of the VAP group compared to the NVAP group and the non-randomized design represent significant limitations, requiring the findings to be interpreted with caution. Further research involving larger, randomized cohorts is essential to validate these preliminary results, assess the generalizability of the technique, and address potential barriers to adoption, such as training requirements, costs, and applicability to diverse clinical settings.

Future implications and research extension potential

The significant reduction in complications and the optimization of surgical times introduced by our VR

technique suggest that this approach could benefit a broad spectrum of patients, especially those at high risk. These results invite a more extensive and detailed exploration of how the VR technique can be further adapted and improved, possibly extending its application to a broader sample of patients in future studies.

Conclusions

Although limited to five cases, our pilot study has demonstrated significant potential benefits of the VR approach in reducing complications and optimizing the aesthetic and functional outcomes of submuscular breast reconstruction. These preliminary results serve as a foundation for future research, which could explore the efficacy and safety of this technique more broadly to establish it as a new standard practice for the care of high-risk patients. The implications of this study suggest a paradigm shift towards personalized and less invasive interventions, placing the patient's specific needs at the centre of the surgical care process.

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Footnote

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aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This article does not involve human participants or animals; hence no institutional ethics was required. This study involved a retrospective analysis of anonymized data collected from patient records. No identifying personal information was included, and only demographic data and surgical outcomes were analyzed. Since the data were anonymized and did not involve direct patient participation or intervention, obtaining individual informed consent was not deemed necessary.

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