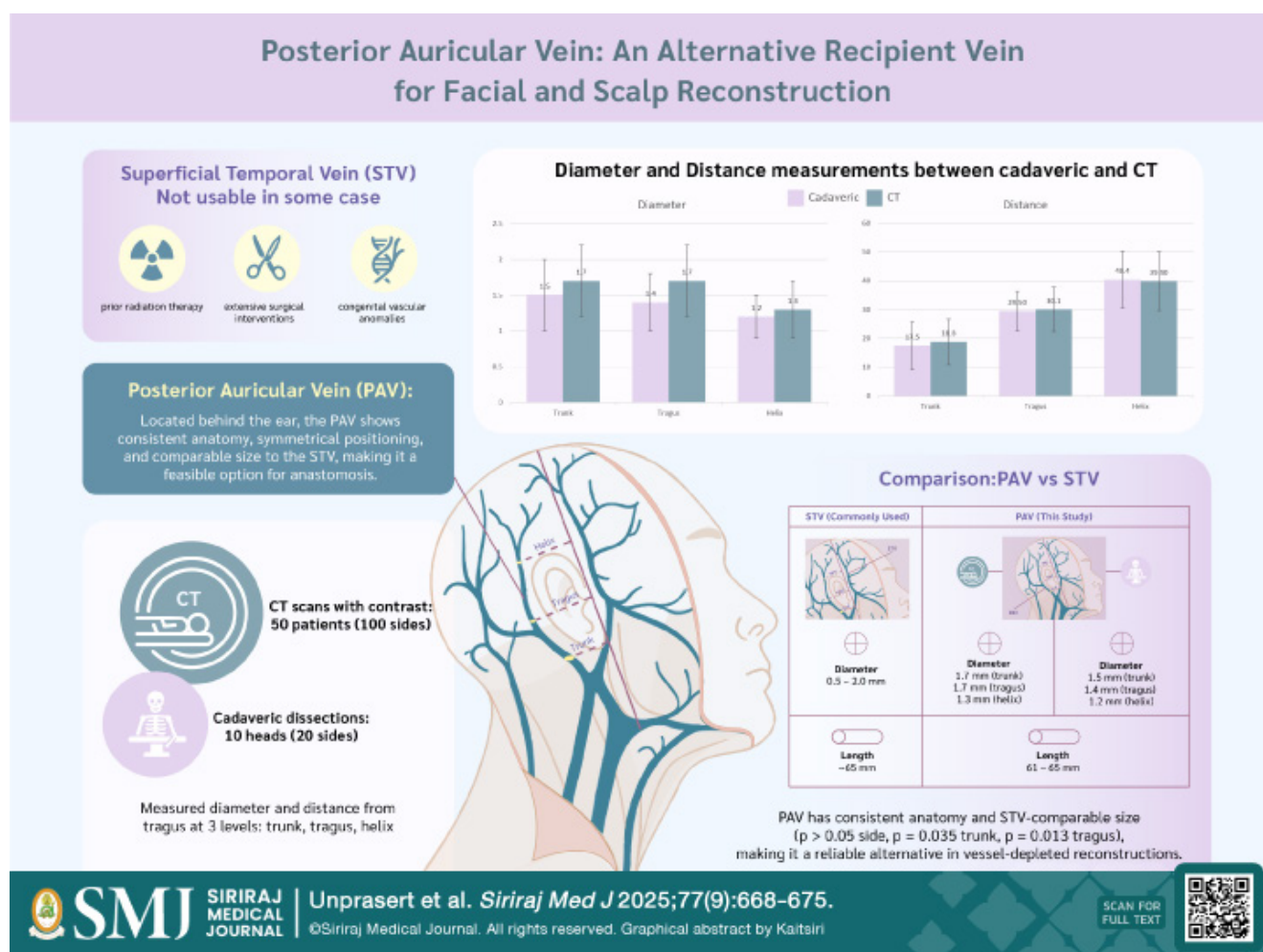


A Comparative Study Using CT Imaging and Cadaveric Dissection in the Evaluation of the Posterior Auricular Vein as an Alternative Recipient Vein for Facial and Scalp Reconstructions

Pongthip Unprasert, M.D.¹, Parkpoom Piyaman, M.D.², Mathee Ongsiriporn, M.D.², Sirichai Kamnerdnakta, M.D.¹, Sirin Apichonbancha, M.D.¹, Chanya Sinmaroeng, M.D.¹, Nutch Yodrabum, M.D.^{2,*}

¹Division of Plastic Surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand, ²Department of Anatomy, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.



*Corresponding author: Nutch Yodrabum

E-mail: n.yodrabum@gmail.com

Received 26 June 2025 Revised 3 August 2025 Accepted 3 August 2025

ORCID ID: <http://orcid.org/0000-0001-8629-7770>

<https://doi.org/10.33192/smj.v77i9.276227>



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ABSTRACT

Objective: To determine the diameter and anatomical location of the posterior auricular vein (PAV) and evaluate its suitability as an alternative recipient vein to the superficial temporal vein in microvascular facial and scalp reconstruction.

Materials and Methods: A retrospective study was conducted using 50 contrast-enhanced cranial CT scans (100 sides) and anatomical dissections on 10 fresh cadaveric heads (20 sides) between 2015 and 2019 at Siriraj Hospital, Mahidol University. Measurements of PAV diameter and its distance from the vertical tragus line were recorded at the trunk, tragus, and helix levels. Descriptive statistics and side-to-side comparisons were analyzed using appropriate analytical tools.

Results: CT scans showed mean PAV diameters of 1.74 ± 0.51 mm (trunk), 1.67 ± 0.49 mm (tragus), and 1.33 ± 0.42 mm (helix). Corresponding cadaveric measurements were 1.47 ± 0.48 mm, 1.39 ± 0.41 mm, and 1.16 ± 0.34 mm, respectively. Statistically significant differences were noted at the trunk ($p = 0.035$) and tragus ($p = 0.013$). The ICC values ranged from 0.81 to 0.91. No significant differences in positional measurements were found ($p > 0.05$).

Conclusion: The posterior auricular vein demonstrates consistent anatomical parameters and a diameter comparable to the superficial temporal vein. These findings support its feasibility as a reliable alternative for venous anastomosis in facial and scalp microvascular reconstruction, especially in vessel-depleted cases.

Keywords: Posterior auricular vein; superficial temporal vein; microvascular surgery; cranial computed tomography; cadaveric dissection (Siriraj Med J 2025; 77: 668-675)

INTRODUCTION

Microvascular reconstruction is a vital surgical technique for addressing complex facial and scalp defects. These procedures rely on the precise anastomosis of small-caliber blood vessels to ensure adequate tissue perfusion and long-term flap viability. The success of such operations largely depend on selecting suitable recipient vessels that can support optimal blood inflow and outflow.¹

Commonly, reliable recipient vessels, such as the superficial temporal vein (STV) are used in facial and scalp reconstructions due to their consistent anatomical location, appropriate diameter, and ease of surgical access.^{1,2} However, the availability of these vessels may be severely compromised by prior radiation therapy, extensive surgical interventions, or congenital vascular anomalies — factors that present major clinical challenges for reconstructive surgeons.^{3,4} In such cases, identifying alternative recipient veins becomes essential to achieving successful reconstruction outcomes.^{5,6}

The posterior auricular vein (PAV) is an anatomically promising yet clinically underexplored candidate located superficially behind the auricle, the PAV offers predictable anatomical features, convenient surgical access, and a suitable size for microsurgical anastomosis.⁷⁻⁹ Despite these advantageous characteristics, the PAV has been rarely investigated or utilized in reconstructive surgery, and existing literature on its feasibility and clinical outcomes remains limited.^{8,10,11}

Cadaveric dissection remains a gold standard for anatomical validation, and several previous studies have exemplified its utility across various anatomical regions and clinical contexts.¹²⁻¹⁴

To address this critical clinical and academic gap, our study comprehensively evaluates the dimensions and anatomical positioning of the PAV using advanced contrast-enhanced computed tomography (CT) imaging, validated by precise anatomical dissections in cadaveric specimens. By providing detailed, clinically relevant anatomical data, this research aims to establish the PAV as a reliable alternative recipient vein. Such validation has the potential to enhance surgical flexibility, improve reconstructive outcomes, and significantly inform microvascular reconstruction planning, particularly in challenging clinical scenarios involving vessel depletion.^{3,4,15}

MATERIALS AND METHODS

This study was designed to assess the posterior auricular vein as an alternative recipient vessel for microvascular facial reconstruction. The research included both living patients and cadaveric specimens, all over the age of 15 years. Two primary approaches were employed for data collection: contrast-enhanced cranial computed tomography imaging in living subjects and anatomical dissection in cadaveric specimens. (Fig 1).

In the imaging cohort, 50 patients underwent contrast-enhanced cranial CT scans using one of three multidetector CT scanners: Discovery CT 750HD (GE

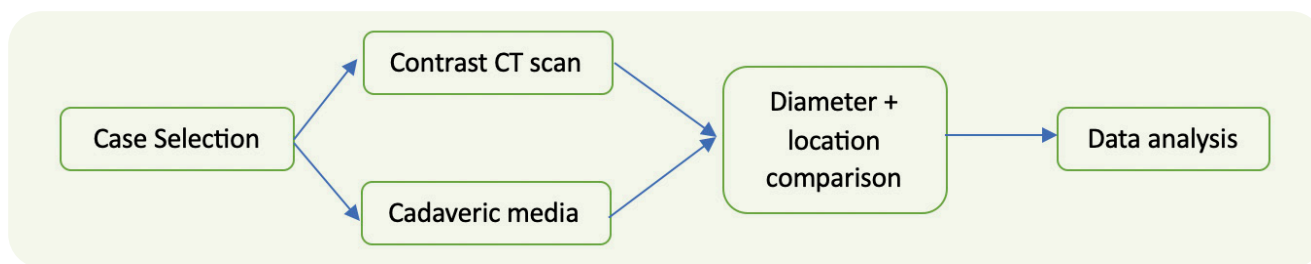


Fig 1. Schematic workflow of the study methodology, including case selection, contrast-enhanced CT scanning, cadaveric dissection, and data analysis.

healthcare, Chicago, IL), Revolution CT (GE Healthcare, Thailand), or Revolution Apex (GE Healthcare, Thailand), with all following standardized contrast protocols. The contrast-enhanced CT scans extended from the sternal notch to the sella and were performed with a tube voltage of 120kVp. Iodinated contrast medium (70 mL) was infused via the dorsal arch of the hand at a rate of 3ml/s, followed by a 20 mL saline flush. The delayed imaging phase was acquired 60 seconds after contrast injection, with a slice thickness of 1.25 mm. Posterior auricular vein diameters were measured on three-dimensional reconstructed images at three anatomically significant landmarks: the trunk, tragus, and superior border of the helix, bilaterally. These landmarks were strategically chosen for their clear anatomical definition, surgical relevance, and ease of intraoperative identification, making the data directly applicable to reconstructive surgeons. (Fig 2). All CT measurements were performed independently by

one radiologist and two surgeons blinded to each other's assessments. Interobserver agreement was calculated using the Intraclass Correlation Coefficient (ICC).

In the anatomical dissection arm, 10 fresh adult cadaveric heads were used. The cadaveric specimens were thawed and vascular structures were carefully injected with a silicone-based contrast medium (Silicone RA320 (Rungart, Bangkok)), diluted in solvent (Por Dee Frame, Bangkok) at a 3:7 weight ratio. An incision was made along the posterior border of the mandibular angle to provide optimal access to the vessels. The silicone mixture was injected at a physiologic rate, allowing for detailed visualization of both venous and arterial structures. After preparation, the posterior auricular vein was dissected and measured at the same three anatomical landmarks used in the CT cohort: trunk, tragus, and helix. Both diameter and positional measurements were recorded for each specimen.

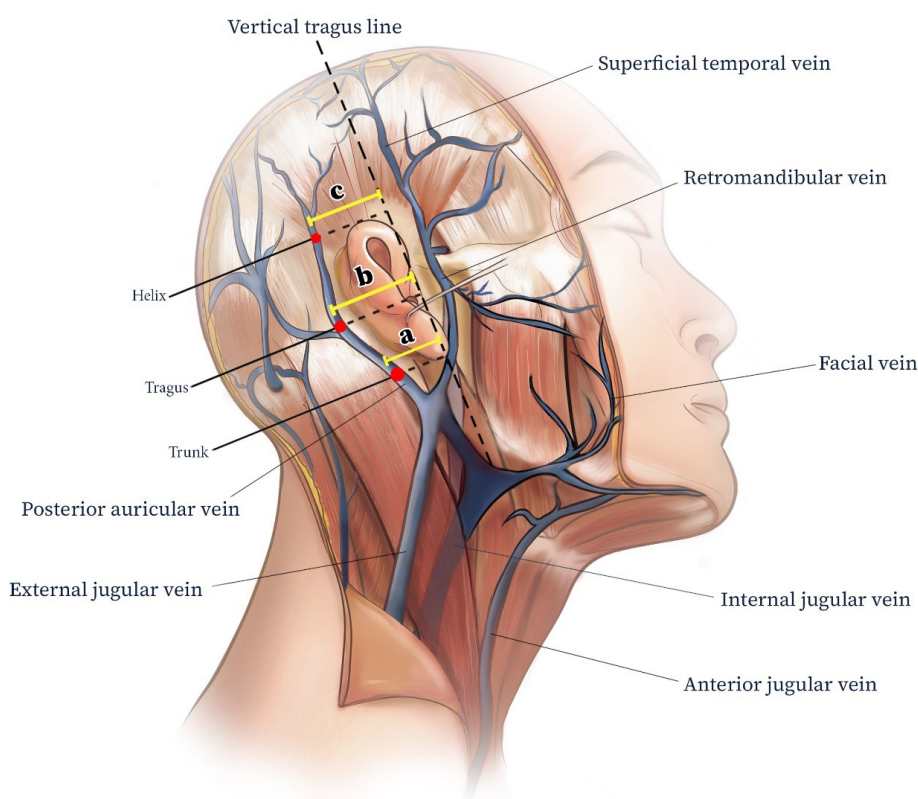


Fig 2. Anatomy of the neck veins showing the External jugular vein (EJV), Internal jugular vein (IJV), Posterior auricular vein (PAV) and other branches including the Superficial temporal vein (STV), Retromandibular vein (RMV), Facial vein (FV) and Anterior jugular vein (AJV). Red dots indicate the measurement points for vein diameter at the trunk, tragus, and helix, measured horizontally at the level of the auricle. The distances of the posterior auricular vein at these levels are labeled as (a), (b), (c) respectively. These distances are measured from the confluence point defined by a line perpendicular to the vertical tragus line and a horizontal line drawn from each of the trunk, tragus and helix.

Statistical analyses

Following data collection, descriptive statistical methods were used to analyze the results. Mean values, ranges, and standard deviations were calculated for both the diameter and location of each anatomical point. Comparisons were made between the CT and cadaveric groups, as well as between left and right sides, to assess anatomical symmetry and validate the findings. Additionally, measurements of the posterior auricular vein were compared with published dimensions of the commonly used superficial temporal vein to evaluate its suitability as a recipient vessel in microvascular reconstruction. Normality was assessed, and group comparisons were conducted using independent t-tests or Mann-Whitney U tests. For normally distributed data, independent t-tests were used. On the other hand, for non-normal distributions, the Mann-Whitney U test was applied. Mean differences and 95% confidence intervals were reported to evaluate the magnitude of anatomical differences between CT and cadaveric groups. All statistical analyses were conducted using SPSS Statistics version 20.0 (SPSS, Inc., Chicago, IL, USA).

This methodological approach was designed to establish a reliable anatomical basis for considering the posterior auricular vein as a potential recipient vein in

patients with depleted neck vessels, especially in cases where the superficial temporal vein is unavailable or unsuitable.

RESULTS

The study included 50 patients who underwent contrast-enhanced cranial CT scans and 10 fresh adult cadaveric heads, yielding comprehensive bilateral data from both living and cadaveric subjects. The sample comprised both genders, with 34 males (68%) and 16 females (32%), with a combined mean age of 66.57 ± 10.30 years, ensuring a representative anatomical assessment.

Measurements obtained from the contrast-enhanced cranial CT scans showed that the mean diameter of the posterior auricular vein was 1.7 mm (range: 0.7–2.9 mm) at the trunk, 1.7 mm (range: 0.7–2.8 mm) at the tragus, and 1.3 mm (range: 0.6–2.2 mm) at the helix. There were no statistically significant differences between the right and left sides at any anatomical level ($p > 0.05$) (Table 1). Similarly, the cadaveric dissection group demonstrated mean diameters of 1.5 mm (range: 0.6–2.6 mm) at the trunk, 1.4 mm (range: 0.7–2.2 mm) at the tragus, and 1.2 mm (range: 0.6–1.8 mm) at the helix. Statistical analysis revealed no significant differences between the right and left sides in this group. (Table 2)

TABLE 1. Mean diameters of the posterior auricular vein measured by CT scans (N=100).

CT (N=100)	Right (mm)		Left (mm)		All (mm)		P-value Right vs Left
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	
Trunk Diameter	1.8±0.6	0.72.9	1.7±0.5	0.72.9	1.7±0.5	0.72.9	0.207
Tragus Diameter	1.7±0.5	0.82.8	1.6±0.4	0.72.5	1.7±0.5	0.82.8	0.085
Helix Diameter	1.3±0.4	0.62.2	1.4±0.4	0.72.1	1.3±0.4	0.62.2	0.305

TABLE 2. Mean diameters of the posterior auricular vein measured by cadaveric dissections (N=20).

Cadaveric (N=20)	Right (mm)		Left (mm)		All (mm)		P-value Right vs Left
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	
Trunk Diameter	1.4±0.4	0.62.2	1.6±0.5	0.62.6	1.5±0.5	0.62.6	0.441
Tragus Diameter	1.3±0.3	0.71.7	1.5±0.4	0.82.2	1.4±0.4	0.72.2	0.498
Helix Diameter	1.1±0.3	0.61.6	1.2±0.3	0.61.8	1.2±0.3	0.61.8	0.505

Regarding anatomical positioning, the mean distance from the vertical tragus line to the posterior auricular vein, as measured on CT, was 18.8 mm at the trunk, 30.1 mm at the tragus, and 39.9 mm at the helix. (Table 3). Cadaveric measurements were comparable, with mean distances of 17.5 mm, 29.5 mm, and 40.4 mm at the trunk, tragus, and helix, respectively. (Table 4) (Fig 2) These positional findings were consistent across both sides and study groups (CT and cadaveric groups), with no statistically significant differences noted ($p > 0.05$). Comparative analysis between the CT and cadaveric cohorts revealed statistically significant differences in diameters at the trunk (right side, $p=0.030$; overall, $p=0.035$) and at the tragus (right side, $p=0.013$; overall, $p=0.013$), with consistently larger diameters observed in the CT group (Fig 3). No significant differences were observed in helix diameters or in anatomical distances at any landmark between the two methods (all $p > 0.05$) (Table 5). The observed discrepancies in trunk and tragus diameters may be attributed to post-mortem tissue changes in cadaveric specimens or limitations in CT imaging resolution.

Importantly, the measured diameters and harvestable lengths of the PAV closely matched those of the commonly used superficial temporal vein (STV), which is typically

reported to have a diameter ranging from 0.5–2.0 mm and a harvestable length of approximately 65 mm. In our study, the harvestable length of the PAV reached up to 65 mm on CT imaging and 61 mm on cadaveric dissection, further supporting its clinical viability.

In summary, the posterior auricular vein demonstrates consistent anatomical dimensions and positioning, comparable to the widely used superficial temporal vein. These findings highlight its potential as a reliable alternative recipient vein for facial and scalp microvascular reconstruction procedures.

DISCUSSION

The study presents a comprehensive anatomical analysis of the posterior auricular vein, evaluating its diameter and positioning using both contrast-enhanced cranial computed tomography and cadaveric dissection. The primary objective was to assess the feasibility of the PAV as an alternative venous recipient for microvascular facial reconstruction, particularly in cases where the commonly used superficial temporal vein (STV) is unavailable due to prior surgery, radiation therapy, or anatomical variation.

Our findings demonstrate that the mean diameter of the PAV at three anatomical points (trunk, tragus,

TABLE 3. Mean distances of the posterior auricular vein measured by CT scans (N=100).

CT (N=100)	Right (mm)		Left (mm)		All (mm)		P-value Right vs Left
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	
Trunk Distance	19.1±8.0	7.039.0	18.6±8.0	5.035.0	18.8±7.9	5.054.0	0.786
Tragus Diameter	31.0±7.8	15.054.0	29.2±7.4	15.045.0	30.1±7.7	15.054.0	0.263
Helix Diameter	40.0±10.1	20.065.0	39.8±10.3	20.060.0	39.9±10.2	20.065.0	0.936

TABLE 4. Mean distances of the posterior auricular vein measured by cadaveric dissections (N=20).

Cadaveric (N=20)	Right (mm)		Left (mm)		All (mm)		P-value Right vs Left
	Mean±SD	Min-Max	Mean±SD	Min-Max	Mean±SD	Min-Max	
Trunk Diameter	18.7±7.6	930	16.2±9.1	533	17.5±8.3	533	0.620
Tragus Diameter	28.9±6.1	2040	30.0±7.9	1944	29.5±6.9	1944	0.773
Helix Diameter	39.7±7.9	2851	41.0±11.9	2561	40.4±9.8	2561	0.819

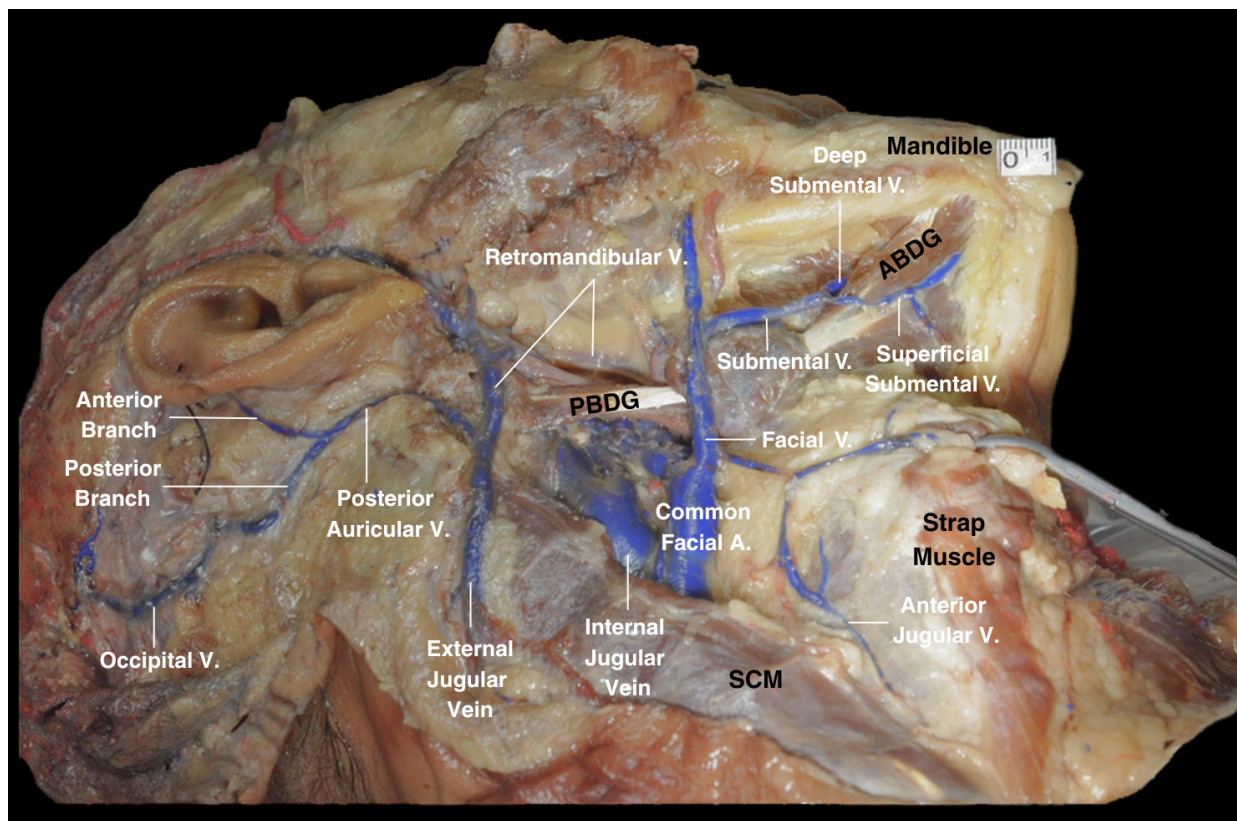


Fig 3. Cadaveric dissection demonstrating the posterior auricular vein (PAV), superficial temporal vein (STV), retromandibular vein (RMV), external jugular vein (EJV), internal jugular vein (IJV), common facial artery (Common Facial A.), occipital vein (Occipital V.), anterior branch (Anterior Branch), posterior branch (Posterior Branch), submental vein (Submental V.), deep submental vein (Deep Submental V.), superficial submental vein (Superficial Submental V.), anterior jugular vein (Anterior Jugular V.), strap muscle (Strap Muscle), mandible, and sternocleidomastoid muscle (SCM). PBDG and ABDG refer to specific labeled anatomic structures.

TABLE 5. Comparisons of diameter and distance measurements between cadaveric and CT groups.

		Cadaveric (N=20)			CT (N=100)			P-value		
		Right	Left	All	Right	Left	All	Right	Left	All
Diameter	Trunk	1.4±0.4	1.6±0.5	1.5±0.5	1.8±0.6	1.7±0.5	1.7±0.5	0.030	0.487	0.035
	Tragus	1.3±0.3	1.5±0.4	1.4±0.4	1.7±0.5	1.6±0.4	1.7±0.5	0.013	0.363	0.013
	Helix	1.1±0.3	1.2±0.3	1.2±0.3	1.3±0.4	1.4±0.4	1.3±0.4	0.201	0.179	0.063
Distance	Trunk	18.7±7.6	16.2±9.1	17.5±8.3	19.5±8.0	18.6±8.0	18.8±7.9	0.896	0.396	0.479
	Tragus	28.9±6.1	30.0±7.9	29.5±6.9	31.0±8.7	29.2±7.4	30.1±7.7	0.423	0.771	0.713
	Helix	39.7±7.9	41.0±11.9	40.4±9.8	40.0±10.1	39.8±10.3	39.9±10.2	0.934	0.749	0.856

and helix), are closely comparable to those of the STV. Specifically, CT imaging revealed mean PAV diameters of 1.7 mm at both the trunk and tragus, and 1.3 mm at the helix. Cadaveric dissection yielded slightly smaller but consistent values: 1.5 mm (trunk), 1.4 mm (tragus), and 1.2 mm (helix), respectively. These results align with previously reported diameter range of the STV, which typically ranges from 0.5 to 2.0 mm. Furthermore, the harvestable length of the PAV reached up to 65 mm on CT and 61 mm in cadaveric specimens, closely matching the average STV length reported in literature (approximately 65 mm).¹⁶

The bilateral symmetry of PAV measurements observed in both living subjects and cadaveric specimens reinforce its reliability as a recipient vessel, regardless of the side chosen for anastomosis. This consistency is notable given the anatomical variability often encountered with STV and its arterial relationships in the pre-auricular region, which can complicate vessel selection.^{1,2,16,17} Our findings suggest that the posterior auricular vein can be confidently considered a suitable alternative in microsurgical reconstruction, offering both anatomical consistency and dimensions comparable to the superficial temporal vein. This supports previous clinical evidence, such as the report by Kim et al, in which a successful anastomosis of a free flap was performed using the PAV in a patient lacking superficial temporal vessels⁸, further highlighting its viability in vessel-depleted scenarios. These findings also align with prior cadaver-based anatomical research from Siriraj Hospital, which has consistently demonstrated the value of combining morphometric analysis with clinical relevance, particularly in regions with complex vascular architecture.¹²⁻¹⁴

Although statistically significant differences in diameter were observed between CT and cadaveric measurements, especially at the trunk and tragus on the right side, these discrepancies may be attributed to the small sample size of cadaveric specimens, postmortem shrinkage and stiffness, as well as intrinsic limitations in CT resolution for fine vascular structures. These limitations are consistent with previous research indicating that cadaveric dissection remains the gold standard for anatomical measurements, while CT and MRI, though valuable, may yield less precise measurements.^{18,19} Expanding sample sizes in future studies will help address statistical bias and confirm our findings.

The clinical relevance of the PAV as an alternative to the STV is underscored by the increasing frequency of complex reconstructions in the vessel-depleted neck.³⁻⁵ The fragile nature of venous structures, compounded by prior interventions or radiation therapy, often limits the

availability of suitable recipient veins. Given its anatomical proximity, comparable size to the STV, and consistent drainage patterns^{2,20,21}, the PAV stands out as a valuable backup option, potentially improving outcomes in cases where conventional recipient veins are unavailable.

This study contributes to the growing body of literature aimed at optimizing reconstructive strategies in head and neck microsurgery. By providing detailed morphometric data and supporting the feasibility of using the PAV as a recipient vein, we offer practical guidance for surgical planning, particularly in challenging clinical scenarios. Notably, these findings support the routine consideration of the PAV in microvascular facial reconstruction, enhancing both versatility and safety in vessel selection.

Limitations of this study include the relatively small cadaveric sample size and the potential for measurement bias inherent in imaging-based assessments. Future investigations involving larger cohorts and improved imaging protocols will be useful in validating these results and further elucidating the anatomical understanding of this promising vessel.

CONCLUSIONS

The posterior auricular vein exhibits consistent diameter and anatomical positioning comparable to the superficial temporal vein. These findings support its clinical feasibility as an alternative recipient vein in microvascular facial and scalp reconstruction, particularly in vessel-depleted cases.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

ACKNOWLEDGEMENTS

The authors are grateful for Nachasa Khongchu, Inthuon Sothon, Ploypun Seesun and Pattarawadee Prakobphol from the Research Department, Faculty of Medicine Siriraj Hospital, Mahidol University, for data collection. This research project was supported by Faculty of Medicine Siriraj Hospital, Mahidol University, Grant Number (IO) R016433020.

DECLARATIONS

Grants and Funding Information

This research project was supported by Faculty of Medicine Siriraj Hospital, Mahidol University, Grant Number (IO) R016433020.

Conflict of Interest

The authors declare no conflicts of interest.

Registration Number of Clinical Trial

None.

Author Contributions

Conceptualization and methodology, P.O., P.P., and N.Y.; Investigation, P.O., P.P., and C.S.; Formal analysis, P.O., P.P., S.A. and N.Y.; Visualization and writing – original draft, P.O., S.A., C.S., P.P. and N.Y.; Writing – review and editing, S.A. and N.Y.; Funding acquisition, N.Y.; Supervision, S.K. and N.Y.; Project administration, N.Y.; All authors have read and agreed to the final version of the manuscript.

Use of Artificial Intelligence

During the preparation of this manuscript, the authors used ChatGPT to improve readability and grammar. All content was subsequently reviewed and edited by the authors, who take full responsibility for the final version.

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