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Superficial Temporal Artery Endoscopic Dissection - Technique Description and it's use for Multiple Grafts

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Abstract

Introduction: The superficial temporal artery (STA) is a critical vessel in neurosurgery, plastic surgery, otolaryngology, maxillofacial, and ocular surgery, serving as main blood supply for vascularized flaps, bypasses, and grafts. Traditional dissection methods are often invasive, with risk of trauma to adjacent tissues. This study describes a minimally invasive fully endoscopic technique for dissection of the STA with accuracy, proposed to reduce tissue trauma, and minimize scarring.

Methods: The study was conducted on six latex-injected cadaveric specimens using a 30° endoscope (Ecleris® and Storz®) and standard microsurgical instruments. The STA was identified above the zygomatic arch, followed to its frontal and parietal branches through a 1inch incision, and mobilized using endoscopic magnification.

Results: The fully endoscopic approach provided accurate identification and mobilization of the STA with minimal collateral damage, allowing dissection up to 3-4 inches from the incision site. Compared to open techniques, it can reduce scar area and accelerate recovery with less discomfort.

Discussion: This technique offers significant advantages for STA-based procedures, including STA revascularization to the middle cerebral artery (MCA) and possible posterior circulation bypass revascularization, ocular grafts, and expanded applications in plastic surgery for anterior/posterior skin grafts and cranial reconstruction. Challenges include equipment costs, a steep learning curve, and risks of intraoperative bleeding in a confined field.

Conclusion: The endoscopic STA dissection technique can increase surgical precision, reduce morbidity, and improve aesthetic outcomes in a variety of disciplines. Its implementation requires specialized training and careful patient selection, and further clinical validation is needed.

Keywords: Superficial temporal artery; Minimally invasive; Endoscopy; Vascular graft

Introduction

The superficial temporal artery (STA), a terminal branch of the external carotid artery, ascends through the temporal region, crossing the zygomatic arch before bifurcating into frontal and parietal branches [1-3]. These branches supply the scalp and adjacent structures, making the STA a versatile conduit for vascular flaps, bypasses, and grafts in neurosurgery, plastic surgery, otolaryngology, maxillofacial surgery, and ocular surgery. Due to its proximity to delicate anatomical elements such as nerves and muscles, meticulous dissection and surgical precision are required in the management of this vessel [4-6]. (Fig.1)

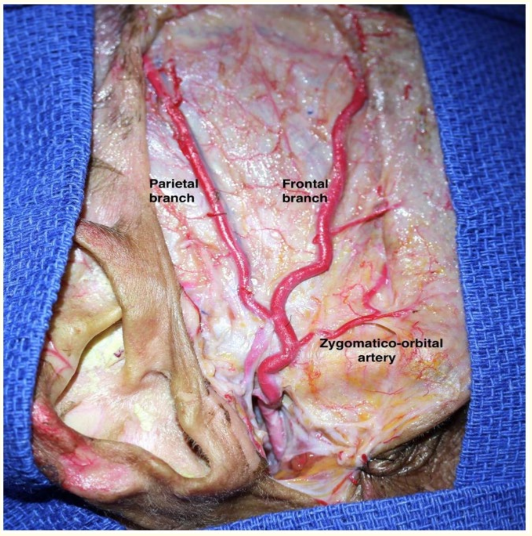

Figure 1: Superficial Temporal Artery. Right side anatomical dissection.

The anatomical advantages of the STA make it ideal for extracranial to intracranial (EC-IC) bypasses (e.g., STA-MCA), posterior circulation revascularization (e.g., STA-superior cerebellar artery [SCA] or posterior cerebral artery [PCA]), ocular region grafts, and plastic surgery applications [4-7]. In plastic surgery, STA-based flaps and grafts are increasingly used for anterior and posterior scalp reconstruction, facial resurfacing, burn-related defects, and cranial reconstruction after trauma or oncologic resection [8-10]. For skull transplantation and grafting, STA provides robust vascularization to ensure graft viability, particularly in composite tissue allografts or autologous bone grafts [11, 12].

This study presents a minimally invasive endoscopic technique for STA dissection, using small incisions to minimize scarring, optimize vessel mobilization, and reduce trauma, thus improving outcomes in these various applications [2, 13].

Ethical Considerations: The study was submitted to the Institutional Review Board (IRB). Considering that the study was conducted in an anatomy laboratory with no potential for donor identification, it was determined that it did not involve human subjects by definition. Therefore, a letter of review from the IRB was deemed unnecessary. Cadaveric images were obtained, ensuring ethical compliance, in a de-identified form.

Technical Description: The procedure was performed on eight latex-injected cadaveric specimens using a 30° endoscope (Ecleris® and Storz®) and microsurgical instruments for precise visualization and manipulation [4, 13, 14]. (Fig.2)

Identification of the Superficial Temporal Artery: The STA can be identified preoperatively by imaging techniques such as angiography, computed tomography angiography (CTA), and magnetic resonance angiography (MRA), and intraoperatively by Doppler ultrasound or direct palpation [15-17].

The STA can be easily identified near above the zygomatic arch and can be traced proximally to its bifurcation into frontal and parietal branches [3, 17]. In the present description of the technique, in addition to palpation, skin transillumination was used, which can be useful to improve visualization of the vessels, due to the translucency of the skin, facilitating accurate identification and dissection of the artery (Fig.3).

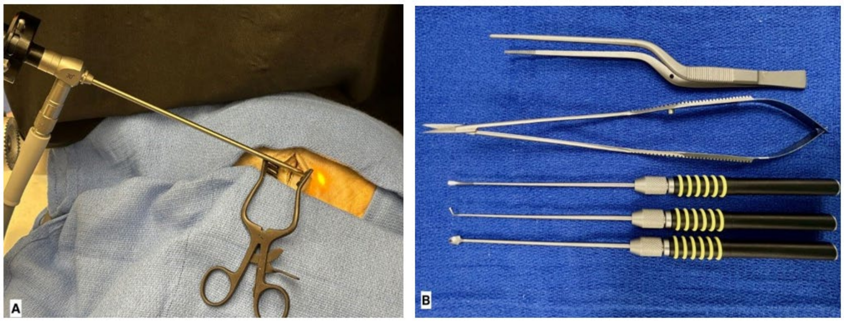

Figure 2: A and B Surgical endoscope and microsurgical intruments.

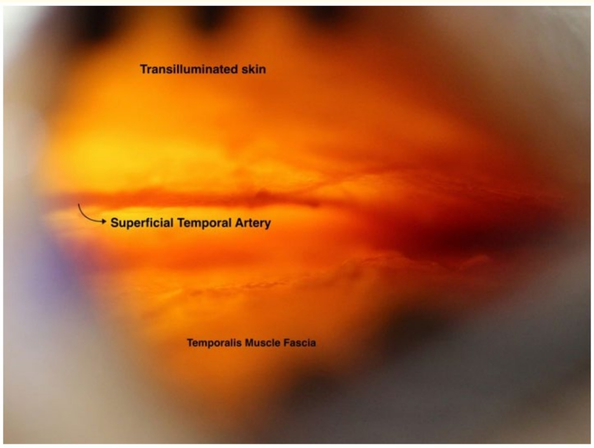

Figure 3: Skin Transillumination Technique.

Positioning: Patient positioning varies depending on the specific pathology to be treated. However, for optimal exposure of the STA, the temporal region should be positioned parallel to the floor, with the zygomatic arch as the highest point. This orientation improves visualization and access to the vessel during the procedure [17].

Incision and Dissection: A 1 inch incision was made 2 inches above the zygomatic arch, posterior to the STA, with positioning adjusted based on surgical goals (e.g., anterior scalp grafts and posterior cranial reconstruction). A second hair-hidden incision can be used as an option (Fig.4).

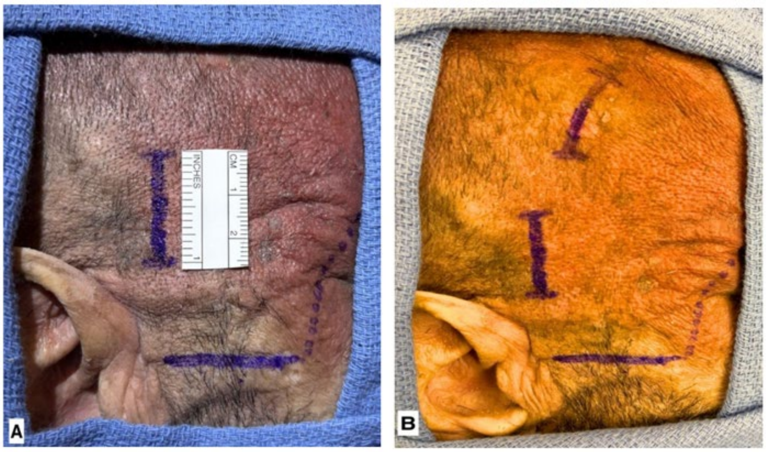

Figure 4: A. 1 inch skin incision. B. Two hair-hidden incision option.

The endoscopic approach allowed artery dissection up to 3-4 inches in length, with the one incision, and ideally hidden within the scalp or hairline for aesthetic purposes (Fig.5) [13]. The areolar tissue was dissected, and a small retractor maintained subcutaneous access. A 30° endoscope was positioned for visualization, and dissection was performed with microdissectors and microscissors. Hemostasis should be achieved using low-power bipolar coagulation [13, 14] (Fig.6). The STA was traced to its bifurcation, isolated, clipped distally, and divided. The remaining distal donor vessel is coagulated, and the proximal segment can be mobilized anteriorly, posteriorly, or inferiorly based on the target graft (Fig.7). Care must be taken to avoid twisting, excessive angulation, compression, or kinking to preserve good graft patency and flow [18, 9].

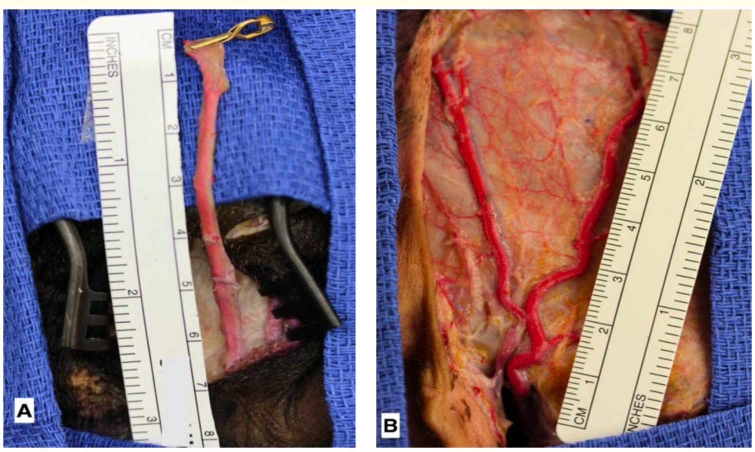

Figure 5: A and B Arterial length dissection, and anatomical mesurements.

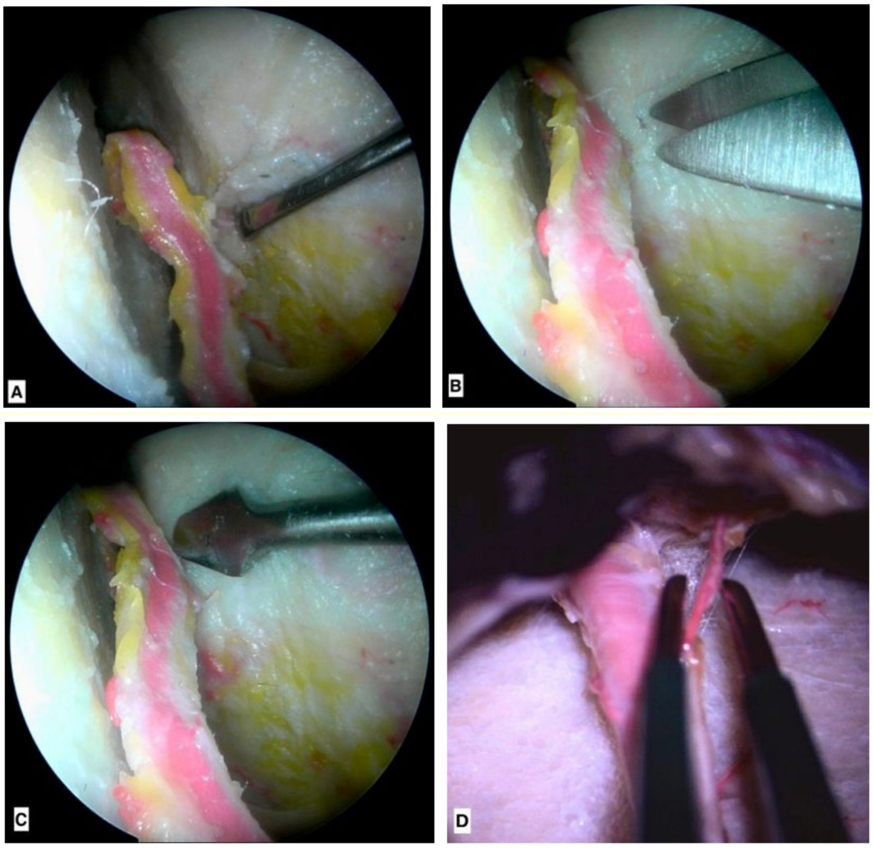

Figure 6: A, B, and C Microdissection technique. D Arterial rami bipolar coagulation.

Discussion

This endoscopic technique allows for precise dissection of the STA, minimizing trauma to adjacent nerves and vasculature and reducing sensory deficits and scarring through a 1 inch hidden incision. It improves recovery compared with open surgery, potentially shortening hospital stays [19]. Endoscopic magnification provides superior visualization, allowing flexibility along the STA course, even in complex reconstructive procedures [13].

The anatomical advantages of the STA—superficial location, robust caliber, and proximity to critical structures—make it indispensable in all surgical specialties [3, 6]:

Neurosurgery: STA assists in EC-IC bypasses, including STA-MCA for Moyamoya disease and aneurysms and STA-SCA/PDA for posterior circulation pathologies (e.g., vertebrobasilar insufficiency, posterior fossa aneurysms) [20-22].

Plastic and Reconstructive Surgery: STA-based flaps and grafts are essential for:

Anterior and Posterior Scalp Reconstruction: Used in burn scars, trauma, or oncologic defects, STA flaps provide vascularized tissue for anterior scalp resurfacing (e.g., forehead, periocular regions) and posterior scalp repair (e.g., occipital defects), ensuring flap viability and aesthetics [1, 14, 9].

Facial Reconstruction: STA flaps aid in facial skin resurfacing for burns, trauma, or congenital deformities by leveraging its frontal branch for a reliable blood supply [3].

Skull Reconstruction and Transplantation: STA vascularizes autologous bone grafts or composite tissue allografts for cranioplasty after trauma, tumor resection, or congenital deformities, improving graft integration and reducing the risk of infection. In vascularized skull allotransplantation, STA ensures the viability of the bone and soft tissue components [11, 12, 23].

Ocular Surgery: STA-based flaps improve vascular supply to eyebrows, orbital structures, and surface reconstruction grafts for ischemic or traumatic conditions [24, 25].

Otorhinolaryngology: STA flaps facilitate auricular and external ear reconstruction after malignant lesions or trauma [26].

Maxillofacial Surgery: STA perforator flaps reconstruct oral mucosa and maxillofacial defects [27, 28].

The endoscopic approach refines minimally invasive surgery, offering precision and reducing morbidity. However, certain factors inherent in the use of an endoscopic approach can pose challenges to the surgical technique. First, the cost of equipment must be considered, as a high-quality surgical endoscope is essential to ensure safe visualization of the surgical field, and appropriate microsurgical instruments for less traumatic dissection. In addition, the learning curve for surgeons is an important consideration. Proficiency in endoscopic manipulation techniques requires practical experience and skill development, which may limit the widespread adoption of this approach [19].

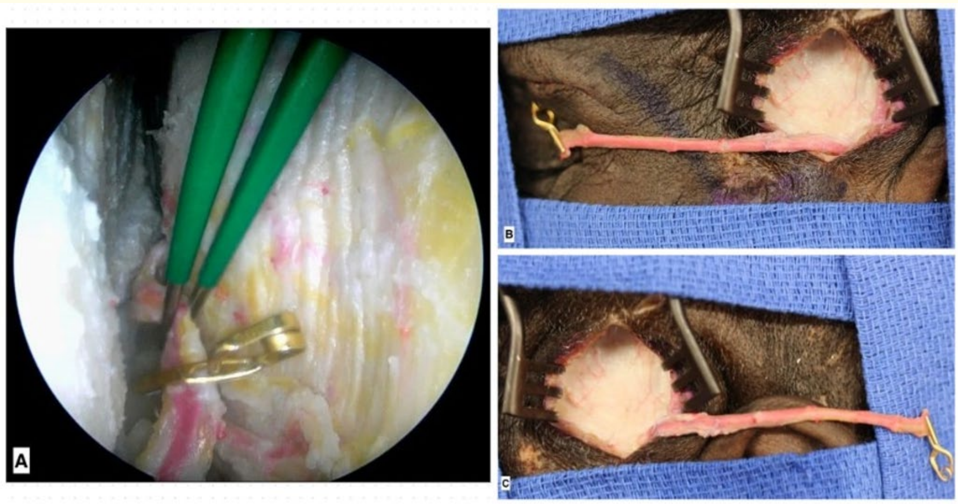

Figure 7: A. Distal artery clipping, coagulation, and section. B and C. Anterior and posterior graft mobilizaation.

It is important to recognize that the cadaveric model also presents inherent limitations that may affect the transposition of the described technique to clinical practice. Intraoperative bleeding could not be simulated under these conditions. Furthermore, due to the fixation process, the skin and vascular tissues become more rigid and less mobile compared to real surgical scenarios, where the tissues present greater elasticity and flexibility. These differences may impact the ease of dissection and mobilization of the vessels, highlighting the need for careful adaptation when applying this technique to clinical practice, as it requires clinical validation [29].

Another potential limitation of minimally invasive techniques is the risk of intraoperative hemorrhage and its control. Bleeding that may occur during some procedures may be more challenging to control within the limited maneuverability and visualization of the surgical field, requiring precise hemostatic techniques and appropriate equipment [2, 30].

Conclusion

This study proposes the introduction and use to improve the fully endoscopic technique for STA dissection for cranial/intra-cranial, and facial reconstructive or revascularization procedures in neurosurgery, plastic surgery, otolaryngology, maxillofacial, and ocular surgeries. The endoscopic approach may increases surgical precision with reduction of soft tissue trauma, and optimizes aesthetic outcomes, thereby improving functional and cosmetic outcomes. Expanded applications include extra-intracranial bypasses, anterior/posterior scalp reconstruction, skull grafts/transplants, and orbital grafts. Implementation requires highquality equipment, training, and careful patient selection. Further clinical studies are needed to confirm its efficacy and require progressive and careful adaptation when applying this technique in clinical practice for clinical validation.

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