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VIDEO

A Simplified Technique for Large Vessel Size Discrepancies: Partial Lumen-Obliteration With Sutures Followed by End-To-End Anastomosis

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ABSTRACT

Managing vessel size discrepancies during microvascular anastomosis presents significant challenges, especially when the size disparity exceeds a 1:4 ratio. It is crucial to employ effective and reliable techniques to prevent thrombosis caused by vessel distortion, intimal lacerations, and abrupt changes in turbulence. This study introduces the partial lumen-obliteration with sutures followed by end-to-end anastomosis (PLOSEA) technique, which addresses these challenges by partially obliterating the lumen of the larger diameter vessel before performing an end-to-end anastomosis. A critical aspect of this technique is the implementation of a horizontal mattress corner stitch, which is key to ensuring successful outcomes. Accompanied by a detailed video demonstration, this article aims to elucidate the PLOSEA method and provide insights into its application for managing vessel size discrepancies greater than 1:4.

INTRODUCTION

Addressing size discrepancies during microvascular anastomosis is a formidable challenge, especially when discrepancies exceed a 1:4 ratio. Traditional techniques require complex suturing and precise alignment, demanding high levels of surgical skill [1–4]. These practices elevate risks such as thrombosis and intimal damage, which stem from misalignment and turbulent flow. These complexities may extend operative times and increase the risk of complications, potentially deterring less experienced surgeons.

This article introduces the partial lumen-obliteration with sutures followed by end-to-end anastomosis (PLOSEA) technique, specifically designed to manage size discrepancies greater than 1:4. This technique involves partially obliterating the lumen of larger diameter vessels and performing end-to-end anastomosis. A key feature of this approach is the horizontal mattress corner stitch, critical for ensuring successful outcomes, as detailed in the accompanying instructional video.

The PLOSEA technique simplifies the anastomosis process, reducing complexity and potential complications. This improvement enhances accessibility and safety, particularly for surgeons with limited experience. By effectively managing substantial vessel size discrepancies, this method may become a valuable enhancement to the microvascular surgery toolkit.

INDICATIONS FOR PLOSEA TECHNIQUE

The PLOSEA technique was applied in four distinct cases, each involving patients who underwent microvascular reconstruction following head and neck oncologic surgeries. Typically, the internal jugular vein or its tributaries were selected as the preferred recipient veins for these procedures. This strategic choice was made to avoid vein grafts in head and neck reconstructions and to align with best practices in surgical efficiency and patient safety.

In situations with substantial size mismatches, specifically when the discrepancy exceeded a 1:4 ratio and the donor vein was long enough to reach the internal jugular vein, an end-to-side anastomosis was typically performed. However, in all reported instances, the skin perforator of the anterolateral thigh flap originated from the oblique branch of the lateral circumflex femoral artery. This branch was notably shorter and narrower, necessitating an end-to-end anastomosis with a tributary of the internal jugular vein.

CASE PRESENTATION

A 55-year-old male required reconstructive surgery following a wide local excision of buccal carcinoma. The patient underwent reconstruction with an anterolateral thigh flap to repair a through-and-through cheek defect. In this reconstruction, the flap was singularly based on a single oblique perforator. The procedure presented specific challenges: the donor vein, approximately 1 mm in diameter, was significantly narrower than the recipient common facial vein, which measured 5 mm in diameter. The pedicle's short length further complicated the procedure, rendering an end-to-side anastomosis with the internal jugular vein impractical. Moreover, the absence of viable alternative recipient veins restricted the surgical options. In response to these challenges, we employed the PLOSEA technique, which effectively managed the significant vessel size discrepancy and facilitated a successful microvascular reconstruction.

DETAILED PROCEDURAL GUIDE OF PLOSEA

Following the completion of the arterial anastomosis, we initiated the venous anastomosis. This stage commenced with suturing the 0° ends of both the donor and recipient veins. To address the size discrepancy, we adopted a meticulous method, progressively reducing the lumen of the larger recipient vein with simple interrupted sutures. The process began at the 180° end and progressed towards the 0° end. The obliteration continued until the lumen of the larger vein equaled the diameter of the smaller donor vein (Figure 1A). We strategically placed a horizontal mat-

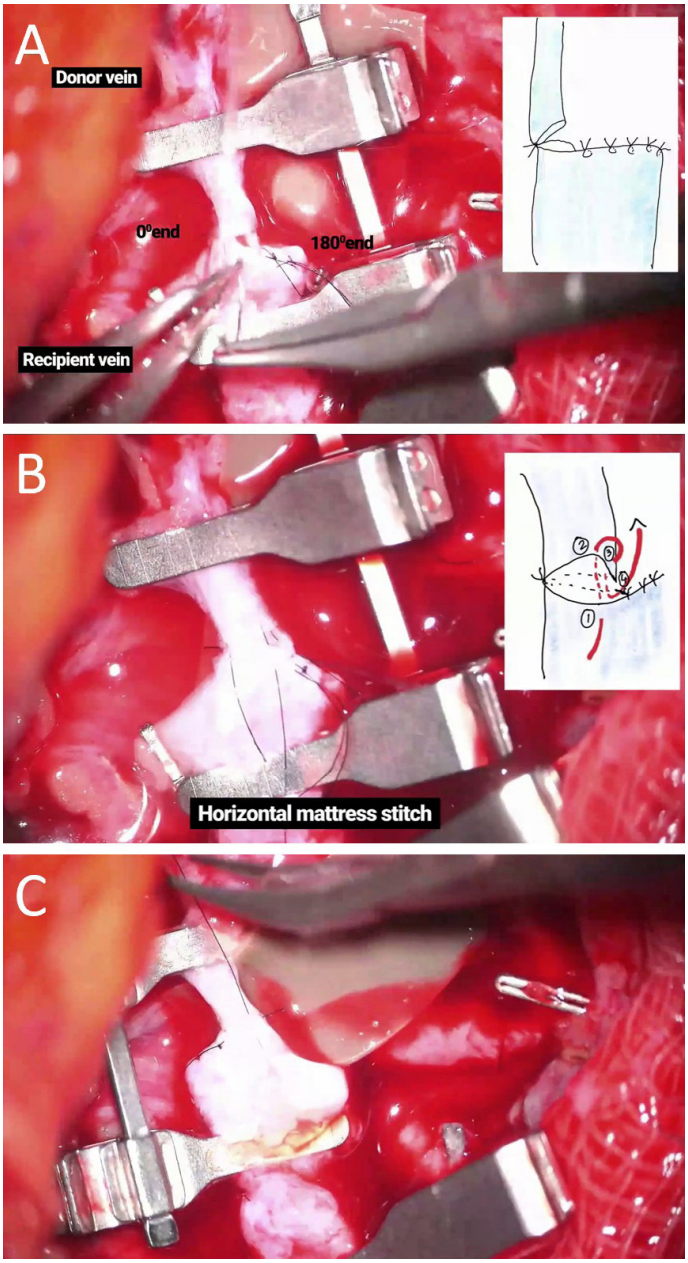

Figure 1. Procedural details of the PLOSEA technique. (A) The 0° end of the donor vein is sutured to the recipient vein. Simple interrupted sutures are employed progressively to obliterate the lumen of the larger recipient vein, initiating at the 180° end and advancing toward the 0° end. Obliteration ceases once the lumen dimensions align with those of the smaller donor vein. (B) A horizontal mattress suture is strategically placed at the 180° end of the donor vein to enhance obliteration of the end of the recipient vein. (C) Anterior and posterior wall sutures are performed in accordance with established surgical protocols to finalize the anastomosis. PLOSEA, partial lumen-obliteration with sutures followed by end-to-end anastomosis.

tress suture at the 180° end of the donor vein to fully obliterate the end of the recipient vein (Figure 1B). The anterior and posterior wall sutures were performed using established surgical techniques (Figure 1C).

The entire venous anastomosis procedure, including each detailed step, is documented in Video 1. This video acts as an exhaustive visual resource, offering a deeper insight into the execution and intricacies of the technique. Video 1 can be accessed online at https://doi.org/10.24983/scitemed.imj.2024.00187.

SURGICAL OUTCOMES OF PLOSEA

Conditions involving substantial vessel size discrepancies and limited donor vein lengths are exceedingly rare. Over the past six years, out of more than 500 free flap procedures, we encountered only four cases that exhibited these specific challenges. Notably, such scenarios have not been observed in reconstructions of the extremities or breast, underscoring the unique complexity and rarity of these cases in head and neck reconstructive surgery.

In these four patients treated with the PLOSEA technique, surgical outcomes were uniformly successful, with each case requiring only a single venous anastomosis. All patients demonstrated uneventful healing, with follow-up periods extending to at least six months. Crucially, there were no incidences of venous congestion or flap loss, and no complications were encountered. These results underscore the efficacy and reliability of the PLOSEA technique in managing significant vessel size discrepancies in complex reconstructive cases.

DISCUSSION

Advancements in Techniques for Vessel Size Discrepancies

Several surgical techniques have been developed to address the challenges posed by vessel size discrepancies, particularly when they exceed a 1:4 ratio in microvascular surgery. Established methods such as spatulated end-to-end anastomosis [1], V-plasty [2], and sleeve technique [3] are tailored to manage these substantial mismatches. While effective, these approaches often involve complex procedures and require high precision and advanced surgical skills, which may restrict their use and increase the risk of complications in certain scenarios.

The spatulated end-to-end technique, detailed by Ridha H et al. [1], necessitates intricate longitudinal incisions to expand the circumference of the smaller vessel, requiring extensive surgical expertise. In contrast, the PLOSEA technique simplifies this process by using partial lumen-obliteration with simple interrupted sutures and a horizontal mattress corner stitch, thereby reducing procedural complexity.

Similarly, the V-Plasty technique by Bakhach et al. [2] involves precise modifications to the larger vessel, such as creating a V-shaped flap, requiring meticulous calculations and surgical precision. The PLOSEA technique, however, circumvents these complicated steps, offering a more streamlined approach that enhances procedural efficiency.

Additionally, the sleeve anastomosis technique described by de la Pena-Salcedo et al. [3] requires overlapping vessel ends, which can lead to alignment challenges and an increased risk of misalignment and turbulent flow. In contrast, the PLOSEA technique directly reduces the lumen size of the larger vessel to match the smaller one, effectively mitigating the risks associated with overlapping and ensuring a smoother, more predictable outcome. This strategic simplification facilitates mastery for surgeons and enhances the reliability and success rate of surgeries involving substantial vessel size discrepancies.

Table 1 provides a comprehensive comparative analysis of the PLOSEA technique against the above-mentioned methods for managing vessel size discrepancies greater than 1:4. The table details specific parameters and outcomes of each method, including the number of procedures performed, success rates, and the technical demands. Notably, the PLOSEA technique boasts a 100% success rate with no complications reported, underscoring its effectiveness and reliability in surgical settings.

PLOSEA: Optimizing Lumen-Obliteration Technique

The PLOSEA technique relies on fundamental microsurgical skills, particularly suturing, to adjust lumen size. Its straightforward nature facilitates rapid learning and application, making it especially suitable for less ex-

Table 1. Comparative Analysis of Techniques for Managing Vessel Size Discrepancy in Microvascular Anastomosis

Technique	PLOSEA technique	Spatulated end-to-end [1]	V-plasty [2]	Sleeve anastomosis [3]
Authors	Current article	Ridha et al.	Bakhach et al.	J. Abel de la Peña-Salcedo et al.
Vessel size discrepancy	1:4 or greater	Up to 5:1	Up to 4:1	Up to 4:1
Total number of anastomoses	4	24	14	34
Number of arterial anastomoses	0	22	4	28
Number of venous anastomoses	4	2	10	6
Success rate	100% success, no complications reported.	1 venous thrombosis reported.	0% thrombosis reported.	1 arterial and 1 venous revision, no thrombosis.
Complexity	Simple technique, minimal learning curve.	Requires precise longitudinal incisions and alignment.	Requires precise mathematical calculations and surgical precision.	Involves overlapping vessels, ensuring proper alignment can be challenging.
Advantages	Easy to learn and perform; avoids complex incisions and overlapping.	Effective for large discrepancies; zero arterial thrombosis reported.	Good success rate; effective for significant discrepancies.	Effective for significant discrepancies; good success rate.
Disadvantages	Long-term data for venous anastomoses is limited, with no available data for arterial anastomoses and microvascular reconstructions outside the head and neck.	High technical skill required; risk of vessel damage.	High complexity; demands precise execution.	Risk of misalignment; potential for turbulent flow.

Abbreviation: PLOSEA, partial lumen-obliteration with sutures followed by end-to-end anastomosis.

perienced surgeons. By eliminating the need for complex incisions and overlaps, this technique significantly reduces complications due to misalignment and turbulent flow. Consequently, it provides a simpler, more accessible method for managing large vessel size discrepancies, making it an attractive option for microsurgeons seeking to reduce procedural complexity and enhance operational efficiency.

Numerous lumen-obliteration techniques have been proposed in the literature [5–6]. For instance, methods involving tapering the larger vessel through wedge excision and performing an end-to-end anastomosis have been documented [5], although they lack detailed descriptions. Suri et al. introduced a ligaclip technique for tapering and obliterating the larger lumen [6]. While promising, this method demands significant expertise due to its irreversible nature. In our series, we have not applied tapering to the wider vessels; however, employing either of the mentioned techniques is feasible. Nevertheless, our instructional video demonstrates that partial lumen-obliteration of the larger vessel with sutures, followed by end-to-end anastomosis, provides a straightforward yet highly effective solution for specific clinical scenarios.

Potential Complications of PLOSEA

The consistent success and lack of complications associated with the PLOSEA technique underscore its potential as a preferred method for similar surgical procedures. Its effectiveness in facilitating successful anastomosis despite substantial size discrepancies makes it especially valuable for reconstructive surgeons, particularly in head and neck surgery where these challenges are more common.

However, potential complications may arise with this procedure, including intimal damage, stenosis, and thrombosis. Adhering to traditional principles of microvascular anastomosis, such as accurate lumen matching and precise horizontal mattress corner suturing, is crucial for mitigating these risks. The patency of the anastomosis can be confirmed using Acland's test.

Turbulent flow across the anastomosis, caused by sudden transitions in vessel sizes, is a known risk factor for thrombosis. In our case series, the internal jugular vein was used as the recipient vein. The inspiratory fall in intrathoracic pressure created a suction effect on venous return, minimizing the risk of stasis and turbulence in the larger vein. Consequently, we did not taper the larger vessel, a tributary of the internal jugular vein, due to this unique physiological advantage.

Pitfalls and Solutions

We have exclusively applied the PLOSEA technique for venous anastomosis in head and neck reconstructions, specifically using the internal jugular vein as the recipient vein. Due to the absence of a "sulking effect" in other veins, we recommend tapering the wider lumen vein either with a clip or with wedge excision followed by suturing. This strategy may reduce the likelihood of stasis and thrombosis. In these specific cases, the sequence of procedures may differ from the standard PLOSEA approach. It is advisable to taper the wider vein lumen after completing the anastomosis. This adaptation ensures a tailored approach to effectively address unique surgical challenges.

We have not yet used this technique for arterial anastomosis. In situations with a significant size mismatch where end-to-side anastomosis is not feasible, the PLOSEA technique could theoretically be applied. However, it should be approached with caution when used for arterial anastomosis. Tapering the wider lumen is crucial to prevent turbulence, stasis, and the associated risk of thrombosis. Alternatively, the branched interpositional vein grafting technique can be considered [4]. Further studies and clinical trials are recommended to evaluate the safety and efficacy of using the PLOSEA technique for arterial anastomosis.

Study Limitations

The limitations of this study include a small sample size and the absence of a control group, largely due to the rarity of the technique's indications. Despite the challenges, future validation through large-scale clinical trials and the establishment of a control group are essential to confirm the

technique's efficacy.

In high-volume microsurgical practices involving head and neck, extremity, and breast reconstructions, we have encountered a variety of vessel wall discrepancies over the years. In our experience, no single method is universally applicable. Depending on the size discrepancy, we have employed most of the techniques discussed. Microsurgeons should be prepared to encounter unusual circumstances and should be capable of applying the appropriate technique safely and reliably. We believe the proposed PLOSEA technique is beneficial for this rare subset of patients with significant size discrepancies. This video demonstration would be particularly helpful to young microsurgeons early in their learning curve.

CONCLUSION

The PLOSEA technique has demonstrated consistent success and no complications in managing significant vessel size discrepancies in head and neck reconstructive surgery. Its simplicity and reduced complexity make it an appealing option for microsurgeons, offering a reliable solution that does not require specialized skills. While effective in venous anastomosis, further research is recommended to validate its safety and efficacy in other contexts, including arterial anastomosis and reconstructions of anatomical regions requiring microvascular anastomosis, such as the extremities and breast. This video demonstration serves as a valuable resource, aiding young microsurgeons in mastering the technique and improving surgical outcomes.

ARTICLE INFORMATION

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