Modern autologous breast reconstruction: integrating innovation across the surgical journey

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Abstract: Modern autologous breast reconstruction has evolved from a technically demanding procedure into a streamlined, patient-centred journey shaped by cumulative innovation. Building on the work of pioneers in perforator flap surgery, contemporary practice integrates advanced imaging, refined operative technique, and enhanced perioperative care to achieve predictable outcomes with minimal donor-site morbidity. Although widely adopted, recent advances in imaging, perioperative optimisation and digital tools are often implemented in a fragmented manner with limited practical guidance on integrating them into a coherent workflow. This article presents our modern approach to autologous breast reconstruction, highlighting how strategic refinements across the pre-operative, intra-operative, and post-operative phases collectively enhance safety, efficiency, and patient satisfaction. We outline the role of cutting-edge technologies, including artificial intelligence (AI)-supported patient communication tools, automated computed tomography angiography (CTA)-based perforator detection, augmented reality visualization, three-dimensional (3D) imaging, and flow-coupler-enabled buried flap reconstruction, in optimising planning, execution, and monitoring. Our operative principles emphasise minimised fascial violation, nerve and muscle preservation, aesthetic donor-site closure, precise footprint-guided flap shaping, and preparedness for revision using superficial venous outflow and interpositional grafts. These techniques, combined with prehabilitation and standardized enhanced recovery after surgery (ERAS) pathways, support shorter operative times, reduced opioid use, accelerated ambulation, and routine early discharge. Throughout, patient-reported outcome measures (PROMs) guide evaluation of long-term quality of life, informing technique selection and ongoing refinement. By uniting technological innovation with a holistic philosophy of care, we demonstrate how modern autologous breast reconstruction can deliver durable, natural results while preserving abdominal function and enhancing the overall patient experience. This work reflects our ongoing efforts to advance the field by taking forward the achievements of the giants who established its foundations.

Keywords: Breast cancer reconstruction; deep inferior epigastric perforator flap surgery (DIEP flap surgery); computed tomographic angiography; artificial intelligence (AI); aesthetic donor site closure

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Introduction

Background

A patient-centric journey in autologous breast reconstruction

Breast cancer affects approximately one in ten women worldwide. Although mortality has declined due to improvements in screening, early detection and oncological treatment, the incidence of breast cancer continues to rise, particularly in women under the age of 50 years (1). As survival rates improve, so does the demand for high-quality breast reconstruction.

Modern autologous breast cancer reconstruction is much more than a single surgical procedure and should rather be seen as a patient journey. It encompasses a continuous experience, from the initial consultation through pre-operative preparation, stepwise intra-operative execution, and comprehensive post-operative care (*Figure 1*). Our philosophy centres on optimising every facet of this journey, recognizing that even small improvements, when cumulatively applied, lead to significant advancements in patient outcomes and satisfaction. This holistic approach is increasingly empowered by cutting-edge technology and a deep commitment to understanding the patient's lived experience.

At the same time, the procedure itself has evolved to become far more streamlined and predictable. Experience has taught us to optimise each step, so that in our practice, autologous breast reconstruction is no longer a strenuous, drawn-out operation requiring prolonged hospitalisation. Instead, when performed within an efficient, well-structured protocol, it should take little longer than a typical combined abdominal contouring and breast surgery, with the same dual focus: contouring the abdomen aesthetically and reconstructing the breast in an equally aesthetic manner. This represents an important shift in mindset—viewing autologous breast reconstruction as an efficient, reproducible procedure with a clear pathway to early discharge and smooth follow-up (2,3).

Building on the work of giants: a brief historical context

The evolution of autologous breast reconstruction, with the deep inferior epigastric perforator (DIEP) flap as the current gold standard, is a testament to the cumulative efforts of surgical pioneers. Koshima *et al.* first described the concept of muscle-sparing perforator flaps in 1989, laying the groundwork for preserving abdominal wall integrity (4,5). Allen *et al.* popularised the DIEP flap for breast reconstruction in 1994, demonstrating its significant advantages over the muscle-sacrificing transverse rectus abdominis muscle (TRAM) flap, including reduced pain and abdominal wall weakness (6). Subsequent studies by Hamdi, Blondeel and others further validated the DIEP flap's efficacy, confirming its benefits in preserving abdominal function and achieving high patient satisfaction (7-13). We must recognise that several high-volume centres were exploring muscle-sparing options in parallel, as reflected in a later long-term publication reporting a DIEP flap performed as early as 1991 in the United Kingdom (14). As with many surgical innovations, such advances often emerge simultaneously in different parts of the world, driven by shared efforts and the rapid exchange of knowledge—a pattern equally evident in the evolution of perforator flap surgery.

These contributions allow us to build on prior work, enabling us to see further and beyond. Our modern approach integrates these established principles with continuous innovation, ensuring versatility, durability, and a natural appearance and consistency in the reconstructed breast, while minimising donor site morbidity. We have explored the use of interposition grafts in primary cases (15), provided algorithms in cases of vessel interruption (16), and looked at alternative donor sites (2,17), implant-based reconstructive options, and even the recruitment of neighbouring tissue with lipofilling (18,19). We also acknowledge the necessity of alternative donor sites, such as the profunda artery perforator (PAP), superior gluteal artery perforator (SGAP), inferior gluteal artery perforator (IGAP), transverse upper gracilis (TUG), and lumbar artery perforator (LAP) flaps, when the abdominal site is unsuitable due to factors like previous abdominoplasty, multiple scars, or vessel interruption (2,16).

Rationale and knowledge gap

In recent years, the uptake of autologous breast reconstruction has increased alongside ongoing technical and perioperative innovations. While recent studies describe important advances in autologous breast reconstruction (20,21), guidance on translating these developments into routine clinical practice remains scarce. In particular, the literature offers little insight on how technical refinements, perioperative optimisation strategies, and emerging digital tools can be aligned within a coherent, patient-centred reconstructive pathway. This article aims to illustrate a modern, workflow-based perspective on autologous breast

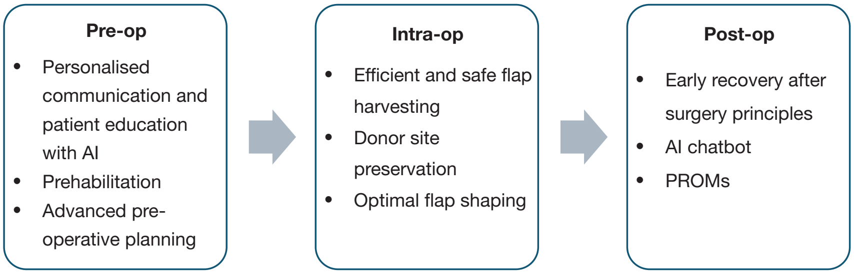

Figure 1 The key domains of cumulative improvements in efficiency and outcome in DIEP flap harvest. AI, artificial intelligence; DIEP, deep inferior epigastric perforator; PROM, patient-reported outcome measure.

reconstruction, structured across the pre-operative, intra-operative, and postoperative phases of care.

Objective

This article outlines our contemporary approach to autologous breast reconstruction, building upon the work of pioneers in the field. At the same time, we highlight ongoing research that can further improve this approach. We aim to present a modern trajectory of patient management, showcasing how our research and integrated technologies enhance each stage of the process for modern autologous breast reconstruction.

Pre-operative optimisation: laying the groundwork for a seamless journey

The pre-operative phase is designed to empower patients, ensuring they are physically and psychologically prepared for surgery. This involves personalised communication, comprehensive prehabilitation, and advanced planning, all of which are critical for optimising outcomes.

Personalized communication and patient education with artificial intelligence (AI)

From the moment a patient enters our consultation room, our focus should be on personalised, clear communication. We are actively studying how AI can enhance this crucial interaction (22,23). The first author uses AI health scribes (Heidi®) to support real-time clinical documentation during consultations, resulting in structured and detailed patient notes while reducing the administrative burden on clinicians.

Based on these AI-generated notes, personalised patient information letters are subsequently created. This ensures that essential information from the consultation is translated into communication tailored to the patient. As part of an ongoing study, patients who receive these information letters are invited to complete structured questionnaires, and a comparative analysis is being conducted between patients who have read the letters and those who have not. Although the study is still ongoing and definitive conclusions cannot yet be drawn, preliminary results are promising in terms of patient satisfaction and perception of understanding their reconstructive journey.

Prehabilitation: building resilience for recovery

Prehabilitation, encompassing targeted exercise and nutrition, is a cornerstone of preoperative strategy. All patients should preferably be seen for a preoperative consultation with a physiotherapist. This ensures that patients receive structured guidance and have realistic expectations regarding the surgical process and postoperative recovery. Our recent study of patients undergoing DIEP flap breast reconstruction highlighted the impact of baseline physical activity on postoperative well-being. We found that patients with lower baseline exercise levels experienced a significant decline in psychosocial (−9.3%, P=0.04) and sexual well-being (−14%, P=0.02) at 1 year postoperatively, while outcomes remained stable in patients with higher preoperative physical activity (24). This underscores the importance of integrating physical activity assessments into preoperative evaluations to inform patient-centred care and optimize recovery outcomes. We previously published on the benefits of exercise and reflexology for breast cancer patients, reporting significant improvements in overall concerns (44.2%), well-being (41.2%), and total MYCaW scores (42.4%) in breast cancer patients (all P<0.0001), with the largest improvements in energy levels, sleep quality, stress and tension, and vasomotor symptoms (25,26). These concepts can be integrated into prehabilitation programs, along with other lifestyle changes, including a combination of aerobic, resistance, and flexibility-based activities, along with breathing exercises to prepare physically and psychologically for surgery.

Furthermore, nutrition plays a vital role in perioperative care, directly impacting healing and recovery. There has already been literature about the benefits of an optimal nutritional status in aesthetic surgery (27,28), as well as higher morbidity in the case of metabolic syndrome and poor nutritional status in breast reconstruction (29). Ideally, patients should enter surgery with adequate reserves, reflected by a post-bariatric prealbumin value of >25 mg/dL, and corrected deficiencies in their key micronutrients, particularly vitamin A, B12/folate, and iron deficiency anemia (27,30).

In this context, we are investigating whether targeted preoperative nutritional optimisation may further improve surgical outcomes. Our ongoing study at the department is assessing the potential role of a high-protein diet, together with essential micronutrients like vitamins B and D, zinc, magnesium, and omega-3, in tissue repair and immune function. The goal is to enhance physiological resilience to surgical stress and potentially reduce postoperative infectious complications. Preliminary observations suggest a favourable trend, though final conclusions await completion of data collection and analysis.

Advanced pre-operative planning with AI and computer-aided detection (CAD) systems

Optimising preoperative planning is crucial for surgical success. We are studying AI and advanced imaging to enhance precision and have developed a proof-of-concept in-house AI-powered automated CAD system for perforators (26) and are working to validate it. Our approach uses AI to automatically detect perforators, aiming to reduce planning time compared with manual interpretation of computed tomography angiography (CTA) scans. By automatically mapping the perforator vascular tree in three dimensions, the system provides objective, reproducible anatomical information to support surgical decision-making. The proposed method achieves 60% accuracy comparable to experts and a distance error of less than 18 mm. While the accuracy of AI software may currently be lower for very small vessels (<1.5 mm), it performs comparably for larger vessels, which are the vessels of interest (31). Recent systematic reviews conducted by our group indicate that machine-learning approaches have been explored for predictive modeling of flap-related complications and for identifying high-risk patient groups that may benefit from targeted interventions (22,23). Furthermore, mobile three-dimensional (3D) imaging applications are being evaluated for accuracy and repeatability, suggesting a future where accessible 3D imaging can be integrated into surgical practice for planning and outcome visualisation (32). Our commitment extends to integrating AI and microsurgical training into plastic surgery education, to prepare future surgeons for precision and efficiency (33,34).

Intra-operative precision: mastering surgical execution

The intra-operative phase is where meticulous planning translates into precise execution, with a strong emphasis on efficiency, accuracy, and aesthetic outcomes, supported by advanced pain management strategies. The key here is maximally preserving the donor site, ensuring aesthetic donor site closure, and optimal shaping of the recipient site, all whilst ensuring maximal efficiency.

Our DIEP workflow is deliberately stepwise to maximise efficiency and accuracy. Preoperative CTA maps the perforator calibre and intramuscular course, reducing dissection time. The use of a handheld Doppler confirms the dominant perforators and transfers them to the skin.

For bilateral reconstruction, we employ a dual-team approach: one team prepares the pocket and recipient internal mammary vessels (usually the senior resident or the fellow) while the second performs flap harvest along standardised steps. After midline orientation and umbilical release, we elevate the cranial flap, bevelling to include adequate adipose tissue for contour while keeping the cranial flap thin for a smooth match on closure; meticulous haemostasis is maintained throughout. We follow six main principles (*Figure 2*).

- ❖ Principle 1: minimise fascial violation (*Figure 3*). Our default is a single, short, centrally based fascial window directly over the selected perforator, lengthened only as required for safe pedicle exposure. We keep a thin adipofascial veil over the anterior rectus sheath to lower seroma rates and protect the fascia. Where additional inflow is indicated, we preferentially add a same-row perforator via a continuous intramuscular tunnel rather than creating

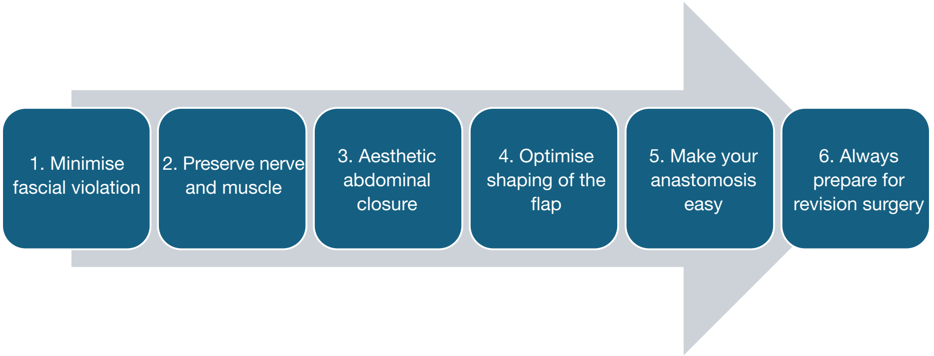

Figure 2 The 6 main principles followed in DIEP flap breast reconstruction. DIEP, deep inferior epigastric perforator.

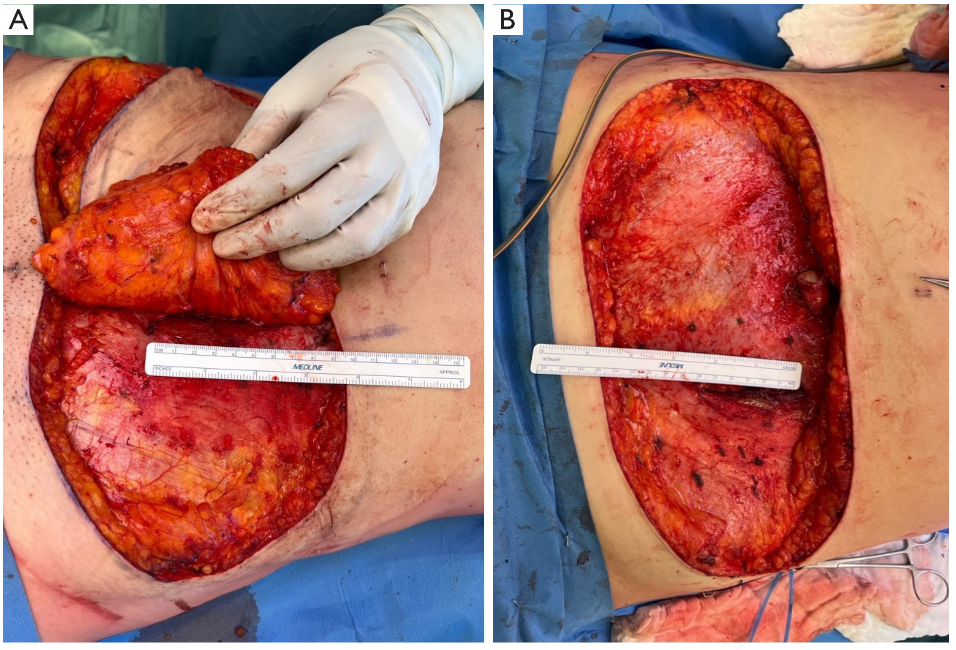

Figure 3 Fascial incision during DIEP flap harvest. The fascial incision is minimised wherever possible, typically limited to the intramuscular course of the selected perforator and, when feasible, shorter. The patient is placed in a mild Trendelenburg position to allow the intra-abdominal contents to shift cranially, creating additional working space. Adequate exposure of the deep inferior epigastric pedicle down to its origin is achieved with proper assistance and long Langenbeck retractors. (A,B) The fascial window with the flap in situ and after flap elevation, respectively, with both being less than 6 cm. DIEP, deep inferior epigastric perforator.

a second distant fascial opening. If broader perfusion is needed, we consider an abdominal perforator exchange (APEX) flap or a short, bipedicled harvest using two small, more central fascial windows (13,35,36); both windows are planned to lie within the intended diastasis repair, where possible, so that definitive closure incorporates and buttresses every fascial incision. Robotic techniques can be beneficial in carefully selected patients, preferably those with one or two closely grouped dominant perforators, a short intramuscular course, and favourable anatomy, allowing for smaller fascial incisions and reduced donor site morbidity. As a practical rule of thumb, the shorter the intramuscular course and the longer the entire pedicle, the greater the potential benefit of the robot. Pioneering work by Selber *et al.* laid the

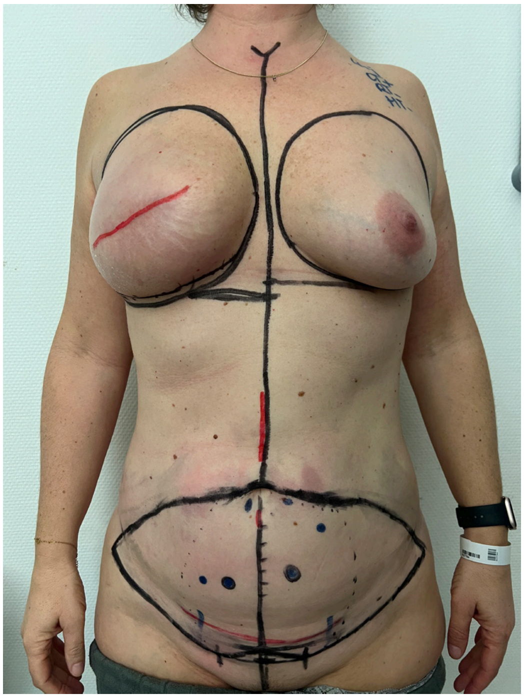

Figure 4 Preoperative design demonstrating a low abdominoplasty-type scar. Markings are performed with the patient standing to define an incision that lies approximately 7 cm above the labia majora commissure. The upper border arches gently above the umbilicus and extends laterally to minimise tension and avoid dog-ear formation. The resulting contour follows aesthetic abdominoplasty principles, positioning the final scar low and easily concealable beneath standard undergarments. This image was published with the patient's consent.

foundation for this concept (37,38).

- Principle 2: preserve nerves and muscle. Intramuscular dissection is performed under full relaxation with gentle retraction to visualise and preserve intercostal motor nerves and side branches, avoiding segmental myotomy and preventing rectus atrophy or laxity. The selected perforator(s) are skeletonised to the origin at the deep inferior epigastric pedicle while maintaining muscle continuity and limiting the caudal extent of the fascial opening. Superficial inferior epigastric veins (SIEVs) are identified early and protected for potential superdrainage; once adequate length is secured, they are managed according to intraoperative need.

  After confirming perfusion, the flap is detached, with de-epithelialisation around a monitoring skin island as indicated. Redundant tissue from zones IV and III is trimmed to optimise shaping. Microvascular anastomoses are performed under the microscope, and indocyanine-green (ICG) angiography may be used to validate flap perfusion.

- Principle 3: aesthetic and functional donor site management. We approach the abdominal donor site not merely as a source of tissue but as an opportunity for comprehensive body contouring. This mindset is particularly beneficial for middle-aged patients, often mothers, for whom a well-managed donor site can significantly improve quality of life, contour, and body harmony. Our aim is to achieve both a functionally robust abdominal wall and an aesthetically refined abdominoplasty closure within one continuous reconstructive process.

  Preoperative markings are made with the patient standing to ensure a low scar position, approximately 7 cm above the labia majora commissure. The cranial border crests just above the umbilicus and sweeps laterally to reduce tension and dog-ear formation. The preoperative markings mirror an aesthetic abdominoplasty, ensuring the scar remains low and easily concealed by underwear, especially important for younger or higher-demand patients (*Figure 4*).

  Rectus diastasis repair is routinely performed through a two-layer musculo-aponeurotic plication, often using a combination of figure-of-eight and running barbed sutures to restore abdominal wall integrity, tension, and contour. All fascial incisions, including the perforator window, are incorporated into this plication whenever possible, distributing forces and minimising herniation risk (*Figure 5*). The fascial window itself is closed primarily with horizontal mattress Ethibond® 0 sutures with periodic locks, ensuring secure reinforcement.

  To optimise postoperative comfort, a transverse abdominal plane (TAP) block is administered with 10 mL of 7.5 mg/mL Ropivacaine 1% on each side before final closure. Injections are administered into the plane between the internal oblique and transversus abdominis muscles. For the lower abdominal wall, we perform three injections is 1–2 cm medial to the anterior superior iliac spine, going 1–2 cm superior and inferior from the landmark (39).

  The umbilicus is reconstructed meticulously to create a shallow, vertically oriented, and superiorly hooded appearance. Three-point dermofascial sutures are placed at 10, 2, and 12 o'clock positions

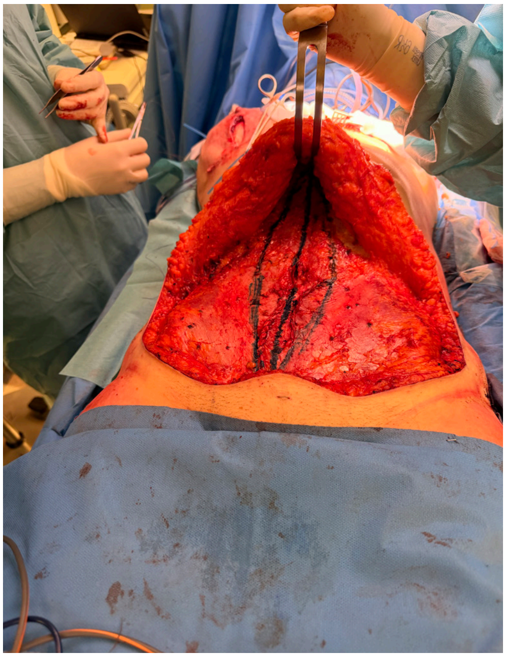

Figure 5 The design of the diastasis repair, in which the closed fascial incisions from the bilateral flap harvest are incorporated and buried within the two-layer musculo-aponeurotic plication. By integrating all fascial openings, including the perforator window, into the combined figure-of-eight and running barbed suture repair, the construct provides a stronger and more uniform reinforcement of the abdominal wall while simultaneously concealing the fascial incisions. This approach helps distribute tension effectively.

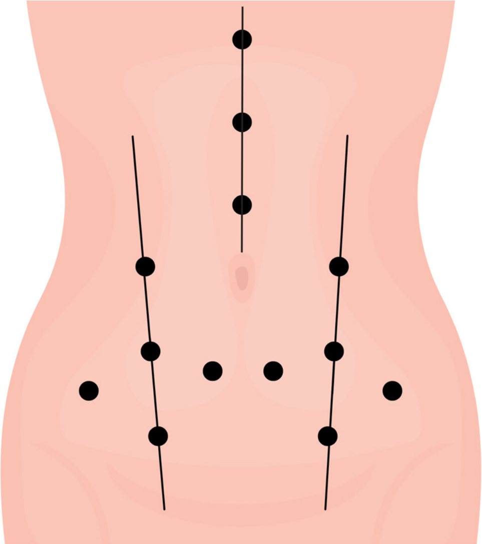

Figure 6 The strategic placement of progressive tension sutures is illustrated here. Interrupted 1–0 Vicryl sutures are used, following the natural anatomical shadows of the abdomen. Typically, three progressive tension sutures are positioned in the midline above the umbilicus along the linea alba. Below the umbilicus, a central depression is considered unaesthetic in the female abdomen; therefore, two paramedian sutures are placed instead. Laterally, three sutures are positioned along each linea semilunaris, with an additional lateral suture placed to advance the cranial abdominal flap, minimize lateral dead space, and reduce the risk of dog-ear formation. This configuration follows the underlying anatomy, preventing unnatural surface depressions or skin puckering.

to recreate a natural downward tilt and prevent widening.

Progressive tension (quilting) sutures are then placed with the table flexed at the hips, advancing from cranial to caudal. These sutures serve multiple purposes: obliterating dead space, distributing tension evenly, reducing shear, and minimising seroma risk - often enabling a drainless closure. A recent refinement involves aligning these sutures along natural anatomical shadows, such as the linea alba, linea semilunaris, and umbilical depression (*Figure 6*), to create subtle contour depressions where shadows naturally fall, thereby enhancing the aesthetic topography of the abdomen.

Layered closure follows in three planes: Scarpa's fascia, dermal, and a running subcuticular skin closure reinforced with topical adhesive. A paraffin gauze protects the umbilicus, and an abdominal binder is applied before mobilisation on postoperative day one to support the plication and reduce fluid accumulation.

When indicated, additional aesthetic refinements, such as monsplasty or waistline liposuction, may be performed to enhance the final contour and improve body harmony. The result is a donor site that is not only structurally sound but also aesthetically rejuvenated, combining a reconstructive necessity with a secondary contouring benefit.

- ❖ Principle 4: optimising recipient site shaping of the flap. Shaping of the recipient site begins already at the stage of pre-operative marking. The width and length of the breast footprint are measured and projected onto the abdominal donor site around the dominant perforator on which the flap will be based. Trimming of the flap is performed after dissection but before detachment. This timing allows clinical

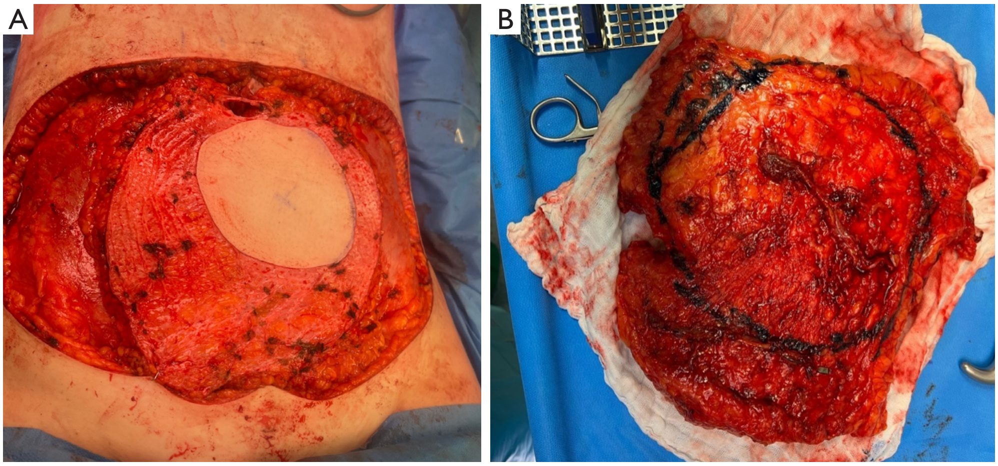

Figure 7 Optimising recipient-site shaping of the DIEP flap. Footprint-guided flap design and staged trimming enhance contour accuracy and ease of inset. (A) Flap shaping is performed while the flap remains attached, allowing a lighter, more manoeuvrable flap for microvascular anastomosis and direct assessment of perfusion. (B) After flap detachment, final adjustments can be made following the pre-marked breast footprint, outlined on the abdominal flap around the dominant perforator; approximately 1 cm of additional margin is maintained circumferentially to avoid over-resection prior to inset.

assessment of flap bleeding and confirmation of flap perfusion. It further facilitates flap stabilisation during microvascular anastomosis, as a smaller flap is less mobile, and simplifies flap inset without the need for excessive trimming.

Rather than formal coning, flap shaping is primarily achieved through cranial undermining, increasing bulk and projection in the lower pole of the reconstructed 180° rotation of the flap on inset. In very thin patients, we do true coning, if needed, with a bipedicled approach. Careful rounding of the flap edges avoids angular contours and ensures a smooth, natural, breast shape. Footprint projection also ensures appropriately sized flaps, which is particularly advantageous in primary breast cancer reconstruction (*Figure 7*).

- ❖ Principle 5: make your anastomosis as easy as possible. In general, we dissect the donor vessels down to their origin to obtain large-calibre vessels and, where possible, to join the paired veins into a single dominant deep vein. This provides ample pedicle length and facilitates tension-free microvascular anastomosis (*Figure 8*).

To ensure optimal quality of the recipient vessels, the third or fourth costal cartilage is often removed in patients with a history of radiotherapy, as the underlying internal mammary vessels are typically of better calibre and flow. In the absence of prior irradiation, a rib-sparing approach is preferred, provided that adequate vessel length can be achieved without compromising access or alignment.

Whenever feasible, neurotization should be incorporated (*Figure 9*). Tuinder *et al.* has shown the impact of neurotization on patient-reported outcomes in DIEP flap breast reconstruction. Their work, involving a significant cohort of patients, demonstrated improved perceived sensation and better physical well-being of the chest domain in innervated flaps, as measured by Breast Surgery Quality of Life and Satisfaction Questionnaire (BREAST-Q) outcomes (6). These findings suggest that sensory nerve coaptation is a meaningful addition to breast reconstruction, enhancing the patient's experience and quality of life (6).

- ❖ Principle 6: always prepare for a revision surgery. Even with meticulous planning and execution, revision surgery remains an inherent part of free-flap reconstruction. The most common cause of revision is venous congestion, often secondary to outflow mismatch, vessel kinking, or unrecognised superficial dominance.

Intraoperative vigilance is key. If a distended or well-developed SIEV or superficial circumflex iliac vein (SCIV) is noted, it may indicate a superficially dominant flap drainage pattern. In such cases,

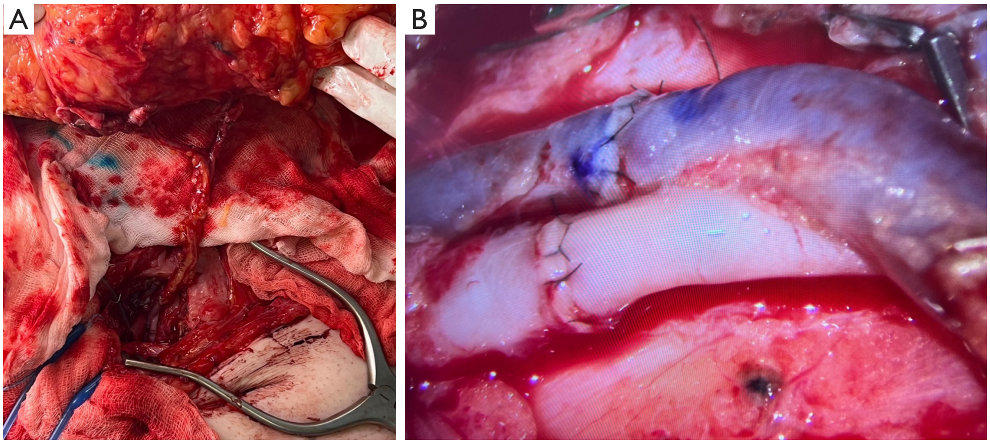

Figure 8 Facilitating tension-free anastomosis through adequate pedicle length and vessel calibre. (A) Three same-row perforators were harvested and dissected to their origin to supply a large flap. Despite inclusion of a distal perforator, the extended pedicle length provides excellent manoeuvrability and enables tension-free shaping and inset. (B) Example of a large-calibre donor-recipient anastomosis, allowing comfortable orientation, improved flow, and stable circulation, particularly beneficial in large-volume flaps.

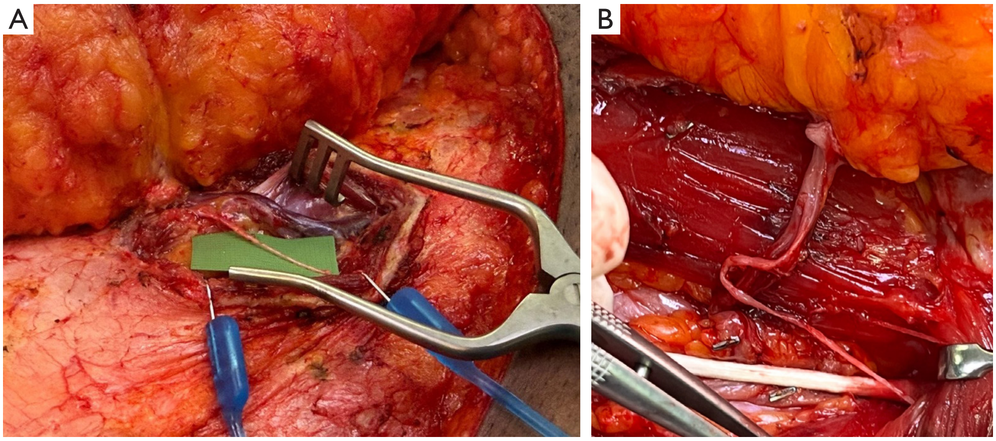

Figure 9 Donor-site sensory nerve dissection for flap neurotization. (A,B) Identification and dissection of the sensory nerve within the abdominal flap when the perforator lies centrally, providing an appropriate dermatome for sensory restoration. The harvested nerve can be coapted directly to the recipient intercostal nerve if sufficient length is available, or connected using an interpositional sural nerve graft.

these veins should be dissected long if they are large and preserved as potential superdrainage conduits (*Figure 10*). Their early preparation can be invaluable if venous congestion develops during or after the inset, allowing rapid salvage through the creation of an additional venous anastomosis. When secondary venous drainage is required, the SIEV can be anastomosed to an available vein in the proximity, usually the lateral thoracic vein. A cephalic vein turnover is reserved for selected cases when no suitable alternative recipient vein is available.

Furthermore, both the SIEV and SCIV can serve as excellent interposition vein-graft options when additional pedicle length is required, whether to bridge a gap to the recipient site, to revise a thrombosed anastomosis, or to perform a secondary superdrainage procedure (15). Their calibre, proximity, and familiarity make them ideal autologous grafts, avoiding the morbidity of harvesting from a distant site.

Flap monitoring in the immediate postoperative period remains essential. Prompt recognition and

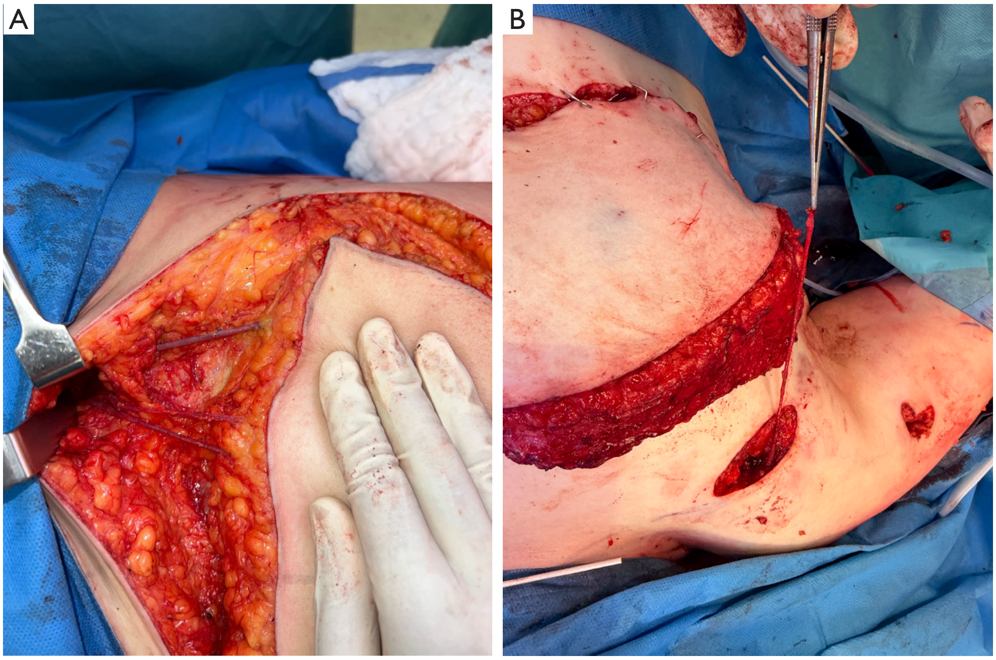

Figure 10 Preparation of superficial venous outflow for revision readiness. (A) In this case, large-calibre SIEV, SIEA, and SCIV were identified and dissected although an SIEA/SIEV flap was considered, the DIEP perforators and mainly the deep inferior epigastric artery were of greater calibre, and a DIEP flap was therefore performed. (B) The preserved SIEV was used as an additional outflow tract, anastomosed to the cephalic vein through a cephalic turnover. Early recognition and preparation of these superficial veins provide valuable options for superdrainage or interpositional grafting, safeguarding flap viability in the event of venous congestion. DIEP, deep inferior epigastric perforator; SCIV, superficial circumflex iliac vein; SIEA, superficial inferior epigastric artery; SIEV, superficial inferior epigastric vein.

intervention in cases of compromised perfusion dramatically improve salvage rates. Maintaining an organised operative field and preserving potential vein grafts during the initial dissection provides crucial flexibility, ensuring that revision, if required, can be performed efficiently and with minimal morbidity.

Preparedness for revision is not pessimism—it is prudent planning that safeguards flap success.

❖ Summary: this approach—CTA-guided mapping, short central fascial windows, same-row perforator preference, judicious use of short bipedicled designs, and routine nerve- and muscle-sparing technique—prioritises perfusion while preserving abdominal wall function and aesthetics, with reliable, efficient execution in unilateral and bilateral settings. Case examples are presented in *Figures 11-13*.

Intra-operative monitoring devices

The use of advanced intra-operative monitoring devices can be useful for ensuring flap viability and optimising patient recovery, particularly for buried flaps. At the same time, it can allow earlier discharge to the ward and mobilisation.

Flow couplers for buried flaps

Flow couplers, such as the Synovis Flow Coupler, represent an advancement in intra-operative and post-operative monitoring of free flaps in breast reconstruction. These devices consist of implantable rings that secure the microvascular anastomosis and a removable Doppler probe that detects blood flow, confirming vessel patency both during and after surgery (*Figure 14*). The audible signal provided by the flow coupler offers a continuous, real-time assessment of venous flow, acting as an early warning system for potential flap ischemia.

The primary benefit of flow couplers is their ability to

Figure 11 Case example of primary breast reconstruction using two medial perforators and SIEV superdrainage. A 42-year-old patient underwent immediate right breast reconstruction following mastectomy. Two medial-row perforators from the left hemi-abdomen were harvested for a DIEP flap. Because the patient demonstrated a superficial-dominant venous system, the SIEV was preserved and anastomosed to the cephalic vein using a cephalic-turnover technique to augment venous outflow. Five months later, the patient underwent contralateral mastopexy, nipple reconstruction, and complementary lipofilling. (A-E) Preoperative clinical photographs. (F) Preoperative markings. (G-K) Postoperative results six weeks after nipple-areola tattooing (11 months post-DIEP flap). The images were published with the patient's consent. DIEP, deep inferior epigastric perforator; SIEV, superficial inferior epigastric vein.

Figure 12 Case example of primary breast reconstruction after previous lumpectomy with positive margins. The original lumpectomy was performed through a radial-lateral incision; therefore, the completion mastectomy was carried out through the same incision to preserve scar placement and optimise access. Donor-site closure was performed using progressive-tension sutures aligned with natural anatomical shadows to enhance abdominal contour. (A-E) Preoperative photographs. (F) Preoperative markings. (G-K) Postoperative results following DIEP flap reconstruction. No secondary procedures were performed at this stage. The patient will undergo nipple reconstruction under local anaesthesia at a later date of her choosing. The case highlights the value of precise flap shaping and an aesthetic abdominoplasty-type closure in achieving a harmonious final result. The images were published with the patient's consent. DIEP, deep inferior epigastric perforator.

Figure 13 Delayed right breast reconstruction after tissue expander placement and radiotherapy. (A-E) Preoperative photographs. (F) Preoperative markings; note how the final elliptical design was lowered by the senior author compared with the initial markings drawn by the resident. Six months after the DIEP reconstruction, the patient underwent contralateral mastopexy on the left breast and nipple reconstruction on the right. (G-K) Postoperative results 2 weeks after this second-stage procedure. An areola tattoo is planned in four months time. The images were published with the patient's consent. DIEP, deep inferior epigastric perforator.

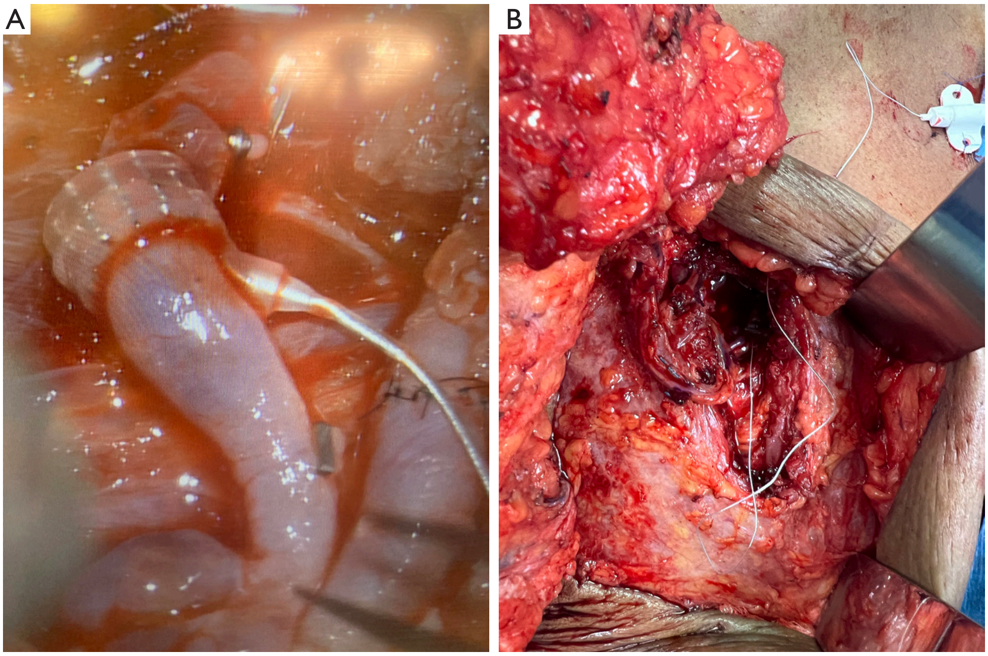

Figure 14 Application and positioning of the venous flow coupler. Proper placement requires aligning the coupler probe perpendicular to the vein to avoid distortion or kinking of the vessel after anastomosis. Adequate laxity of the probe wire is essential to prevent traction on the vein. (A) Correct perpendicular orientation of the probe relative to the vein. (B) Appropriate slack in the probe wire to minimise tension on the venous anastomosis.

enable buried autologous breast reconstruction (BABR) (40). In BABR, the entire flap is de-epithelialised and placed beneath the native breast envelope, eliminating the need for a monitoring skin paddle. This approach can significantly reduce the number of procedures required to complete the reconstructive journey, as it often negates the need for nipple reconstruction or secondary adjustments of the breast mound in selected patients, particularly following nipple-sparing mastectomy. By preserving the native nipple-areolar complex and breast envelope, BABR can significantly reduce the stigmata of surgery on the reconstructed breast, which has been shown to improve sexual and psychological well-being (41).

Flow couplers facilitate swift monitoring, allowing for accurate and timely detection of flap compromise, which is critical for successful flap salvage. Studies indicate that flow couplers are reliable, sensitive, and specific as anastomotic flap monitoring adjuncts, with a high positive predictive value for identifying compromised flaps (42,43). The ability to monitor buried flaps effectively contributes to a "one-stop" autologous breast reconstruction pathway, with immediate buried breast reconstruction, which can be safe, effective, and cost-saving (44). This streamlined process, combined with enhanced recovery protocols, can also contribute to earlier patient discharge, typically on postoperative day 3, when the flow couplers are removed.

Optimising pain control with anaesthesia

Effective pain management is a critical component of the intra-operative and postoperative phases, significantly affecting patient comfort, recovery, and overall satisfaction. The anaesthetist has a central role in minimising opioid reliance and enhancing patient well-being (45,46).

Multimodal analgesia and regional nerve blocks

It is ideal to employ a multimodal analgesia strategy, which combines various pain-relieving agents and techniques to achieve superior pain control with reduced opioid consumption. This approach minimizes opioid-related side effects such as nausea, vomiting, and constipation, facilitating earlier mobilisation and a quicker return to daily activities (47).

The TAP block, as mentioned above, is highly effective for controlling abdominal donor site pain after DIEP flap reconstruction. This block anaesthetises the nerves supplying the anterior abdominal wall, typically spanning T6–L1 (48); however, the exact dermatomal spread may vary depending on injection level and technique, while still providing robust analgesia.

Studies have shown that TAP blocks significantly decrease postoperative opioid requirements, reduce the need for patient-controlled analgesia (PCA) infusions, and can lead to shorter hospital stays and reduced anti-nausea medication use (49-53). Ropivacaine is preferred over bupivacaine because it provides more effective pain relief than Bupivacaine (54).

The use of liposomal bupivacaine (LB) in TAP blocks may prolong the duration of analgesia, as reflected by lower pain scores in the first 24 postoperative hours. However, existing literature suggests that this does not necessarily translate into a significant reduction in postoperative analgesic requirements (55).

The TAP block is surgeon-administered, relatively uncomplicated, and does not take much time at all. Combining this with scheduled oral non-opioid analgesics (e.g., acetaminophen, celecoxib, gabapentin) and judicious use of intravenous opioids for breakthrough pain forms a comprehensive pain management strategy. This proactive approach ensures patient comfort, promotes early recovery, and aligns with our enhanced recovery after surgery (ERAS) protocols (49,51).

Post-operative course: sustaining outcomes and enhancing recovery

The post-operative phase is integral to the success of breast reconstruction, focusing on accelerated recovery, effective pain management, and long-term assessment of patient outcomes. This phase leverages structured protocols and patient feedback to ensure sustained benefits and continuous improvement in care.

ERAS protocols

Multiple centres across the world implement ERAS protocols, which are evidence-based, multimodal approaches designed to accelerate patient recovery and improve outcomes (45,46). The ERAS protocol for autologous breast reconstruction has demonstrated significant benefits, including decreased opioid consumption, shorter hospital stays, and a reduction in overall complications, without increasing the risk of flap loss (56-59). Patients typically experience earlier mobilisation and a quicker return to daily activities, with discharge often occurring on postoperative day 3 or 4.

Key tenets of the ERAS approach include:

- ❖ Minimal preoperative fasting (6 hours) and carbohydrate loading: this helps maintain metabolic balance and reduce surgical stress.
- ❖ Multimodal analgesia: as detailed above, this approach reduces reliance on opioids, minimizing their associated side effects and contributing to better pain control.
- ❖ Judicious fluid administration: careful fluid management helps prevent fluid overload and its complications. We follow a standardised anesthesiology and surgical protocol with optimal intravenous fluid during the operation (45). During the operation, the patient receives crystalloids, e.g., Plasmalyte™ 1,500 mL. The postoperative fluid regimen consists of 2,000 mL over 24 hours of a crystalloid fluid. Fluid management is blood pressure-oriented, and we aim to maintain a blood pressure of 120/80 mmHg. intravenous is only given during the night itself, after which everything is administered per os. The urinary catheter is removed on postoperative day 1.
- ❖ Early refeeding: initiating oral intake soon after surgery supports gut function and overall recovery, with clear liquids commenced on postoperative day 0 and progression to a regular diet from postoperative day 1.
- ❖ Early postoperative mobilisation: encouraging patients to ambulate shortly after surgery (typically day 1) helps prevent complications like deep venous thrombosis and pulmonary embolism, and promotes faster return to function.
- ❖ Drain and catheter management: urinary catheters are typically removed on day 1, and breast drains are removed when output is minimal, usually by day 2. Because of the quilting sutures, abdominal drains are usually not required.
- ❖ Activity restrictions and physiotherapy: patients are advised to avoid heavy lifting and strenuous exercise for approximately 6 weeks, with light activities and walking encouraged earlier. Physiotherapy is recommended to prevent shoulder stiffness and aid recovery, often starting 2 weeks post-operatively.

Post-operative patient feedback: patient-reported outcome measures (PROMs)

PROMS are integral to the assessment of surgical quality and for guiding clinical decisions in breast reconstruction. Authors utilise PROMs, such as the BREAST-Q, to capture the patient's perspective on physical and psychological health, body image, sexual well-being, and overall satisfaction. This allows for a holistic evaluation of reconstructive success (60,61). PROMs show higher patient following autologous breast reconstruction compared with implant-based techniques (62).

Importantly, we are currently studying the role of an AI-powered chatbot designed to deliver validated, evidence-based information to patients and assist them in finding accurate answers to common questions—information they would otherwise seek through search engines, where reliability varies widely. This ongoing study aims to evaluate how such tools can improve patient understanding, support informed consent, and enhance the overall patient experience.

Alternative donor sites

Beyond the abdomen, the same principles of aesthetic donor-site management, enhanced recovery, and streamlined perioperative care extend naturally to alternative autologous options such as the PAP, SGAP, and LAP flaps. Contemporary posterior thigh, gluteal, and lumbar perforator harvests can be performed with minimal functional disruption through careful perforator selection, limited fascial violation, and closure techniques designed around natural contour lines (63).

The emphasis is no longer solely on flap survival, but on achieving harmonious 3D contour of the donor site—flattening the lumbar roll in LAP harvests, lifting the upper thigh in PAP harvests, and providing a subtle buttock contour enhancement in SGAP harvests.

When combined with meticulous nerve preservation, tension-free layered closure, and drain-minimising strategies, these refinements allow surgeons to offer non-abdominal flaps without the historically burdensome morbidity associated with early gluteal and thigh flaps.

Equally impactful is the recognition that the most powerful determinant of early discharge and rapid functional recovery is not the flap choice, but the patient preparation. Modern autologous reconstruction emphasizes education, expectation-setting, and patient empowerment—all part of "prehabilitation". By reframing reconstruction as a "restorative aesthetic surgery" with a recovery trajectory similar to a combined abdominoplasty and breast surgery, rather than a prolonged, medicalised postoperative course, patients enter surgery with agency, confidence, and a clear understanding of milestones. Consistent counselling, digital communication platforms, and early mobility coaching reduce anxiety, support opioid-sparing analgesia, and shift recovery behaviour from passive dependence to active participation. These cultural changes—combined with ERAS pathways, refined operative technique, and technology-enabled flap monitoring—have allowed autologous breast reconstruction, whether DIEP, PAP, SGAP or LAP, to evolve into a predictable, efficient, patient-centred experience that prioritises aesthetics, safety, and swift return to normality.

Limitations

This article is a clinical practice review that covers the main author's practical workflow and techniques in autologous breast reconstruction. It is not a systematic review, and the literature has been selected to support the key concepts rather than to search through a systematic search strategy. There is, therefore, some selection bias for study inclusion and no quantitative analysis of the chosen intervention. However, every intervention is performed based on existing literature.

It also does not contain any prospective patient data, and many ongoing studies within two departments are mentioned where relevant, but definitive conclusions can only be drawn once complete data collection and analysis have been carried out.

In addition, several elements described reflect the practice patterns and resources of high-volume centres. The feasibility and impact of technologies such as AI-supported communication tools, automated CTA processing and other interventions may vary across institutions depending on infrastructure, costs, local expertise, and availability. Consequently, the generalisability of certain components may be limited, particularly in lower-volume settings.

Many of the innovations are also rapidly evolving. Some concepts are supported by limited evidence, but long-term and multicentre data are still lacking. There is also a lack of cost-effectiveness for certain new techniques.

Conclusions

Modern autologous breast cancer reconstruction, as practiced and advanced by the authors, represents an ongoing evolution in patient care. By integrating the work of pioneers with cutting-edge technology and a steadfast patient-centric philosophy, our perspective on breast reconstruction is one of a comprehensive journey, not merely a surgical event.

Our commitment to optimizing every stage—from AI-enhanced personalised communication and robust prehabilitation to precise intra-operative techniques and structured post-operative recovery—ensures that each patient receives truly individualized care. The strategic application of AI in planning, advanced CAD systems for perforator identification, and innovative monitoring devices like flow couplers for buried flaps exemplifies our dedication to surgical excellence and efficiency. Furthermore, our rigorous use of PROMs ensures that the patient's voice and quality of life remain the ultimate arbiters of success.

This integrated approach, continuously refined through ongoing research and clinical experience, allows the delivery of increasingly natural, durable, and satisfying reconstructive outcomes.

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References

1. Kim J, Harper A, McCormack V, et al. Global patterns and trends in breast cancer incidence and mortality across 185 countries. Nat Med 2025;31:1154-62.
2. Hamdi M, Kapila AK, Waked K. Current status of autologous breast reconstruction in Europe: how to reduce donor site morbidity. Gland Surg 2023;12:1760-73.
3. Kapila AK, Iyer H, Mohanna P, et al. Enhancing abdominal donor site aesthetics: The double diamond drainless closure with barbed progressive tension sutures. J Plast Reconstr Aesthet Surg 2024;96:53-5.
4. Koshima I, Soeda S. Inferior epigastric artery skin flaps without rectus abdominis muscle. Br J Plast Surg 1989;42:645-8.
5. Koshima I, Moriguchi T, Soeda S, et al. Free thin paraumbilical perforator-based flaps. Ann Plast Surg 1992;29:12-7.
6. Allen RJ, Treece P. Deep inferior epigastric perforator flap for breast reconstruction. Ann Plast Surg 1994;32:32-8.
7. Blondeel PN, Boeckx WD. Refinements in free flap breast reconstruction: the free bilateral deep inferior epigastric perforator flap anastomosed to the internal mammary artery. Br J Plast Surg 1994;47:495-501.
8. Blondeel PN. One hundred free DIEP flap breast reconstructions: a personal experience. Br J Plast Surg 1999;52:104-11.
9. Blondeel N, Vanderstraeten GG, Monstrey SJ, et al. The donor site morbidity of free DIEP flaps and free TRAM flaps for breast reconstruction. Br J Plast Surg 1997;50:322-30.

10. Blondeel PN, Beyens G, Verhaeghe R, et al. Doppler flowmetry in the planning of perforator flaps. Br J Plast Surg 1998;51:202-9.
11. Hamdi M, Blondeel P, Van Landuyt K, et al. Algorithm in choosing recipient vessels for perforator free flap in breast reconstruction: the role of the internal mammary perforators. Br J Plast Surg 2004;57:258-65.
12. Hamdi M, Weiler-Mithoff EM, Webster MH. Deep inferior epigastric perforator flap in breast reconstruction: experience with the first 50 flaps. Plast Reconstr Surg 1999;103:86-95.
13. Hamdi M, Khuthaila DK, Van Landuyt K, et al. Double-pedicle abdominal perforator free flaps for unilateral breast reconstruction: new horizons in microsurgical tissue transfer to the breast. J Plast Reconstr Aesthet Surg 2007;60:904-12; discussion 913-4.
14. Arya R, Healy C, Frame JD, et al. 21 year follow up of a DIEP (deep inferior epigastric perforator) flap: a tale of a "nulltiple". J Plast Reconstr Aesthet Surg 2014;67:1436-9.
15. Kapila AK, Wakure A, Morgan M, et al. Characteristics and outcomes of primary interposition vascular grafts in free flap breast reconstruction. J Plast Reconstr Aesthet Surg 2020;73:2142-9.
16. Kapila AK, Kempny T, Knoz M, et al. An Algorithm in Managing Deep Inferior Epigastric Vessel Interruption in Free Flap Breast Reconstruction. Plast Reconstr Surg Glob Open 2023;11:e4938.
17. Chowdhury RA, Kapila AK, Mohanna PN, et al. Patient-reported and surgical outcomes of profunda artery perforator (PAP) flap breast reconstructions compared to deep inferior epigastric perforator (DIEP) using BREAST-Q. J Plast Reconstr Aesthet Surg 2025;102:489-97.
18. Abboud MH, Kapila AK, Bogaert S, et al. Composite Breast Remodeling After Implant Removal by Tissue Recruitment and Loops Fixation With Power-Assisted Liposuction and Lipofilling (PALLL). Aesthet Surg J 2021;41:770-82.
19. Abboud MH, El Hajj H, Kapila AK, et al. Scarless Composite Breast Reconstruction Utilizing an Advancement Skin Flap, Loops, and Lipofilling. Aesthet Surg J 2022;42:38-53.
20. Cho MJ, Schroeder M, Flores Garcia J, et al. The Current State of the Art in Autologous Breast Reconstruction: A Review and Modern/Future Approaches. J Clin Med 2025;14:1543.
21. Scaglioni MF, Martini F, Meroni M. Present and Future of Autologous Breast Reconstruction: Advancing Techniques to Minimize Morbidity and Complications, Enhancing Quality of Life and Patient Satisfaction. J Clin Med 2025;14:2599.
22. Kapila AK, De Vleminck L, Hamdi M. Three key domains for optimizing preoperative preparedness in plastic surgery with AI. Plast Aesthet Res. 2025;12:N-A.
23. Kapila AK, Georgiou L, Hamdi M. Decoding the Impact of AI on Microsurgery: Systematic Review and Classification of Six Subdomains for Future Development. Plast Reconstr Surg Glob Open 2024;12:e6323.
24. Kapila AK, Iyer H, Mohanna P, et al. The impact of physical activity on patient-reported outcomes following deep inferior epigastric perforator flap breast reconstruction. J Plast Reconstr Aesthet Surg 2024;97:6-12.
25. Kapila AK, Hamdi M, Patel A. Clinicians Should Actively Promote Exercise in Survivors of Breast Cancer. Clin Breast Cancer 2018;18:e747-9.
26. Kapila AK, Herd A, Knife N, et al. A Prospective Cohort Study on the Impact of Reflexology in Patients With Breast Cancer Using the MYCaW Scale. Clin Breast Cancer 2019;19:e319-26.
27. Agha-Mohammadi S, Hurwitz DJ. Enhanced recovery after body-contouring surgery: reducing surgical complication rates by optimizing nutrition. Aesthetic Plast Surg 2010;34:617-25.
28. Vitagliano T, Garieri P, Lascala L, et al. Preparing Patients for Cosmetic Surgery and Aesthetic Procedures: Ensuring an Optimal Nutritional Status for Successful Results. Nutrients 2023;15:352.
29. Escobar-Domingo MJ, Bustos VP, Kim EJ, et al. The impact of metabolic syndrome in breast reconstruction decision-making and postoperative outcomes: A nationwide analysis. J Plast Reconstr Aesthet Surg 2024;89:21-9.
30. Masoomi H, Greives MR, Cantor AD, et al. Effect of Anemia in Postoperative Outcomes of Autologous Breast Reconstruction Surgery. World J Plast Surg 2019;8:285-92.
31. Ceranka J, Lamtenzan D, Boonen P, et al. Computer-Assisted Surgical Planning for DIEP Flap Breast Reconstruction Surgery. Lecture Notes in Computer Science 2026;16142 LNCS:123-33.
32. Botti E, Jansen B, Ballen-Moreno F, et al. Evaluating the Accuracy and Repeatability of Mobile 3D Imaging Applications for Breast Phantom Reconstruction. Sensors (Basel) 2025;25:4596.
33. Kapila AK, Hamdi M. Time to Evolve Plastic Surgery Education? Integrating Robotic Techniques and Artificial

Intelligence into Training Curricula. Plast Reconstr Surg Glob Open 2024;12:e5778.
34. Allan AY, Chasapi M, Kapila A, et al. Three-dimensional microscope skill acquisition: A randomised controlled study comparing two-dimensional laboratory microscope training, video gaming and virtual reality gaming. J Plast Reconstr Aesthet Surg 2024;98:373-80.
35. Zoccali G, Farhadi J. Abdominal perforator exchange flap (APEX): A classification of pedicle rearrangements. Microsurgery 2021;41:607-14.
36. DellaCroce FJ, DellaCroce HC, Blum CA, et al. Myth-Busting the DIEP Flap and an Introduction to the Abdominal Perforator Exchange (APEX) Breast Reconstruction Technique: A Single-Surgeon Retrospective Review. Plast Reconstr Surg 2019;143:992-1008.
37. Selber JC. The Robotic DIEP Flap. Plast Reconstr Surg 2020;145:340-3.
38. Wittesaele W, Vandevoort M. Implementing the Robotic deep inferior epigastric perforator Flap in daily practice: A series of 10 cases. J Plast Reconstr Aesthet Surg 2022;75:2577-83.
39. Homsy C, Lindsey JT. Regional Anesthetic Blocks in Plastic Surgery Using Portable Ultrasound: A Simplified Approach. Ann Plast Surg 2019;82:S374-9.
40. Rose V, Cooper L, Pafitanis G, et al. Single-stage buried autologous breast reconstruction (BABR). J Plast Reconstr Aesthet Surg 2022;75:2960-9.
41. Creasy H, Citron I, Davis TP, et al. Buried Autologous Breast Reconstruction: Outcomes and Technical Considerations. J Clin Med 2024;13:1463.
42. Shtarbanov P, Kodama H, Nikkhah D. Early experience with Synovis Flow Coupler and major pitfalls in its use in 18 microsurgical free flaps. J Plast Reconstr Aesthet Surg 2024;90:326-9.
43. Kapila AK, Mughal M, Roblin P, et al. Reply to: Early experience with Synovis Flow Coupler and major pitfalls in its use in 18 microsurgical free flaps. J Plast Reconstr Aesthet Surg 2024;90:330-2.
44. Mughal M, Berner JE, Ho-Asjoe M, et al. One-stop autologous breast reconstruction: A safe and effective cost-saving pathway. J Plast Reconstr Aesthet Surg 2024;92:276-81.
45. Stockmans ALP, Kyriazidis I, Dumont H, et al. A standardized anesthesiology and surgical protocol leads to zero VTE events: A retrospective study in 502 autologous breast reconstructions. J Plast Reconstr Aesthet Surg 2025;103:1-7.
46. O'Neill AC, Mughal M, Saggaf MM, et al. A structured pathway for accelerated postoperative recovery reduces hospital stay and cost of care following microvascular breast reconstruction without increased complications. J Plast Reconstr Aesthet Surg 2020;73:19-26.
47. Schoenbrunner AR, Joshi GP, Janis JE. Multimodal Analgesia in the Aesthetic Plastic Surgery: Concepts and Strategies. Plast Reconstr Surg Glob Open 2022;10:e4310.
48. Chi D, Chen AD, Ha AY, et al. Comparative Effectiveness of Transversus Abdominis Plane Blocks in Abdominally Based Autologous Breast Reconstruction: A Systematic Review and Meta-analysis. Ann Plast Surg 2020;85:e76-83.
49. Salibian AA, Frey JD, Thanik VD, et al. Transversus Abdominis Plane Blocks in Microsurgical Breast Reconstruction: Analysis of Pain, Narcotic Consumption, Length of Stay, and Cost. Plast Reconstr Surg 2018;142:252e-63e.
50. Abdou SA, Daar DA, Wilson SC, et al. Transversus Abdominis Plane Blocks in Microsurgical Breast Reconstruction: A Systematic Review and Meta-analysis. J Reconstr Microsurg 2020;36:353-61.
51. Wheble GA, Tan EK, Turner M, et al. Surgeon-administered, intra-operative transversus abdominis plane block in autologous breast reconstruction: a UK hospital experience. J Plast Reconstr Aesthet Surg 2013;66:1665-70.
52. Chi D, Chen AD, Ha AY, et al. Comparative Effectiveness of Transversus Abdominis Plane Blocks in Abdominally Based Autologous Breast Reconstruction: A Systematic Review and Meta-analysis. Ann Plast Surg 2020;85:e76-83.
53. Park RH, Odega UK, DeVito RG, et al. The Efficacy of Transversus Abdominis Plane Blocks in Abdominal Tissue Free Flap Breast Reconstruction. J Reconstr Microsurg 2025. [Epub ahead of print]. doi: 10.1055/a-2671-7296.
54. Sinha S, Palta S, Saroa R, et al. Comparison of ultrasound-guided transversus abdominis plane block with bupivacaine and ropivacaine as adjuncts for postoperative analgesia in laparoscopic cholecystectomies. Indian J Anaesth 2016;60:264-9.
55. Park RH, Chou J, DeVito RG, et al. Effectiveness of Liposomal Bupivacaine Transversus Abdominis Plane Block in DIEP Flap Breast Reconstruction: A Randomized Controlled Trial. Plast Reconstr Surg 2024;154:52S-59S.
56. Offodile AC 2nd, Gu C, Boukovalas S, et al. Enhanced recovery after surgery (ERAS) pathways in breast reconstruction: systematic review and meta-analysis of the literature. Breast Cancer Res Treat 2019;173:65-77.
57. Temple-Oberle C, Shea-Budgell MA, Tan M, et al.

Consensus Review of Optimal Perioperative Care in Breast Reconstruction: Enhanced Recovery after Surgery (ERAS) Society Recommendations. Plast Reconstr Surg 2017;139:1056e-71e.
58. Gort N, van Gaal BGI, Tielemans HJP, et al. Positive effects of the enhanced recovery after surgery (ERAS) protocol in DIEP flap breast reconstruction. Breast 2021;60:53-7.
59. Gnaneswaran N, Perera M, Perera N, et al. Enhanced recovery after surgery (ERAS) pathways in autologous breast reconstruction: a systematic review. Eur J Plast Surg 2016;39:165-72.
60. Lagendijk M, van Egdom LSE, Richel C, et al. Patient reported outcome measures in breast cancer patients. Eur J Surg Oncol 2018;44:963-8.
61. Cordova LZ, Hunter-Smith DJ, Rozen WM. Patient reported outcome measures (PROMs) following mastectomy with breast reconstruction or without reconstruction: a systematic review. Gland Surg 2019;8:441-51.
62. Phan R, Hunter-Smith DJ, Rozen WM. The use of Patient Reported Outcome Measures in assessing patient outcomes when comparing autologous to alloplastic breast reconstruction: a systematic review. Gland Surg 2019;8:452-60.
63. Kapila AK, Iyer H, Gianchandani A, et al. Alternative flaps in immediate whole breast reconstruction. In: Hamdi M. editor. Essentials of Oncoplastic Breast Surgery Techniques. London: Genius Publishing; 2026:399-420.

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