

Review Article

A Comprehensive Review Of The Best Use Of Drain Tubes For Diep Flap Breast Reconstruction.

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Abstract

Although deep inferior epigastric perforator (DIEP) flap breast reconstruction is becoming more and more common, there is debate about how best to employ closed suction drains (CSD) at the abdominal donor site. Current research on the use of CSD, placement/removal criteria, and complications in DIEP flap operations is summarized in this narrative review. There is also discussion of alternative methods and their consequences for postoperative care. Techniques: In August 2024, a comprehensive search was carried out across many databases to find English-language research on the application of CSD in DIEP flap breast reconstruction. Original research on topics including CSD volume criteria, time, problems, substitutes like progressive tension sutures, and effects on patient outcomes and bathing was required for inclusion. Relevant paper references were manually searched. Although CSD may lessen the formation of seromas or hematomas, early removal (≤ 3 days) did not result with more problems or a shorter hospital stay.

With evidence of similar or fewer problems and better recovery than CSD, progressive tension sutures appear to be a promising substitute. It's uncertain if taking a shower early with drains is safe. Conclusions: More thorough randomized studies are required to provide evidence-based procedures for the timing of removal and show the effectiveness of new drain-free treatments on patient-centered outcomes, even while CSD attempts to reduce postoperative problems. Practice variability may be decreased by using standardized criteria. The long-term effects of drainage techniques on both functional and aesthetic outcomes should be investigated in more detail.

Keywords : *DIEP; breast reconstruction; drain tubes; closed suction drain; timing.*

INTRODUCTION

An important development in post-mastectomy therapy is autologous breast reconstruction using the deep inferior epigastric perforator (DIEP) flap, which provides comparable aesthetic results with lower donor site morbidity [1–3]. The DIEP flap procedure was chosen by 23,324 out of 137,808 breast reconstruction patients in the US in 2020 [4]. In the surgical community, postoperative management—more especially, the use of closed suction drainage (CSD) at the donor site—remains controversial despite its widespread use [4–6]. By reducing dead space and avoiding fluid buildup, CSD can reduce the risk of seroma formation and associated problems, which is the typical justification for its use in DIEP flap breast reconstruction [3]. Nevertheless, there are drawbacks to the treatment; using drains may raise the risk of infection, cause pain, limit movement, and lengthen hospital stays, all of which have led to research into other, drain-free closure methods [7, 8]. The situation is made more difficult by differing surgical preferences, as drainage clearance standards range greatly, from daily amounts of 5

mL to 80 mL [6,9,10]. The absence of agreement and defined procedures in the sector is highlighted by this heterogeneity [10]. Additionally, early postoperative showering may improve patient comfort.

With an emphasis on the placement, duration, and removal criteria in relation to DIEP flap breast reconstruction, this narrative review seeks to condense and unify the diverse research on CSD application. Furthermore, we intend to examine the available data regarding alternative techniques like progressive tension sutures and barbed sutures in order to evaluate their effectiveness in lowering complications, consider their effects on patient outcomes and hospital resource allocation, and examine the consequences of postoperative showering practices for patients with CSD—a subject that is rarely covered in the literature at this time.

MATERIALS AND METHODS

Two separate authors conducted searches across the Cochrane Library, Web of Science, EMBASE, Scopus, and PubMed databases from the beginning to August 2024 to

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guarantee comprehensiveness and lessen selection bias. "DIEP flap," "breast reconstruction," "autologous breast reconstruction," "closed suction drainage," "CSD," "drain," "drainage volume," "postoperative care," "seroma," "wound dehiscence," "infection," "postoperative showering," and "patient outcomes" were the terms and phrases used in the search.

To find any more relevant literature, we looked through the references of earlier reviews and the papers that were part of our original search. English-language, peer-reviewed original research articles, systematic reviews, meta-analyses, and clinical trials were all required to meet our inclusion criteria. The studies had to specifically address the use of CSD in DIEP flap breast reconstruction in human participants, covering topics like drainage volume criteria for removal, when to remove the drain, CSD use complications, alternative techniques to CSD, and how CSD affects patient outcomes and postoperative showering. Articles that were not published in English, non-peer-reviewed works including editorials, opinion pieces, and letters to the editor, research that was not specifically about the application of CSD in DIEP flap breast reconstruction or its substitutes, and research that used animal models were all disregarded.

The following was included in a standardized narrative review checklist (Supplementary File S1):

- The research question is well defined.
- A methodical approach to searching using pre-established databases and keywords.
- Criteria for inclusion and exclusion to find pertinent research.
- Assessment of the studies' caliber and applicability.
- The findings are combined to create a logical story.
- A discussion of how the results may affect clinical practice.
- Finding gaps in the literature and making recommendations for additional study.

RESULTS AND DISCUSSION

The Justification for Closed Suction Drains

In order to help avoid fluid buildup and lower the possibility of problems, closed suction drains are frequently utilized during breast reconstruction procedures with DIEP flaps. Native tissue at the recipient site, such as blood vessels and lymphatics, sustains some degree of trauma during surgery, especially if DIEP reconstructive surgery is performed right after a mastectomy. This can result in the accumulation of fluid (such as blood, serum, or lymph) beneath the skin flaps after the procedure [11,12]. This fluid buildup results in hematomas or seroma collections, which can put strain on surrounding structures. Compression of the flap pedicle resulting in decreased flap viability is a major problem [13,14]. Additionally, elevated subcutaneous pressure puts tension

on the native mastectomy skin, raising the possibility of wound dehiscence or skin necrosis [15,16]. Additionally, static fluid creates an environment that is conducive to bacterial development, which can result in superimposed infection of these fluid collections, decreased oxygenation of the tissue, and frequently the need to return to the theater for drainage [17, 18].

In this situation, closed suction drains offer a way to remove extra fluid in the early postoperative phase in a controlled manner. Using a vacuum-sealed reservoir or connector, the drains are positioned beneath the skin and provide gentle, continuous suction to enable drainage through a tiny, perforated tube. By removing fluid buildup from dead space, this is supposed to lessen strain and swelling beneath the flaps [19]. Less stress and edema may contribute to better blood flow within the tissue, which may increase the longevity of flap or native skin. Additionally, drains may give surgeons measurable information on fluid drainage volumes over time, which may indicate the emergence of possible problems like hemorrhage.

In the event that production suddenly increases or turns bloody, a hematoma may be developing. A persistently high discharge could indicate a lymphatic leak. These findings aid in early intervention and could reduce the likelihood of flap loss or other complications. As a result, there are several possible advantages to using closed suction drains, which supports their application in DIEP flap breast reconstruction. Remarkably, a study conducted by Skorocho et al. on 743 patients found that seroma formation rates were higher in instances with a single drain tube than in those without [20]. Notwithstanding the inconsistent findings of that one study, the bulk of data points to closed suction drains as a successful strategy for lowering the development of hematomas and seromas.

Location of the CSD in DIEP Flap Reconstruction

The placement of drains is a crucial factor to take into account after the selection has been made. CSDs are often positioned at both the donor and recipient sites in the abdomen, frequently with two drains per site [20–22]. When bilateral DIEP reconstructions are performed, this might leave patients with up to six drains in place, which can be uncomfortable and limit their movement after surgery. More recently, studies have demonstrated that the use of progressive tension sutures, specifically barbed sutures, in donor site closure may eliminate the need for donor-site drain placement. When compared to the use of drains alone, these studies have found improved or comparable postoperative donor site complications [5,8]. Drains are usually positioned laterally and inferiorly in a dependent position at the recipient site to enable efficient fluid drainage whether the patient is sitting up in bed or lying down. Additionally, the drain is positioned

here to avoid the flap pedicle, which is frequently medial. The appearance of scars after drain insertion is another factor to take into account. One of the most often mentioned concerns for patients undergoing DIEP flap surgery is the appearance of drain scars [23]. Involving patients in the drain placement planning process may help reduce their anxiety, as they may have specific preferences for the drain site [23].

Based on the research, there is still disagreement over the ideal number of drains for DIEP flap reconstruction. Studies like those by Miranda et al. and Philips et al. draw attention to the variation in CSD protocols according to surgeon choice [1,9], while other research suggests that alternate methods, like drain-free closures and barbed sutures, might be just as well or perhaps better [5,8,25]. Drain-free methods can lower hospital stays and complications without sacrificing patient safety, according to research by Thacoor et al. and Nagarkar et al. [7, 8]. Furthermore, Skorochod et al. discovered that a single drain is associated with increased seroma production but decreased infection rates, which makes drain placement selections more difficult [20]. Overall, new data supporting drain-free techniques suggests the need for consistent rules, even in the face of historical support for drains.

Duration of CSD Placement and Elimination in DIEP Flap Reconstruction

When it comes to the postoperative care of a patient who has had a DIEP flap, the length of time a drain is left in place and when it is removed are crucial factors. Although there is disagreement, CSDs are usually maintained until the output drops below a predetermined volume during a specified period of time (generally 20–50 mL over 24 hours for two days in a row) [7,9]. Theoretically, this criterion should guarantee that the danger of hematoma or seroma formation is reduced prior to drain removal. Therefore, the time of its removal varies widely from patient to patient and is dependent on a number of criteria, such as the extent of the procedure, surgeon choice, and patient considerations. While late removal causes prolonged agony and raises the danger of infection, early removal can increase the risk of seroma or hematoma. However, it has been demonstrated that early drain removal (within three days of surgery) is linked to shorter hospital stays without raising the risk of complications [9]. Additionally, it has been demonstrated that the suggested Enhanced Recovery After Surgery (ERAS) protocols for DIEP are safe and successful for patients with DIEP, with the goal of release within 24 to 48 hours [24]. In the end, optimizing results requires postoperative monitoring of drain outputs and teaching patients and medical personnel about drain care and the identification of issues associated to drains. The literature indicates that, when done appropriately, early drain removal can lower hospital stays without increasing the risk of complications, even though there is no set method for

this process and it depends on a number of variables. This technique is further supported by ERAS protocols, which encourage safe and efficient discharge schedules.

Possible Issues with CSD Positioning in DIEP Flap Repair

Several possible problems may arise with the insertion of a CSD for DIEP flap reconstruction. The entry of germs along the drain tube can cause infection, which is a serious complication that can compromise the flap's viability and result in infected collections that need to be debrided or washed away. Moreover, harm to the vascular pedicle itself is another potential consequence of drain use. On the other hand, Skorochod et al.'s 743 patients showed comparable outcomes to Philips et al.'s 130-patient sample, which revealed lower infection rates linked to closed suction drains (CSDs) [1,22]. Although more research has been suggested to improve the trustworthiness of these findings, other studies looking at the use of CSD similarly show a decline in overall complication rates [7,25].

The literature highlights the importance of closed suction drains (CSDs) in postoperative treatment and generally supports their usage as an efficient strategy to lower infection and overall complication rates. Although it is uncommon, unintentional damage may happen if the drain tube is forcibly implanted during surgery or moves thereafter if it is positioned too near the vascular anastomosis or pedicle. Additionally, drains make patients less mobile and more uncomfortable, which can result in more nursing care needs and longer hospital stays, raising the possibility of more problems while the patient is in the hospital [7, 8]. To reduce hazards and guarantee the best results for patients undergoing closed suction drains, careful patient selection and monitoring are crucial. There is little research on how CSDs affect postoperative showering; only one pertinent study has been found [4]. Showering after surgery does not raise the risk of complications, according to Ogawa and Tahara's analysis of 30 patients' data, which showed no discernible variations in complication rates according on the number of CSD tubes attached to the abdominal donor site [4]. Additionally, the number of CSD tubes had no bearing on when patients could start taking showers or when the drains were removed. It's interesting to note that, in contrast to those who had one or none, patients with two drains did not take a shower earlier. Statistical analysis showed no significant differences between the groups, indicating that patients with two or fewer drains can shower safely, despite a few issues reported in patients with one drain left. The safety of early postoperative bathing for individuals with CSDs is generally supported by their findings [4]. To fully examine the connection between CSD use, postoperative shower timing, and related problems, more research is necessary.

Alternative Options

According to certain research, drain-free abdominal closure in DIEP reconstruction is safe [7,8,25,26]. When compared to the same procedures involving drain placement ($n = 109$), Thacoor et al. (2018) discovered that donor-site drain-free DIEP repair reduces inpatient hospital stays and did not raise complication rates [7]. A drainless DIEP flap concept was tried on 47 patients by Evgeniou et al. in 2023. They discovered that the treatment resulted in shorter overall hospital stays without an increase in complication rates [25]. As previously noted, using progressive tension sutures (PTSs) to achieve abdominal closure during abdominoplasty surgeries has shown outcomes similar to those of CSD implantation [27], and new research has validated the effectiveness of PTS use in DIEP flap reconstructions [8,27,28]. When compared to CSD, Mohan et al. (2015) discovered that using PTSs for abdominal flap closure following DIEP flap harvest was linked with less post-operative discomfort and an earlier discharge without a higher risk of complications ($n = 93$). None of the 17 patients evaluated in a 2020 retrospective analysis who had DIEP flap donor site closure with PTS experienced seroma development, and their release times were quicker than those of their counterparts who received traditional care with drains [26]. Drain-free surgeries may be appropriate for all patients. Patients who have a body mass index more than 30 kg/m², for instance, may be more susceptible to problems in these situations [25]. Although the evidence suggests that PTS can produce abdominal closure results comparable to those of CSD, it is not conclusive that PTS removes the need for drains in all patients. Complication risks can be influenced by individual characteristics, such as body mass index. To find out which patients can safely get drain-free PTS closure, more research is required.

Because quilting sutures can lower seroma rates and volume, they are becoming more and more common [29–33]. In a retrospective analysis of 235 patients with breast cancer, Wu et al. discovered that the traditional suture group had a greater incidence of Grades 2 and 3 seromas than the quilt suture group (19.3% vs. 9.5%, $p = 0.032$) [29]. In a similar vein, Bhagchandani et al. found that their quilted suture group experienced a shorter hospital stay (4.28 vs. 9.76 days, $p = 0.0001$) and lower rates of seroma formation than the traditional suture group (23.26% vs. 57.58%, $p = 0.002$) [31]. The combination of quilted sutures with other prophylactic strategies, such as fibrin sealants, has been proposed for further study [33]. Quilting sutures are increasingly being used because they can reduce seroma volume and rates [29–33]. Wu et al. found that the traditional suture group had a higher incidence of Grades 2 and 3 seromas than the quilt suture group (19.3% vs. 9.5%, $p = 0.032$) in a retrospective review of 235 patients with breast cancer [29]. Similarly, Bhagchandani et al. discovered that their quilted suture group had lower

rates of seroma formation (23.26% vs. 57.58%, $p = 0.002$) and a shorter hospital stay (4.28 vs. 9.76 days, $p = 0.0001$) than the standard suture group [31]. More research has been suggested on the use of quilted sutures in conjunction with other preventative measures, like fibrin sealants [33].

Limitations

Despite being thorough in its current breadth, this narrative review has a number of limitations that should be noted. First off, it is difficult to prove causation and account for confounding variables because most of the included research are retrospective in nature. Direct comparisons are made more difficult by the retrospective design, which frequently results in a lack of uniform techniques among studies, especially with regard to placement and removal criteria for drains. A comprehensive review and meta-analysis could not be carried out because there are also very few RCTs in the literature, despite the fact that they are the gold standard for assessing clinical therapies. The strength of the evidence comparing the safety and effectiveness of CSD against drain-free procedures in DIEP flap breast reconstruction is limited by the lack of such trials. In a narrative evaluation, it might be challenging to measure and account for the surgeon's competence and experience, which can have a significant impact on surgical outcomes in DIEP flap reconstruction. Additionally, the evaluation mostly concentrates on short-term results, like the length of hospital stay and early postoperative problems. This creates a knowledge gap about the long-term effects of various draining techniques, especially with regard to patient satisfaction, flap viability, and cosmetic results. Additionally, the patient demographics in the analyzed studies might not accurately reflect the variety of people undergoing breast reconstruction. Variables in demographics, comorbidities, and varying BMI ranges can all have a substantial impact on surgical outcomes and complications, but the literature currently in publication does not always take these aspects into consideration [33]. Last but not least, the evaluated papers did not go into great detail on the DIEP flap procedure's dissection technique, which may have an impact on seroma formation and fluid accumulation. There is currently a dearth of research on the effects of various dissection methods, such as scalpel versus electrocautery dissection, on postoperative results. The material provided above does not go into great detail about the dissection technique used in the DIEP flap procedure. However, it might be a confusing element that influences drain impact and seroma formation. Conventional electrocautery is linked to less blood loss than knife dissection, but it may have an effect on postoperative fluid accumulation [37].

Future Research

Even though DIEP flap breast reconstruction has advanced and our understanding of the use of CSD has grown, there are still important knowledge gaps that need to be filled in future studies in order to improve patient outcomes. There is an urgent need for prospective RCTs that compare the safety and effectiveness of CSD to more recent, drain-free methods such as progressive tension sutures. To find out if some subgroups benefit more from particular procedures, these studies should stratify patients based on pertinent characteristics such as age, BMI, comorbidities, and extent of surgery. To fully assess the effects of draining techniques, attention must also be paid to patient-reported outcomes, such as pain, mobility, and general satisfaction. Additionally, research is required to determine the best time to remove the drain during DIEP flap restoration. The goal of research should be to provide evidence-based, consistent standards for drain removal, which could lessen the variation in present procedures. Investigating the relationship between drainage volume and the likelihood of problems like seroma and hematoma formation may fall under this category. It's also important to investigate how new materials and technology might help prevent seromas and other issues. For example, novel approaches to wound closure in DIEP flap restoration may be presented by the use of biocompatible adhesives or sealants as substitutes for conventional suturing techniques.

CONCLUSIONS

Although closed suction drainage is still frequently used to reduce problems such as seroma formation, new drain-free methods like progressive tension sutures are being used more frequently and have the potential to improve patient comfort and shorten hospital stays. In order to build evidence-based procedures, more thorough, randomized controlled trials are required, as the study highlights the lack of consensus and defined protocols in drainage management. Furthermore, it is essential to investigate patient-centered outcomes and the long-term effects of drainage techniques on both functional and cosmetic outcomes. In addition to shedding light on the state of the art in the area, this review points out important gaps in the literature, which will direct future studies to improve patient outcomes in DIEP flap breast reconstruction.

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