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# **Different hydraulic constructs to optimize the venous drainage of DIEP flaps in breast reconstruction. Decisional algorithm and review of the literature**

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# **Different hydraulic constructs to optimize the venous drainage of DIEP flaps in breast reconstruction. Decisional algorithm and review of the literature**

## **ABSTRACT**

### Background

Venous congestion is the most common perfusion related complication of DIEP flap.

Several hydraulic constructs can be created for venous super-drainage in case of flap venous engorgement or as a preventive measure.

These can be classified based on the choice of the draining vein of the flap, either a second DIEV or a SIEV, and of the recipient vein, either a vein of the chest or the DIEV.

### Methods

We conducted a comprehensive systematic literature review in Medline, Scopus, EMBASE, Cochrane Library, and Google Scholar to find publications that reported on venous congestion in DIEP flap. The keywords used were DIEP Flap, breast reconstruction, venous congestion, supercharging, super-drainage, SIEV and DIEV.

### Results

Based on the studies found in the literature, we developed an algorithm to guide the surgeon's decision when choosing the veins for the super-drainage anastomosis.

### Conclusion

Several alternatives for venous anastomosis in super-drainage are available. We propose an algorithm to simplify the choice. The use of the ipsilateral SIEV to be connected to a vein of the chest appears to be advantageous. The anatomical position that allows the easiest anastomosis dictates which chest vein to favor.

**Keywords: DIEP flap, superdrainage, algorithm, review**

## INTRODUCTION

Vascular-related complications represent the main risk of failure of autologous breast reconstruction with the Deep Inferior Epigastric artery Perforator (DIEP) flap<sup>1,2</sup>.

Total flap failure is reported to occur in up to 5 % of cases, while partial failures are diagnosed in approximately 17% of patients<sup>3-5</sup> and include fat necrosis and partial flap necrosis, at times leading to unsatisfactory aesthetic results, and even return to the operating room<sup>4</sup>.

The most common vascular impairment of the flap is venous congestion.

Its clinical manifestations range from subtle signs of superficial veins turgidity, to faster capillary refill or darker discoloration at the flap periphery, to complete change in color of the skin island from pink to purple.

Some causes of venous congestion, such as occlusion of the microsurgical anastomosis, vessel torsion or kinking, or a flap that is oversized for the chosen perforator are reversible. In these cases, the prompt solution of the problem can reverse the clinical signs of congestion.<sup>1</sup>

When the causes of venous congestion are not reversible, as in the case of an unfortunate choice of perforator, a pedicle damaged during dissection, or even the unfavorable anatomy of the venous system<sup>1</sup>, the use of flap venous supercharging (also called super-drainage) is of great help to solve the problem, as widely reported in the literature.<sup>6-16</sup>

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When venous super-drainage of the flap is chosen, to treat or to prevent venous congestion, the adjunctive anastomosis can be performed in numerous ways depending on the choice of the vessels to be connected.

Most of the articles in the literature, for anatomical and physiological reasons<sup>8,17</sup>, favor the use of the superficial inferior epigastric vein (SIEV) of the flap as donor<sup>1,17,19</sup>.

In this study, we reviewed the pertinent literature and, based on the present knowledge and on our experience, we propose an algorithm to help the surgeon in the choice of the veins to anastomose in different settings.

## **METHODS**

We conducted a comprehensive systematic literature review in June 2019, and again in April 2020, searching major scientific databases (Medline, Scopus, EMBASE, Cochrane Library, and Google Scholar) to find publications that reported on venous congestion in DIEP flap.

To reduce inclusion bias, two of the Authors (VP and FG) performed, separately, the initial article search and selection with pertinent keywords ("Deep inferior epigastric perforator" OR "DIEP" AND "flap" [All Fields] AND venous congestion [All Fields] AND ("additional anastomosis"[Subheading] AND "superficial inferior epigastric vein"[All Fields] OR "SIEV"[All Fields] AND "supercharging" OR "superdrain" OR "super-drainage"). (Figure 1)

Duplicated articles, isolated abstracts, case reports, correspondence and letters were excluded and only full-text articles in English regarding DIEP flaps and venous congestion were considered.



## RESULTS

After thorough evaluation of all the articles retrieved on the subject of venous super-drainage, we have come down to 11 studies on various functional factors<sup>6-16</sup>, 18 studies reporting on the results of a single center on hydraulic constructs<sup>2,5,17-32</sup>, one review of the literature<sup>33</sup>, six studies on treatment algorithms<sup>1,15,34-37</sup>, and one meta-analysis<sup>38</sup>. (Table 1).

Based on the evidence and the recommendations of these studies<sup>1,2,5,6,15-37</sup> we developed a practical algorithm to help guiding the surgeon's decision on the choice of the veins for the adjunctive anastomosis (super-drainage) as explained in detail in Figures 1 to 4.

Table 1 shows all the articles that have been studied and contributed to the development of our proposal.

We recommend, when starting the DIEP flap's dissection through the sovrapubic incision, to always preserve and dissect to an adequate length the right and left SIEV. If a super-drainage is performed, the first choice is anastomosing the SIEV, if available, to a chest vein. The choice of what chest vein to use as recipient, should be based on the position in the chest of the two veins to be connected.

### **1<sup>st</sup> choice: SIEV to chest vein**

If SIEV, due to the flap inseting, is medial, the surgeon can choose to prepare for the extra anastomosis, one of the following. a) an Internal Mammary Vein (IMV), comitant of the main recipient artery (the Internal Mammary Artery-IMA), or , b) a perforator of the IMV (IMVp), or c) in a retrograde fashion, the

caudal stump of the IMV (the cranial stump being used as recipient vein of the primary vein anastomosis), or d) the intercostal vein (ICV). (Figure 2)

If the SIEV is located centrally in the hemithorax, the thoraco-acromial (TAV), intercostal (ICV) or cephalic veins can be chosen. (Figure 3)

If the SIEV is located laterally, the surgeon can prepare a) the lateral thoracic vein (LTV), b) a vein of the subscapular trunk (SSV) such as the thoraco-dorsal (TDV) or circumflexa scapulae (CSV), and finally c) the cephalic vein. (Figure 4)

When possible, the anastomosis is performed and the super-drainage is completed. If the SIEV and the vein of the chest are too far from each other to be anastomosed, a vein graft can be used.

### **2<sup>nd</sup> choice: SIEV to DIEV**

If the anastomosis is, for any reason, not possible, the SIEV can be connected to the DIEV with an intra-flap anastomosis<sup>39</sup>.

### **3<sup>rd</sup> choice: DIEV to chest vein**

If, when deciding to perform a super-drainage, the SIEV is unavailable for anatomical reasons or for a technical problem during dissection, (Figure 1, going back to the top of the flowchart), chances of success drop dramatically. However an attempt to solve the venous congestion can be tried using the second DIEV as flap donor vein for the super-drainage anastomosis, knowing that this measure will be useless to recruit the superficial venous system.

The DIEV can be anastomosed to a vein of the chest, depending, again on its position. The location of the comitant DIEV essentially depends on the vessels chosen for the main anastomosis (it will be medial or central if the IM vessels have been anastomosed, it will be lateral if to have been chosen were the TD vessels).

The veins of the chest that can be used, are the same described above, grouped according to their position in the hemi-chest (medial, central, lateral).

**4<sup>th</sup> choice: alternative methods**

In case of frank clinical signs of venous congestion, if the anastomosis between the comitant DIEV and a vein of the chest is not possible, only alternative methods remain (Figure1).

## DISCUSSION

Because, when it develops, venous congestion needs to be solved promptly, the operator should have the surgical options ready in mind. These options may be useful also for preventive super-drainage.

Once the causes of the venous congestion have been investigated and the ones due to technical error have been ruled out, using venous super-drainage can solve the problem.

Based on the data of the literature, we have therefore suggested a practical algorithm on how to choose the veins to be anastomosed for super-drainage creating different hydraulic constructs.

This decisional flow-chart may help even the less experienced surgeon to choose how to proceed when needed.

Our review of the literature suggests that using the SIEV as flap vein for super-drainage is the best possible choice<sup>1,15,34-37,40</sup>

Also, if the etiology of the venous congestion is, at least in part, a lack of communication between the superficial and the deep systems<sup>41,42</sup>, choosing the SIEV to increase the venous drainage provided by the principal anastomosis (DIEV to IMV or to TDV/CSV) seems reasonable. (Figure 5)

It is preferable to use the SIEV of the same side of the chosen perforator because in the majority of cases the contralateral SIEV is at the borders with perfusion-zone 4 that is routinely discarded. The contralateral SIEV can be used as a vein

graft if required. If the SIEV is unavailable (for anatomical reasons or a technical problem during dissection), the second DIEV can be chosen as donor vein for the super-drainage anastomosis. The latter is considered here for the sake of completeness, although using a 2nd DIEV as donor vein can rarely work. In fact this donor vein does not use alternative draining routes and in particular does not promote the drainage of the superficial system.

Several possibilities are available also when choosing the recipient vein for the superdrainage anastomosis<sup>1,34,36,40</sup>.

While some authors prefer the intra-flap anastomosis (SIEV to DIEV) as discussed below, others<sup>5,29-34,40,43</sup> prefer, as recipient vein, instead of the DIEV a vein of the chest, so that the excessive venous output will be drained by an independent route, without the risk of engorging the flap's main pedicle<sup>31,32,43</sup>.

In the literature, the only prospective, randomized study on the subject<sup>40</sup>, reported a reduced venous congestion, and consequent necrosis of DIEP flaps, when an adjunctive extra-flap anastomosis between the SIEV and the thoraco-acromial vein was performed.

Therefore the use of a chest vein as recipient for the super-drainage appears to be preferable. The choice of the extra-flap recipient vein to use, should take into consideration the reliability of the vein and its ease of dissection, the donor site morbidity, in terms of additional incisions and subsequent scars, and the location<sup>34</sup>.

In the literature there is not enough evidence to identify the best recipient vein for the secondary venous anastomosis.

From a practical point of view, we prefer the recipient vein to be the one anatomically located in a favorable position for anastomosing. In our algorithm,

therefore, we grouped the different possible recipient veins into the ones reachable on the medial side, on the central area, and on the lateral area of the hemithorax.

If flap venous congestion is present, but performing a second anastomosis is not possible (either with SIEV or DIEV, nor with the use of vein grafts), some alternative methods may be considered as a last resort, being aware that they rarely help in salvaging the flap, but, at the same time, cause discomfort to the patient. Among them are the use of medicinal leeches<sup>44</sup>, SIEV cannulation<sup>45</sup> or off-label use of drugs such as rTPA<sup>46</sup>, nitroglycerin ointment<sup>47</sup>, sildenafil<sup>48</sup>.

Signs of venous congestion may appear during flap harvesting, when the main deep inferior epigastric vessels have not yet been touched. This problem, if the dissection technique has been precise and uneventful, strongly suggests an intrinsic imbalance between arterial input and venous output that requires an adjunctive draining route through a second venous anastomosis.

If the signs of venous congestion appear after the transfer of the DIEP to the chest and after the microsurgical anastomosis of one artery (most commonly Deep Inferior Epigastric Artery to IMA) and one vein (most commonly DIEV to IMV), the surgeon should start by re-exploring the anastomotic site and evaluating the vessels' patency. If the pedicle is compressed by adjacent tissues or is kinked or twisted, the impairment can be solved by releasing, repositioning or anchoring the pedicle to the surroundings. Conversely, if the anastomosis is not patent it should be resected, the vessels should be irrigated with heparinized solution or thrombolytic agents to wash-out the flap circulation, and the microsurgical suture should be repeated.

In case of flap congestion despite a well-positioned pedicle and patent vessels, venous super-drainage becomes necessary.

Accurate planning based on the vascular anatomy, of the DIEP flap procedure, may help preventing some cases of venous congestion.

In fact, recent studies discuss how to choose the perforators more adequate to prevent venous congestion<sup>49</sup>.

To do so, preoperative Computed Tomographic Angiography and contrast-enhanced magnetic resonance angiography can be used for the analysis of the in-vivo connections between the deep and superficial venous systems<sup>8,41,42</sup>.

The choice of a perforator with a large accompanying vein<sup>50</sup>, of medial row perforators<sup>8</sup> and the use of multiple perforators<sup>8,49</sup>, have all been suggested to reduce the risk of venous congestion.

The diameter of the flap's SIEV has also been studied. While some authors sustain that a large diameter of the SIEV is predictive of superficial venous system dominance and therefore involves a higher risk of venous congestion<sup>2,21,51</sup>, other authors oppose this theory<sup>13</sup>,

Patients with previous Pfannenstiel scars seem to have a reduced risk of venous congestion<sup>52</sup>, possibly because the surgical incision produces a delay phenomenon, blocking the superficial venous drainage in the lower abdominal soft tissue, while enhancing the deep venous system.

Several authors also recommend the use of the superficial venous system supercharging as a preventive measure<sup>10,18,25,27,29,34,40,42,49,53</sup>.

Many factors are involved in re-establishing a balance between arterial input and venous output in DIEP free flaps. Therefore a few proposals (among which six

algorithms) to help in the choice of the veins to be used for the anastomosis have been published<sup>1,15,34-37</sup>. (TABLE 1, TABLE 2)

The options for the donor flap vein are either the SIEV or the DIEV. The options for the recipient veins are either a deep vein of the pedicle of the flap (intra-flap anastomosis), or a vein of the chest (extra-flap anastomosis)

Each algorithm gives priority to different aspects: i.e to the flap inseting, to the reconstruction outcome or to the surgical setting and operative time.

The main difference between our proposal and the previously published algorithms is the choice of donor and recipient veins for the second anastomosis. (TABLE 2)

In particular, some algorithms favor the intra-flap anastomosis between SIEV and DIEV, performed with a number of technical variations<sup>1,35,37</sup> to optimize surgical time, simplify the procedure by avoiding further dissection in the chest, and possibly perform the adjunctive anastomosis at the abdominal site before dividing the main pedicle and transferring the flap.

The algorithms that favor a connection between the SIEV and a vein of the chest (extra-flap anastomosis) are based on the assumption that a completely alternative drainage route may be more successful, by reducing the risk of overloading of the deep system and of the main anastomosis of the flap (the one between DIEV and IMV or DIEV and TDV-CSV).

The use of the SIEV as donor vein, is supported by the fact that the superficial system is the dominant drainage system of the lower abdomen. <sup>15,17,18,35</sup>



However, there is no evidence whether it would be better to connect the SIEV to the DIEV (intra-flap anastomosis)<sup>1,17,35,37</sup> or to a vein of the chest (extra-flap anastomosis)<sup>15,34,36</sup>.

Adding a second venous anastomosis with the super-drainage has also drawbacks.

Performing an adjunctive anastomosis prolongs the surgical procedure (up to 105 minutes, as reported in the literature)<sup>25,40</sup>.

Choosing a vein of the chest as recipient adds to the procedure the time of vessel preparation, if not previously dissected (i.e. IMV or TDV).

Moreover the presence of two anastomosed pedicles may limit the freedom of flap inseting<sup>54</sup>.

The present study has some limitations. First, the algorithm proposed is derived from a review of the literature and reflects the limitations of the published studies, none of which has an evidence level of I or II.

Another limitation is due to the fact that the literature data have not been, in this study, evaluated statistically and a clear-cut conclusion is therefore not possible.

## **CONCLUSIONS**

DIEP flap perfusion is a complex subject involving several anatomical, physiological, and surgical variables. When super-drainage of the flap is deemed useful, knowledge of the surgical options is necessary. The use of an algorithm simplifies the matter. We favor the use of the ipsilateral SIEV to be connected to a vein of the chest, the choice of which depends on the anatomical position that allows the easiest anastomosis.

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# LEGENDS

## Figure 1

### **Algorithm and schematic representation of veins position in the chest.**

If a super-drainage is performed, the first choice is using the SIEV. Its length, patency and flow should be verified. If the SIEV can be used, go to the right of the flow chart.

#### **At the right of the flow chart: 1<sup>st</sup> choice: SIEV to chest vein**

SIEV medial: 2nd Internal Mammary Vein (2<sup>nd</sup> IMV), retrograde Internal Mammary Vein (Retro IMV), perforator of Internal Mammary Vein (IMVp), InterCostal Vein (ICV). (details in Figure2)

SIEV central: Thoraco-Acromial (TAV), intercostal (ICV) or Cephalic veins can be chosen. (details in Figure 3)

SIEV lateral: Lateral Thoracic Vein (LTV) or a vein of the SubScapular (SS) trunk (Thoracodorsal-TD or Circumflexa Scapualae-CS) or the Cephalic vein. (details in Figure 4)

If needed, a vein graft can be used.

#### **2<sup>nd</sup> choice: SIEV to DIEV**

If the anastomosis is, for any reason, not possible, the SIEV can be connected to the DIEV with an intra-flap anastomosis

#### **3<sup>rd</sup> choice: DIEV to chest vein**

If the SIEV is unavailable, chances of success drop dramatically.

Going back to the top left of the flowchart we represented in a red square the remaining 3<sup>rd</sup> and 4<sup>th</sup> options described in the literature as last resorts. (additional details in the text)

The second DIEV can be chosen as donor vein for the super-drainage anastomosis to a vein of the chest, again on the basis of the location.

#### **4<sup>th</sup> choice: alternative methods**

In case of frank clinical signs of venous congestion, if no super-draining anastomosis is possible, only alternative methods remain

#### **Figure 2**

Vein options for the extra anastomosis in the medial chest: 2<sup>nd</sup> Internal Mammary Vein (2<sup>nd</sup> IMV), retrograde Internal Mammary Vein (Retro IMV), perforator of Internal Mammary Vein (IMVp), InterCostal Vein (ICV) .

The flap is represented in a horizontal in-setting with a traditional large skin island for clarity. Other flap in-settings and smaller skin islands (de-epithelized flap in skin-sparing mastectomies or a pre-expanded skin envelope) are possible

#### **Figure 3**

Vein options for the extra anastomosis in the central chest: Thoraco-Acromial (TA), intercostal (ICV) or Cephalic veins.

#### **Figure 4**

Vein options for the extra anastomosis in the lateral chest: Lateral Thoracic Vein (LTV) or a vein of the SubScapular (SS) trunk (Thoracodorsal-TD or Circumflexa Scapulae-CS) or the Cephalic vein

**Figure 5**

A DIEP flap is transferred to the left chest for breast reconstruction.

One of the possible hydraulic constructs is shown. The main anastomosis is between DIEA and IMA and between DIEV and IMV.

Venous supercharging is drawn between the SIEV and the 2nd IMV

**TABLE 1**

Studies reporting on venous super-drainage in DIEP flaps for breast reconstruction.

**TABLE 2**

Previously published decisional algorithms suggesting which veins should be connected when adding a super-drainage anastomosis in DIEP flaps

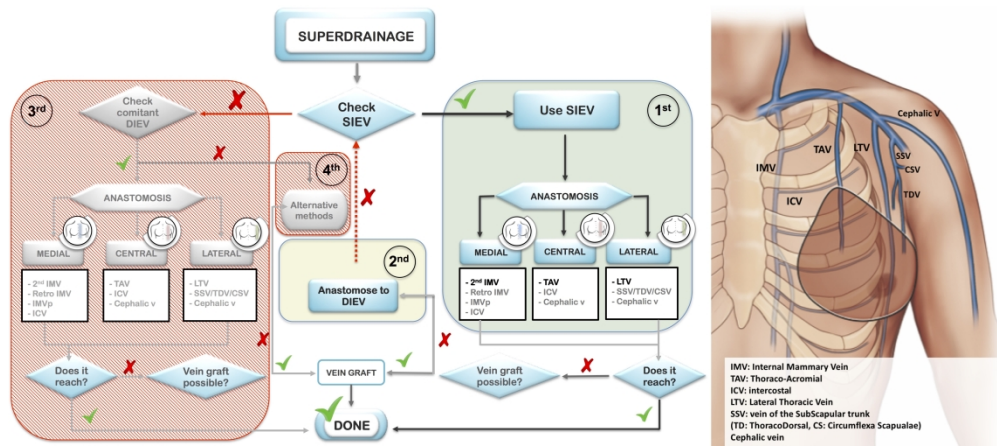


Figure 1

659x290mm (300 x 300 DPI)



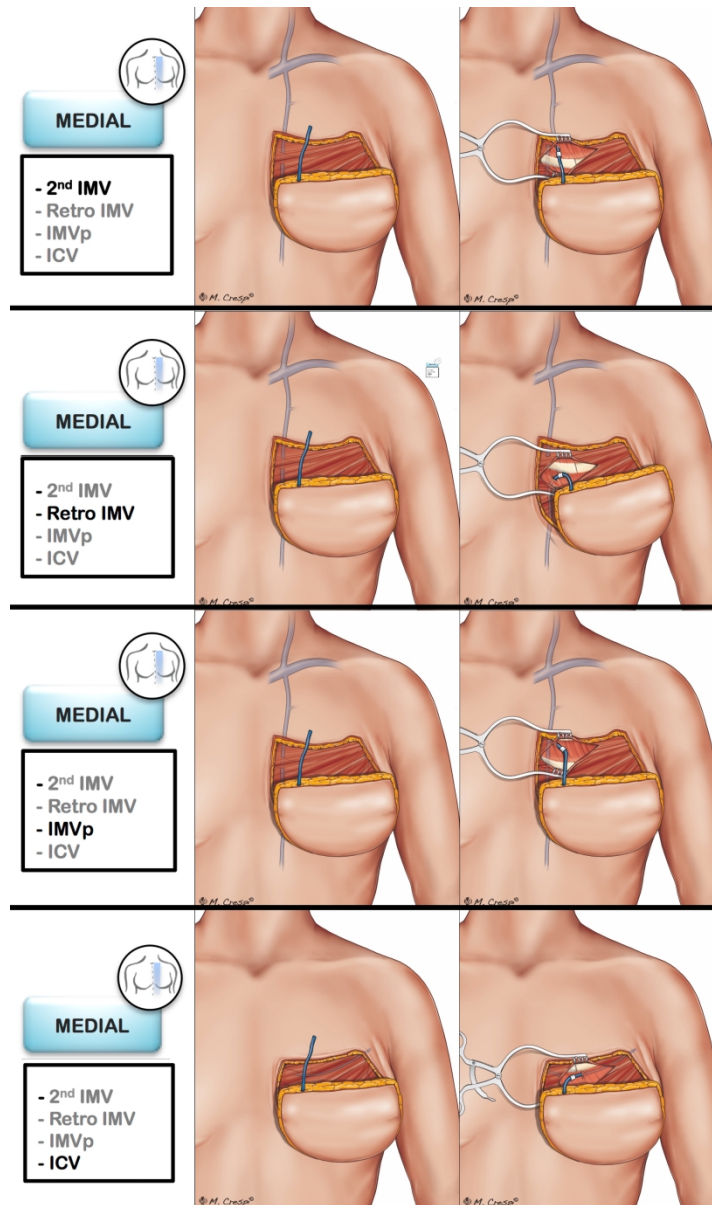


Fig 2

381x640mm (300 x 300 DPI)

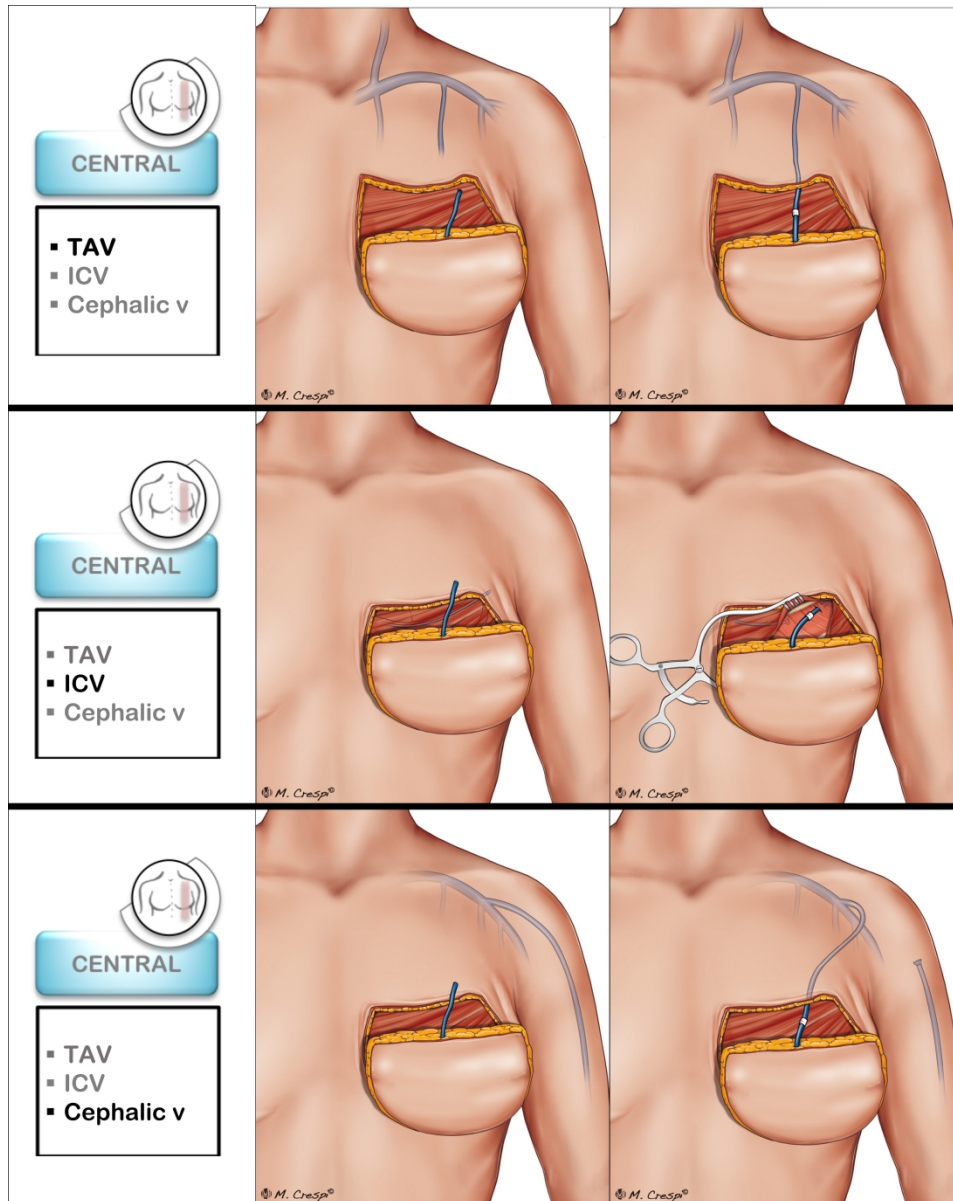


Figure 3

406x510mm (300 x 300 DPI)

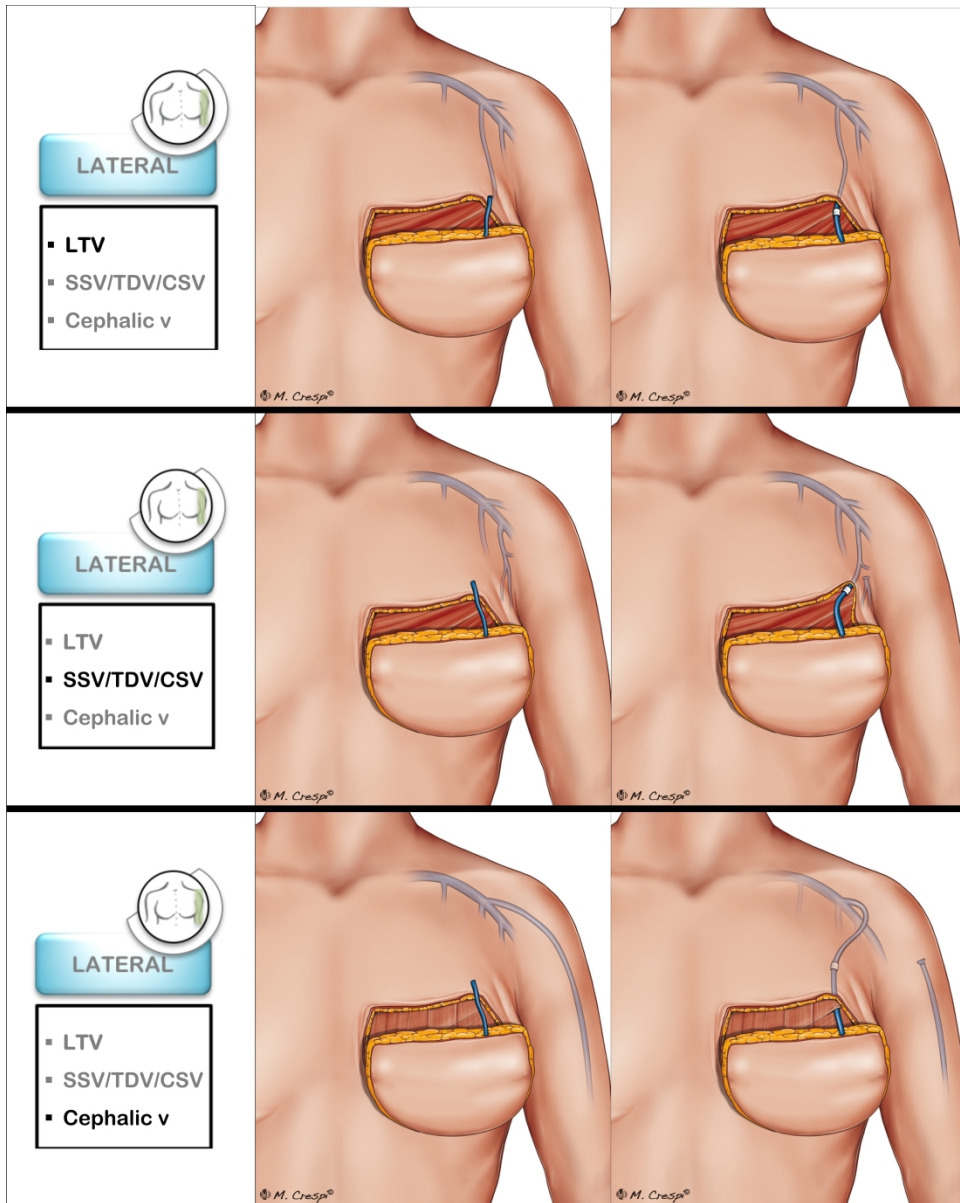


Figure 4

406x506mm (300 x 300 DPI)

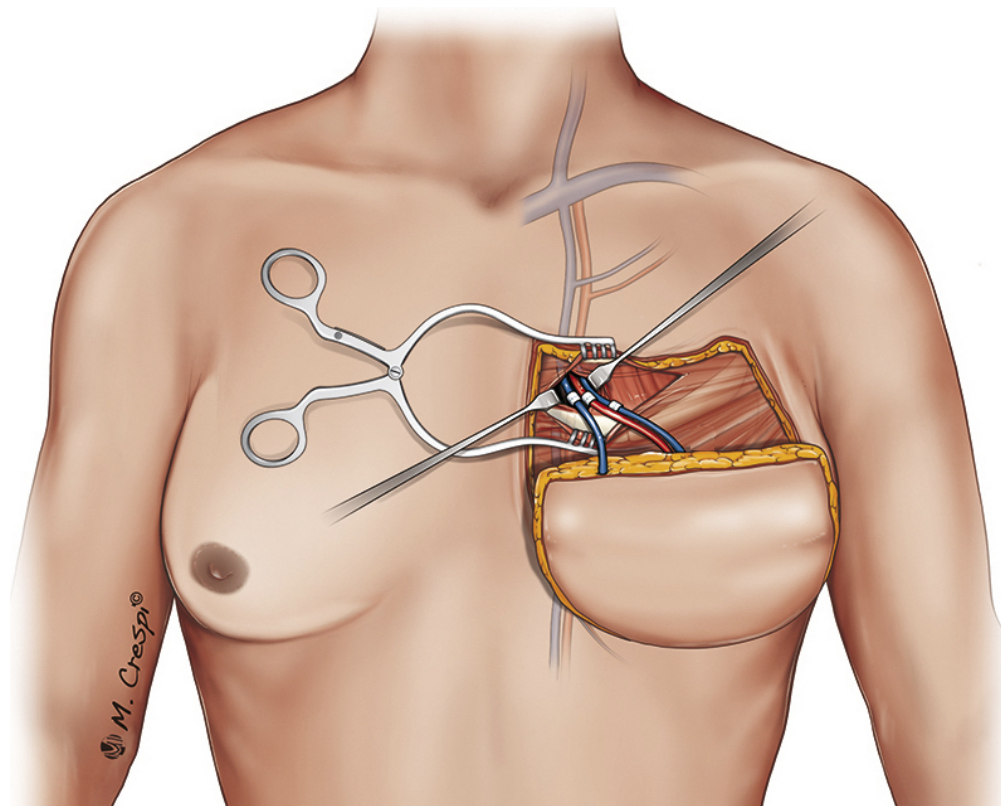


Figure 5

67x53mm (300 x 300 DPI)

	<b>TITLE</b>	<b>FIRST AUTHOR</b>	<b>YEAR</b>	
<b>ANATOMICAL PHYSIOLOGICAL RADIOLOGICAL ETIOLOGICAL</b>	▪ A study of the haemodynamics using laser Doppler flowmetry and lightguide reflectance spectrophotometry	<b>Figus</b>	<b>2005</b>	
	▪ Correlation between vessel diameters of superficial and deep inferior epigastric systems- Doppler ultrasound assessment	<b>Ayhan</b>	<b>2007</b>	
	▪ Relationship between venous congestion and intraflap venous anatomy in DIEP flaps using contrast-enhanced MR angiography	<b>Schaverien</b>	<b>2010</b>	
	▪ A quantitative analysis of the venous outflow of the DIEP based on the perforator veins and the efficiency of SIEV supercharging	<b>Rothemberg</b>	<b>2012</b>	
	▪ Augmentation of Venous Drainage in Deep Inferior Epigastric Perforator Flap Breast Reconstruction- Efficacy and Advancement	<b>Xin</b>	<b>2012</b>	
	▪ Venous perforators in DIEAP flaps- An observational anatomical study using duplex ultrasonography	<b>Figus</b>	<b>2012</b>	
	▪ Hemodynamic Effect of Different Kinds of Venous Augmentation in a Pig Transmidline Flap Model of DIEP Flap	<b>Minqiang</b>	<b>2013</b>	
	▪ Predictive Value of SIEV Caliber and Superficial Venous Dominance in Free DIEP Flaps	<b>Sadik</b>	<b>2013</b>	
	▪ Refining perforator selection for deep inferior epigastric perforator flap: the impact of the dominant venous perforator	<b>Gravvanis</b>	<b>2014</b>	
	▪ Anastomosis of the Superficial Inferior Epigastric Vein to the Internal Mammary Vein to Augment DIEAP Flaps	<b>Vijayasekaran</b>	<b>2017</b>	
	▪ Intraoperative objective evaluation of venous congestion in deep epigastric artery perforator flap breast reconstruction- A pilot study	<b>Akita</b>	<b>2017</b>	
	<b>SINGLE TECHNIQUE AND/OR CENTER EXPERIENCE</b>	▪ Venous superdrainage in deep inferior epigastric perforator flap breast reconstruction	<b>Wechselberger</b>	<b>2001</b>
		▪ Easy venous superdrainage in DIEP flap breast reconstruction through the intercostal branch	<b>Tutor</b>	<b>2002</b>
▪ Microvascular Complications of DIEP Flaps		<b>Tran</b>	<b>2007</b>	
▪ The basilic vein- An alternative drainage of diep flap in severe venous congestion		<b>Guzzetti</b>	<b>2008</b>	
▪ A single center comparison of one versus two venous anastomoses in 564 consecutive diep		<b>Enjat</b>	<b>2009</b>	
▪ DIEP flap rescue by venesection of the superficial epigastric vein		<b>Stasch</b>	<b>2009</b>	
▪ The Retrograde Limb of the Internal Mammary Vein- An Additional Outflow Option in DIEP Flap Breast Reconstruction		<b>Kerr-Valentic</b>	<b>2009</b>	
▪ Venous congestion and blood flow in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps		<b>Blondeel</b>	<b>2010</b>	
▪ A case of intraoperative venous congestion of the entire DIEP-flap - A novel salvage technique and review of the literature		<b>Momeni</b>	<b>2010</b>	
▪ Double Venous System Drainage in Deep Inferior Epigastric Perforator Flap Breast Reconstruction- A Single-Surgeon Experience		<b>Boutros</b>	<b>2012</b>	
▪ Strategies for recognizing and managing intraoperative venous congestion in abdominally based autologous breast reconstruction		<b>Sbitany</b>	<b>2012</b>	
▪ Salvage of Intraoperative DIEP Flap Venous Congestion with Augmentation of Venous Outflow- Flap Morbidity and Review of the Literature		<b>Ochoa</b>	<b>2013</b>	
▪ Cephalic vein transposition versus vein grafts for venous outflow in free-flap breast reconstruction		<b>Chang</b>	<b>2014</b>	
▪ Predictive and Protective Factors for Partial Necrosis in DIEP Flap Breast Reconstruction Does Nulliparity Bias Flap Viability?		<b>Santanelli</b>	<b>2015</b>	
▪ Predictors of Reoperations in Deep Inferior Epigastric Perforator Flap Breast Reconstruction		<b>Unukovych</b>	<b>2016</b>	
▪ Intraoperative superficial inferior epigastric vein preservation for venous compromise prevention in breast reconstruction by DIEP flap		<b>Hindi</b>	<b>2018</b>	
▪ Autologous Breast Reconstruction With a Delay Procedure of the DIEAP Flap Because of Venous Congestion of the Flap on Pedicle		<b>Hillberg</b>	<b>2019</b>	
▪ Muscle-splitting approach to thoracoacromial vein for superdrainage in deep inferior epigastric artery perforator flap breast reconstruction		<b>Kim</b>	<b>2019</b>	

<b><i>PROSPECTIVE RANDOMIZED</i></b>	<ul style="list-style-type: none"> <li>▪ A Comparative Study between DIEAP and Thoracoacromial Venous Supercharged Deep Inferior Epigastric Artery Perforator Flaps</li> </ul>	<b>Ayestaray</b>	<b>2016</b>
<b><i>ALGORITHM</i></b>	<ul style="list-style-type: none"> <li>▪ Surgical strategies to salvage the venous compromised deep inferior epigastric perforator flap</li> <li>▪ Selection of the Recipient Veins for Additional Anastomosis of the SIEV in Breast Reconstruction With Free TRAM or DIEAP Flaps</li> <li>▪ The superficial outside-flap shunt (SOS) technique for free deep inferior epigastric perforator flap salvage</li> <li>▪ Use of the retrograde limb of the internal mammary vein to avoid venous congestion in diep flap breast reconstruction: further evidences of a reliable and time-sparing procedure</li> <li>▪ Anastomosis of the Superficial Inferior Epigastric Vein to the Internal Mammary Vein to Augment Deep Inferior Artery Perforator Flaps</li> <li>▪ Algorithmic Approach for Intraoperative Salvage of Venous Congestion in DIEP Flaps</li> </ul>	<b>Ali</b> <b>Eom</b>  <b>Davies</b> <b>La Padula</b>  <b>Vijayasekaran</b>  <b>Bartlett</b>	<b>2010</b> <b>2011</b>  <b>2014</b> <b>2016</b>  <b>2017</b>  <b>2018</b>
<b><i>REVIEW</i></b>	<ul style="list-style-type: none"> <li>▪ Intraoperative venous congestion in free transverse rectus abdominis musculocutaneous and deep inferior epigastric artery perforator flaps during breast reconstruction- A Systematic review</li> </ul>	<b>Kim</b>	<b>2015</b>
<b><i>META-ANALYSIS</i></b>	<ul style="list-style-type: none"> <li>▪ Benefits of superdrainage using siev in diep flap breast reconstruction: a systematic review and meta-analysis</li> </ul>	<b>Lee</b>	<b>2015</b>



SECOND ANASTOMOSIS	ALI 2010	EOM 2011	DAVIES 2014	LA PADULA 2016	VIJAYASEKARAN 2017	BARTLETT 2018	PIGNATTI 2020
<b>INDICATIONS</b>	Congestion	Congestion OR Without a sign of flap congestion	Congestion	Congestion	When technically feasible irrespective of the incidence of venous congestion	Congestion	When technically feasible
<b>FLAP VEIN</b>							
FIRST CHOICE	SIEV	SIEV	SIEV	SIEV	SIEV	SIEV	SIEV
SECOND CHOICE				second DIEV	second DIEV	SCIV	second DIEV
<b>RECIPIENT VEIN</b>							
FIRST CHOICE	DIEV-IMV axis	CHEST VEIN (position, easiness of dissection, inset of the flap, geometry of the additional vein anastomosis)	DIEV	Retrograde IMV	Second IMV	DIEV	CHEST VEIN (position and easiness of dissection)
SECOND CHOICE	Substitute DIEV with SIEV		CHEST VEIN		Retrograde IMV	CHEST VEIN (IMV)	DIEV
<b>DETAILS</b>	Original DIEV-IMV axis as recipient for the SIEV obviates the need for a vein graft and facilitates optimal breast shaping	<ul style="list-style-type: none"> <li>▪ The independent draining route is safer</li> <li>▪ Time for the preparation of another recipient vein can be minimal</li> <li>▪ The prophylactic use of SIEV should be contemplated</li> </ul>	The technique does not require harvest of a further recipient vein or vein graft	<ul style="list-style-type: none"> <li>▪ Independent outflow for superficial and deep systems</li> <li>▪ Dual venous anastomosis could be carried out in routine practice</li> </ul>	<ul style="list-style-type: none"> <li>▪ SIEV because superficial system is dominant.</li> <li>▪ No downsides to routine venous augmentation other than maybe adding 20 minutes to the operative time and the cost of a venous coupler.</li> <li>▪ So the authors ask: "Why not?"</li> </ul>	Additional venous rerouting should be performed prior to pedicle anastomosis: <ul style="list-style-type: none"> <li>▪ no increase in operative time</li> <li>▪ no tethering of the anastomosis, -no, difficulties in flap inset.</li> </ul>	<p><b>1st choice:</b> <b>SIEV - chest vein</b> because safer</p> <p><b>2nd choice:</b> <b>SIEV - DIEV</b> because faster</p> <p><b>3rd choice:</b> <b>DIEV - chest vein</b> as last resource</p> <p><b>4th choice:</b> alternative methods</p>