

New approach to an overlooked flap: Technique to augment venous drainage of the infrahyoid myocutaneous flap

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Abstract

Background: To describe a technique in which the anterior jugular vein is preserved in the infrahyoid myocutaneous flap (IHMCF) to augment skin paddle venous drainage.

Methods: From April 2018 to December 2019, 14 patients with primary oral cancer underwent radical resection and IHMCF reconstruction. Three-dimensional reconstruction of the anterior jugular vein was used to assess the venous drainage of the skin paddle preoperatively. The anterior jugular vein was preserved during dissection of the flap. Healing of the recipient and donor sites was observed.

Results: Total flap necrosis occurred in one patient and marginal skin paddle necrosis occurred in one patient. No flap complications occurred in the other 12 patients.

Conclusion: This new approach to augment venous drainage of the IHMCF appears to be effective for decreasing risk of flap necrosis.

KEY WORDS

anterior jugular vein, head and neck, infrahyoid myocutaneous flap, pedicle flap, venous drainage

1 | INTRODUCTION

Infrahyoid myocutaneous flap (IHMCF), introduced by Wang et al in 1986,¹ is a versatile and convenient flap for repairing defects in and around the oral cavity. The IHMCF, which comprises the sternohyoid and sternothyroid muscles, the superior belly of the omohyoid muscle, and the overlying platysma and skin, is fed by the superior thyroid vessels and innervated by the ansa cervicalis. This thin and pliable flap provides a skin island of about 7 × 4 cm from the central part of the anterior neck and can be transferred on its pedicle to reconstruct medium-sized defects around the oral cavity.^{1–6} However, with advances in microsurgery techniques, various microvascular free flaps are now used for

reconstruction of defects caused by resection of head and neck cancers, and the IHMCF is often overlooked.⁷

The complication rate of the IHMCF ranges from 0% to 47%, with the most common complication being partial or complete loss of the skin paddle due to venous insufficiency.^{1–3,5,6,8–11}

Studies of the venous anatomy of the IHMCF show that the infrahyoid muscles are drained by the superior thyroid vein, and the skin paddle by the anterior jugular vein (AJV) or the external jugular vein, or both. Preservation of the cranial portion of the AJV, retrograding venous flow to the facial vein or external jugular vein, can ensure better venous drainage from the skin paddle and reduce the risk of skin paddle necrosis.^{10,12,13}

TABLE 1 Demographics and clinical characteristics in 14 patients

| No./sex | Age (years) | Tumor site | Stage | Neck dissection | Skin paddle dimensions/cm | AJV drainage | Complications |
|-----------------------|-------------|----------------|-------------------------------|-----------------|---------------------------|-------------------------|-------------------|
| 1/male | 76 | Tongue | T ₂ N ₀ | SND | 4 × 6 | Facial vein | |
| 2/male | 69 | Tongue | T ₂ N ₀ | SND | 4 × 6 | IJV | |
| 3/female ^a | 65 | Alveolar ridge | T ₃ N ₀ | SND | 4 × 8 | Facial vein | |
| | | | | | | Bilateral communication | |
| 4/male | 61 | Buccal | T ₃ N ₀ | SND | 4 × 9 | Facial vein | |
| 5/female | 68 | Floor of mouth | T ₃ N ₀ | SND | 4 × 7.5 | IJV | |
| 6/female | 82 | Tongue | T ₃ N ₀ | SND | 4 × 11 | EJV | |
| 7/female | 73 | Tongue | T ₃ N ₀ | SND | 3.5 × 6 | IJV | |
| 8/male | 62 | Tongue | T ₃ N ₀ | SND | 4 × 6 | IJV | |
| 9/female | 56 | Tongue | T ₂ N ₀ | SND | 3.5 × 7 | IJV | |
| 10/male | 54 | Tongue | T ₂ N ₀ | SND | 3.5 × 6 | IJV | Total necrosis |
| 11/male | 63 | Tongue | T ₂ N ₀ | SND | 4 × 6 | Facial vein | |
| 12/ female | 74 | Buccal | T ₂ N ₀ | SND | 4 × 6 | IJV | |
| 13/male | 60 | Alveolar ridge | T ₂ N ₀ | SND | 4 × 7 | IJV | |
| 14/male | 49 | Floor of mouth | T ₂ N ₀ | SND | 4 × 8 | IJV | Marginal necrosis |

^aNo. 3: a horizontal infrahyoid musculocutaneous flap with bilateral superior thyroid pedicle.

Abbreviations: AJV drainage, the cranial of the AJV drainage; EJV, external jugular vein; IJV, internal jugular vein; SND, selective neck dissection.

However, the location and communications of the superficial veins are variable, and it may not always be possible to harvest sufficient veins to prevent venous congestion and subsequent flap necrosis.

We have devised a technique to augment skin paddle venous drainage by preserving the cranial portion of the AJV during flap dissection, using preoperative CT and three-dimensional (3D) reconstruction to accurately identify the AJV drainage system. In this article we describe the technique and retrospectively review the patients who underwent oral defect reconstruction by this method at our hospital.

2 | SUBJECTS AND METHODS

The data of 14 patients who underwent reconstruction with IHMCF after radical resection of primary oral cancer between April 2018 and December 2019 at the Peking University Hospital of Stomatology were retrospectively reviewed. Patients were eligible for reconstruction with IHMCF if (a) they had a medium-sized

defect located in the lower part of the oral cavity; (b) preoperative contrast-enhanced CT examination showed the ipsilateral neck to be clinically free from lymph node involvement; and (c) the AJV could be identified on CT in the ipsilateral neck skin. Patients who had previously undergone thyroidectomy or ipsilateral neck dissection, or had received radiation to the neck, were considered unsuitable for IHMCF reconstruction. Table 1 presents the demographics and clinical characteristics of the patients.

The Ethics Committee of Peking University Hospital of Stomatology approved this study.

2.1 | The procedure

2.1.1 | Preoperative assessment

Preoperative CT data were used for three-dimensional (3D) reconstruction of the AJV (Figure 1). The path followed by the vein and the cranial drainage were identified, and the surgical plan was devised accordingly.

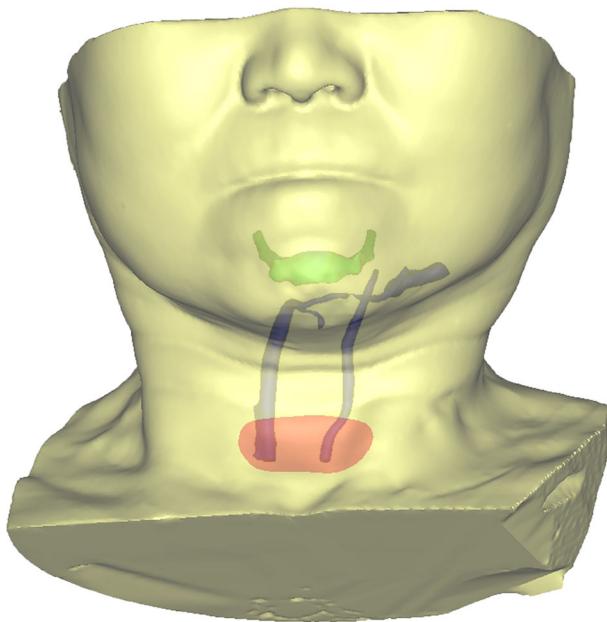


FIGURE 1 The three-dimensional reconstruction shows the communication between the cranial portions of the AJV of the two sides. This figure is the patient No. 3 from Table 1 [Color figure can be viewed at wileyonlinelibrary.com]

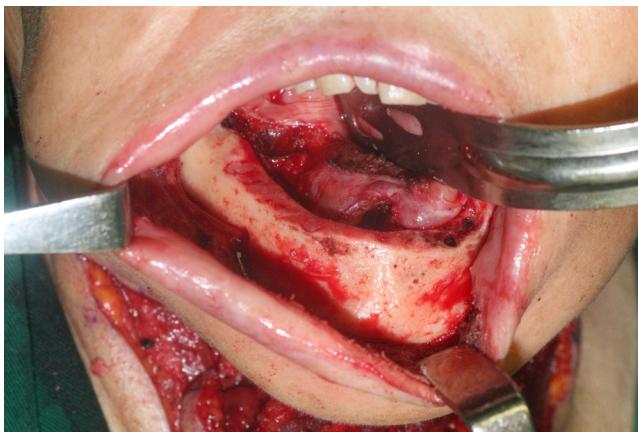


FIGURE 2 The defect in the oral cavity. This figure is the patient No. 3 from Table 1 [Color figure can be viewed at wileyonlinelibrary.com]

2.1.2 | Surgical technique

The IHMCF was harvested before neck dissection was performed. The shape and size of the skin paddle was finalized after the recipient area had been completely prepared (Figures 2-4). The flap was raised starting from the lateral edge, and the superior belly of the omohyoid was divided from the inferior segment. After opening the linea alba, the surface of the thyroid cartilage and the internal border of sternohyoid muscle was exposed successively by dissection. Distally, the AJV and the sternohyoid and



FIGURE 3 The skin paddle was designed based on the position of the AJV and the pedicle vessels on both sides. This figure is the patient No. 3 from Table 1 [Color figure can be viewed at wileyonlinelibrary.com]

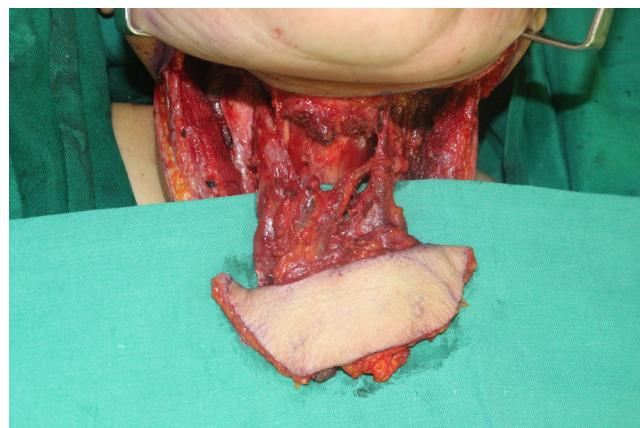


FIGURE 4 The IHMCF was harvested, preserving the AJV, which showed the communication as the 3D preoperative. This figure is the patient No. 3 from Table 1 [Color figure can be viewed at wileyonlinelibrary.com]

sternothyroid muscles were divided near their origins. Care was taken to avoid injury to the small musculocutaneous perforators when suturing the skin paddle to the muscle. At the cranial end, the AJV was located with the help of the 3D reconstructed image and dissected. The superior thyroid vessels and the internal jugular vein were preserved. After ligation of major vessel branches to the thyroid gland, the flap was developed cranially. Flap elevation was completed by sharp dissection of the muscles from the thyroid cartilage. Venous drainage was ensured by preserving the superior thyroid vein, which drains into the internal jugular vein, and the cranial portion of the AJV with retrograde flow.

A tunnel was prepared in the neck through which the flap was passed and placed in the recipient site. The donor site was closed without tension (Figures 5,6).



FIGURE 5 The IHMCF was transferred into the oral cavity and sutured in place. This figure is the patient No. 3 from Table 1 [Color figure can be viewed at [wileyonlinelibrary.com](#)]

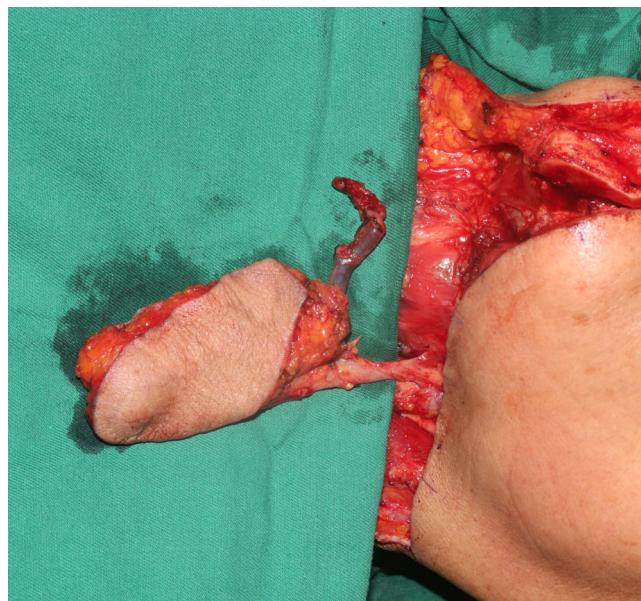


FIGURE 7 The cranial portion of the AJV was cut. This figure is the patient No. 5 from Table 1 [Color figure can be viewed at [wileyonlinelibrary.com](#)]



FIGURE 6 The donor site was closed without any tension. This figure is the patient No. 3 from Table 1 [Color figure can be viewed at [wileyonlinelibrary.com](#)]



FIGURE 8 The cranial portion of the AJV was anastomosed to the external jugular vein. This figure is the patient No. 5 from Table 1 [Color figure can be viewed at [wileyonlinelibrary.com](#)]

3 | RESULTS

A total of 14 patients (9 males, 5 females) underwent reconstruction with IHMCF after cancer resection and neck dissection as a single-stage procedure. The ages of the patients ranged from 49 to 82 years (median age, 65 years). All patients had squamous cell carcinoma; the location of the primary was in the tongue ($n = 8$), floor of the mouth ($n = 3$), buccal region ($n = 1$), and alveolar ridge ($n = 2$). While eight patients had American Joint Committee on Cancer 2010 (AJCC) T2 classification, the other six had T3 classification. All patients had clinical and pathologic N0 disease and underwent selective neck dissection (levels I-III). The skin paddles ranged in size from 6×3.5 cm to 11×4 cm. All flaps had two systems of venous drainage; preservation of the cranial portion of the AJV was successful in all cases. The cranial

portion of the AJV drained into the internal jugular vein in nine patients, into the facial vein in four patients, and into the external jugular vein in one patient. Two patients (patient 5 and patient 7), the flap could not be

rotated because of the AJV location. The cranial part of the AJV was cut and re-anastomosed to the external jugular vein (Figures 7,8) (patient 5) or the facial vein (patient 7). All flaps were transferred to the recipient sites without tension.

Total necrosis occurred in one patient (patient 10) who had squamous cell carcinoma in the left margin of the tongue; the wound healed after 1 month. Another patient (patient 14) had marginal necrosis of the skin paddle; this healed after 2 weeks. No patient developed fistula or wound dehiscence.

4 | DISCUSSION

As a pedicle flap, the IHMCF has several advantages: it is suitable for reconstruction of medium-sized defects of the oral cavity; it leaves an acceptable scar in the neck; and it allows preservation of the motor innervation via the branch of the ansa cervicalis when tongue reconstruction is needed.^{6,14–16} The IHMCF is an excellent reconstructive option in selected patients, especially elderly and frail patients, in whom a microvascular free flap may not be feasible.^{1,2,7} Dolivet has shown IHMCF robotic reconstruction after transoral robotic surgery for oropharyngeal malignancy to be a reliable minimally invasive reconstruction method.¹⁷ IHMCF reconstruction can prevent postlaryngectomy major pharyngocutaneous fistula.¹⁸ The neurovascular infrahyoid flap is claimed to be useful for reconstruction of defects of the tongue base after partial resections or total glossectomies; it can prevent scarring and atrophy of the reconstructed tongue.^{7,15,16} In addition, tracheal reconstruction with an IHMC flap has been shown to be a less invasive and safer surgical procedure than reconstruction with free flaps or end-to-end anastomosis.¹⁷ Thus, even in this free flap era, the IHMCF remains a valuable reconstruction method for reconstruction of head and neck defects.

The main problem associated with the IHMCF is skin paddle necrosis due to insufficiency of venous return. The skin paddle overlying the infrahyoid muscles has two venous drainage systems: the superficial system of the AJV, which is the primary drainage system, and the superior thyroid vein.^{2,10,12,13} There is considerable anastomosis between the two systems, and so the AJV is usually sacrificed during dissection of the flap.² The only remaining route for venous drainage is the superior thyroid vein, which may explain why necrosis of the skin paddle is common but not necrosis of the infrahyoid muscles. Many technical modifications have been proposed for reducing the risk of skin paddle necrosis^{12–14}; the suggested measures include (a) preservation of either the external or internal jugular

vein for better venous flow in the flap,¹ (b) inclusion of a portion of the superficial cervical fascia in the flap to increase venous drainage,⁶ and (c) preservation all the veins which drained the flap area to enhance the venous drainage.^{19,20}

Ouyang et al reported a modified incision of the IHMCF, the IHMCF had two drainage systems, and venous drainage of the skin paddle and the platysma muscle came from the superficial venous system. The necrosis rate of the skin paddle could be reduced by carefully protecting its supply and drainage vessels.¹³ In a study of 20 patients who underwent IHMCF reconstruction after resection of oral or hypopharyngeal carcinoma, Peng et al reported no skin paddle necrosis in 13 patients in whom the cranial portion of the AJV was preserved; flap survival was significantly higher in these 13 patients than in the other seven patients.¹² Lockhart et al reconstructed intraoral defects of the lower portion of the face with the IHMCF in 21 patients and reported no skin paddle necrosis in six patients in whom the AJV and its ramus communicans or communicating branch were preserved; however, among the other patients, there were four cases of total necrosis and four of partial necrosis.¹⁰ Thus, preservation of the cranial portion of the AJV may ensure better venous drainage of the skin paddle and reduce the risk of skin paddle necrosis.

Anatomical variations are common in the venous drainage system, but advances in CT technology have made preoperative assessment of the AJV feasible. We used 3D reconstruction of the AJV to assess the venous drainage and designed the flap accordingly. The cranial portion of the AJV was identified and preserved during the dissection of the IHMCF. During the dissection, the contribution of the AJV was assessed by first blocking the vein and observing the hardening of the skin paddle due to venous engorgement and, then, removing blockage and observing the relief of the manifestations. With preservation of the cranial portion of the AJV, flap repair was totally successful in 12 patients in this study; one patient only had marginal necrosis of the skin paddle, and one patient had total necrosis of the flap.

It is important to make a large enough tunnel to avoid compression of the pedicle of the flap. In the present study, in one patient who had resection of squamous cell carcinoma in the left margin of the tongue, the cranial portion of the AJV drained into the internal jugular vein. Although good venous return was confirmed during the operation, there was total necrosis of the flap postoperatively. Preservation of the muscle in the floor of the mouth contributed to compression of the flap pedicle and resulted in total flap necrosis.

Previous thyroidectomy, neck dissection, radiotherapy, and massive neck metastasis are classical contraindications for IHMCF. In sometimes, the contraindication may be relativized. Mirghani et al have reported successful flap repair in two patients with history of prior neck dissection.²⁰ Due to the contribution of the AJV in the IHMCF, we paid more attention to the preoperative detection on the AJV by the contrast CT examination. During the period of this study, a patient who underwent the treatment was not in our study because of the AJV was missing. With squamous cell carcinoma in the posterior left buccal region, this patient underwent radical resection, selective neck dissection, and transfer of the IHMCF with the AJV missing to reconstruct the defect. Total necrosis of the skin paddle was observed, and the patient had limited mouth opening after secondary epithelialization of the underlying muscle. Seidl et al used the infrahyoid muscle flap for correction of pharyngeal fistulae after cervical spine surgery in six patients and reported no complications²¹; however, the IHMCF must not be a choice for reconstruction of oral defects when the AJV is not detected.

In this limited series, our results support the importance of the preservation of the cranial portion of the AJV; however, further study with large samples is necessary to verify it.

5 | CONCLUSION

Preservation of the cranial portion of the anterior jugular vein, aided by preoperative CT scanning and 3D reconstruction, may result better venous drainage of the IHMCF and prevent flap necrosis.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

DATA AVAILABILITY STATEMENT

All data included in this study are available upon request by contact with the corresponding author.

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