Case Report
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Closure of Large Tracheocutaneous Fistula With Island Deltopectoral Flap

Hye-Bin Jang, In Seok Kang, Hyeong Seok Lee, and Joon Kyoo Lee

Department of Otolaryngology-Head and Neck Surgery, Chonnam National University Medical School and Hwasun Hospital, Hwasun, Korea

섬 형태의 삼각흉근 피판을 이용한 거대 기관피부 누공 폐쇄술

장혜빈 · 강인석 · 이형석 · 이준규

전남대학교 의과대학 화순전남대학교병원 이비인후과학교실

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Address for correspondence
Joon Kyoo Lee, MD, PhD
Department of Otolaryngology-Head and Neck Surgery, Chonnam National University Medical School and Hwasun Hospital, 322 Seoyang-ro, Hwasun 58128, Korea
Tel +82-61-379-8190
Fax +82-61-379-7761
E-mail joonkyoo@jnu.ac.kr

Tracheocutaneous fistula (TCF) formation is a complication of long-term tracheostomy use. Surgical closure is necessary for a persistent TCF because this can lead to various complications. Herein, we describe our use of an island deltopectoral (DP) flap to treat a large TCF. A 62-year-old male, who had previously undergone supraglottic partial laryngectomy with laser and radiation therapy, presented with a second recurrence of supraglottic cancer. Supracricoid partial laryngectomy and cricohyoidoepiglottopexy (CHEP) were performed. Afterward, a large TCF measuring about 2.0×2.5 cm developed. The island DP flap facilitated successful TCF closure. There have been no recurrences or complications, and both the reconstruction site and donor site are well-maintained after 25 months of follow-up. The island DP flap can be a useful option for large TCF closure, even for patients who have had previous radiation therapy.
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Keywords Island flap; Reconstructive surgical procedure; Respiratory tract fistula; Surgical flaps; Tracheostomy.

Introduction

Long-term tracheostomies can be complicated by tracheocutaneous fistula (TCF) formation.[1,2] The process of TCF formation is explained by the migration of squamous epithelium into the trachea, creating an epithelialized tract.[1] TCFs often occur in patients for whom decannulation fails, necessitating long-term tracheostomy tube use for various indications, such as airway obstruction, pulmonary dysfunction caused by chronic disease, and neurogenic respiratory failure.[2] Additionally, factors like radiation therapy and worsening medical conditions can contribute to the likelihood of TCF formation.[3]

Persistent TCFs can lead to the following complications: excessive secretions, pulmonary infections, skin infections, voice disturbances, limitations of daily activities like bathing, cosmetic issues, and accompanying psychological problems.[4-6] Therefore, TCFs should be closed.

There are two standard TCF closure methods: primary closure and flap surgery. For small TCFs, primary closure is commonly performed, involving the excision of the fistulous tract followed by a multi-layered suture technique or second-intension healing.[7-9] Large TCFs, for which repair is challenging through primary closure, require flap surgery, which is a complex and potentially challenging method.[10] However, there is still no consensus regarding the optimal surgical approach for TCF closure.

Therefore, we present a case of successful reconstruction

using an island deltopectoral (DP) flap for a large TCF in a patient who had previously undergone tracheostomy and radiation therapy.

Case

This study was approved by the Institutional Review Board (CNUHH-2023-238).

A 62-year-old male presented with a 1-month history of persistent hoarseness. He had no underlying disease but had a 30-year history of smoking and consumed half a bottle of alcohol four times a week. Upon examination, a mass lesion was found on the right false vocal cord. The patient underwent transoral laser supraglottic partial laryngectomy. Histopathologic examination confirmed the diagnosis of squamous cell carcinoma. He subsequently received a total radiation dose of 6450 cGy.

The patient was monitored regularly for 4 years through clinical examinations and imaging studies, with no recurrence observed during this period. However, after 4 years, the patient presented with voice disturbances, and a recurrence was identified in the right false vocal cord. The patient underwent a second transoral laser supraglottic partial laryngectomy. Postoperatively, the patient received adjuvant chemotherapy with cisplatin and 5-fluorouracil administered in a 6-week cycle.

Ten months later, a suspected recurrence was observed in the right false vocal cord. Neck computed tomography revealed that the mass on the right false vocal cord had invaded the paraglottic space and there was evidence of necrosis near both thyroid cartilages close to the cricothyroid joint. There was no evidence of invasion toward the free border of the epiglottis.

To preserve the patient's voice, supracricoid partial laryngectomy and cricohyoidoepiglottopexy (CHEP) with tracheal fenestration were performed. Additionally, right thyroid lobectomy with central neck dissection and bilateral lateral neck dissections were carried out. Tracheal fenestration (not tracheostomy) was designed to block the bilateral neck dissection field from the tracheal airway, preventing any positive pressure into the drain or sputum contamination to the field. In doing so, unintentionally, fenestration opening was made somewhat large in size.

The tracheal fenestration site had not spontaneously closed after 8 postoperative months, and a TCF measuring approximately 2.0×2.5 cm developed (Fig. 1). There was no evidence of a tracheoesophageal fistula on flexible laryngoscopy, but granulation tissue (considered benign) was observed in the subglottis, possibly due to irritation of exposed suture material from the previous CHEP. Accordingly, we planned for TCF closure using a right island DP flap with subglottic granulation tissue removal.

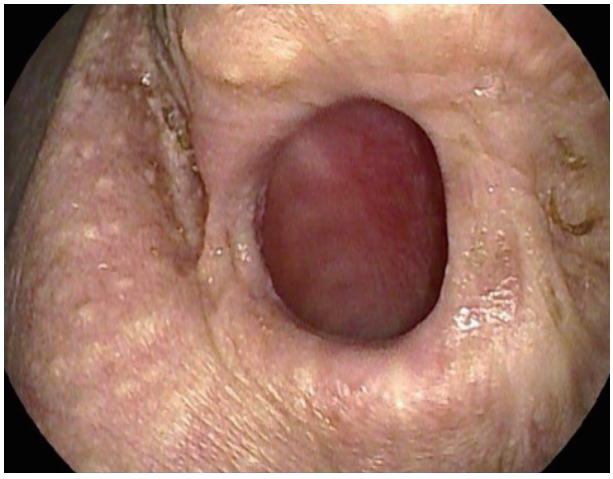

Fig. 1. Tracheocutaneous fistula to previous tracheal fenestration, measuring approximately 2.0×2.5 cm.

Under general anesthesia, laryngoscopic removal of the subglottic granulation tissue was performed. The surgical procedure for TCF closure proceeded as follows (Figs. 2 and 3): initially, the epithelized tissue around the tracheostoma was separated from the cartilage. A pedicled island DP flap was harvested from the upper right chest wall. It was then tunneled beneath the neck skin flap and brought up over the TCF. Skin tissue was sutured to form the inner wall of the trachea, closing the tracheal defect.

Postoperatively, both the graft site and donor site have recovered well without any complications. The patient has been under regular follow-up for 25 postoperative months (Fig. 4). The flap observed inside the trachea also has been gradually stabilizing in position, and it is currently forming the tracheal inner wall effectively in the area where the fistula existed (Fig. 5).

Discussion

TCFs often occur in patients who require long-term tracheostomy tube maintenance.[2] A persistent TCF can lead to respiratory tract infections, voice impairment, and cosmetic concerns,[4-6] necessitating TCF closure.

Several TCF closure methods have been reported. For small TCFs, primary closure or excision with second-intention heal-

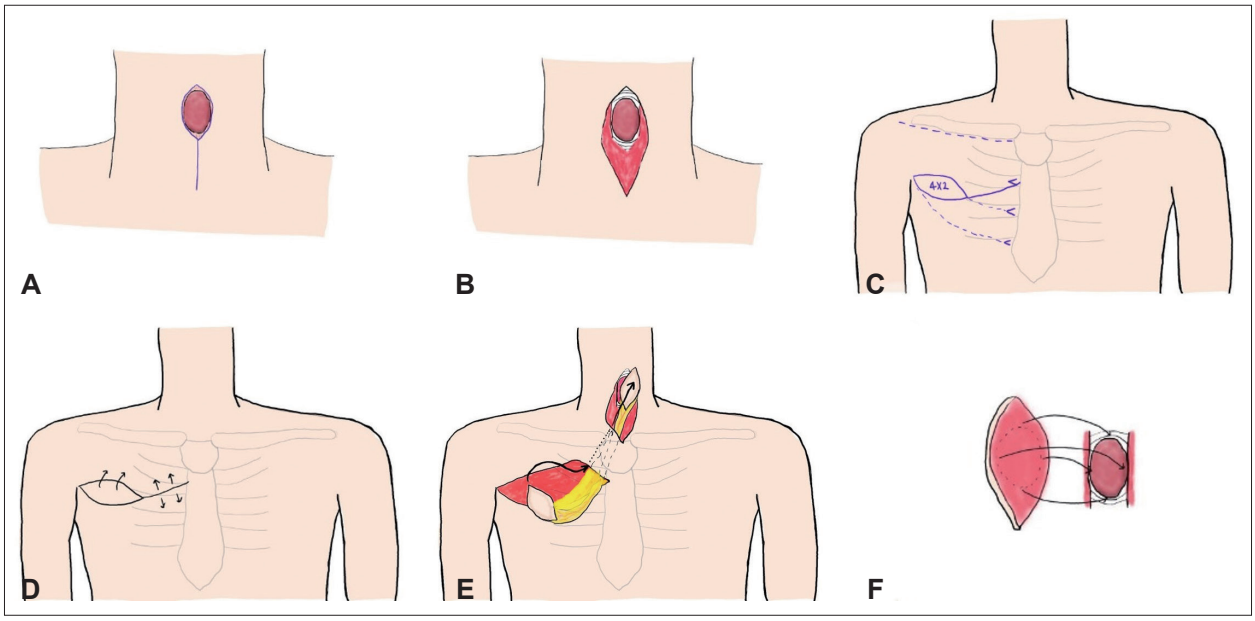

Fig. 2. Schematic diagrams of the surgical procedure for tracheocutaneous fistula (TCF) closure. The epithelialized tissue around the tracheostoma was separated from the cartilage (A) and surroundings was dissected further (B). An island type of deltopectoral flap was designed on the right upper chest wall (C), skin incision was made (D), and dissected just beneath the epidermal and dermal layer, leaving the subcutaneous tissue and the fascia on the base. Then the island flap and distal pedicle was tunneled beneath the neck skin flap and brought up over the TCF (E). Island skin was inversely sutured to form the inner wall of the trachea, covering the tracheal defect (F).

Fig. 3. Landmarks and skin incision design for the use of an island deltopectoral flap: sternal edge; infraclavicular line; and second, third, fourth intercostal spaces (*We have attached images from another patient since there are no photographs for this case. Please note, in this patient, the left-right orientation is reversed, but the skin markings and skin incision design are identical).

Fig. 4. The external wound at the donor (right upper chest wall) and tracheocutaneous fistula closure site had healed well after postoperative 25 months.

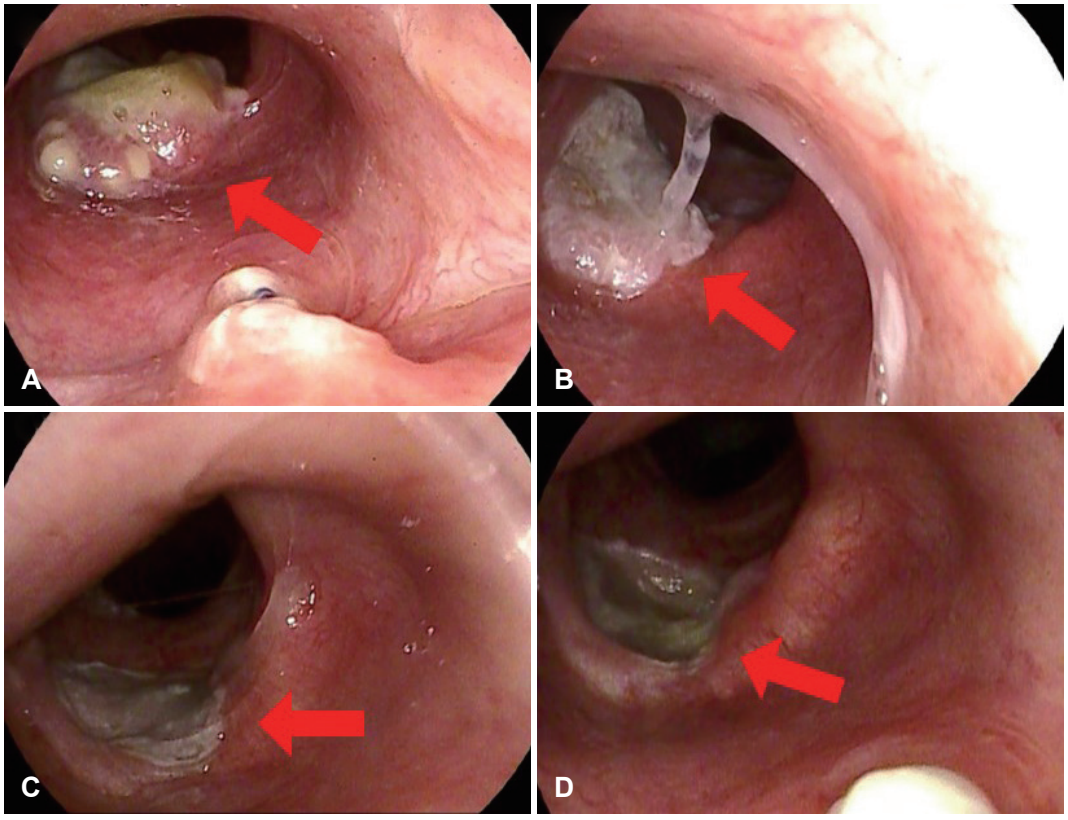

Fig. 5. Progressive flap healing and stabilization inside the trachea. Postoperative 2 weeks (A), 3 weeks (B), 6 weeks (C), and 14 weeks (D) (arrows), respectively.

ing is often performed.[7-9] For large TCF, local or regional flaps are used.[11] Local flaps may include superiorly based turnover skin flaps, turnover-hinged skin flaps, rhomboid flaps, and z-plasty repairs.[9,12] Regional flaps may involve a pectoralis major myocutaneous (PMMC) flap alone, the combined use of the PMMC and sternocleidomastoid muscles, or the combination of conchal cartilage with a DP flap.[11,13,14] Free flaps, such as the conchal cartilage combined with radial forearm free flap (RFFF), have also been reported.[9]

In this case, given the large TCF and the history of radiation therapy and neck dissection, we decided to use a regional flap rather than a local flap. Specifically, an island DP flap was chosen for the following reasons: firstly, it is a fasciocutaneous flap, which allows for the creation of appropriate thickness, flatness and size to reconstruct the TCF. Secondly, it involves tissues that were not within the previous radiation therapy area and is a pedicled flap, close to the defect site, that typically has a good success rate.

A PMMC flap procedure was not selected because such flaps are too bulky to be suitable for TCF closure despite the advantages of being relatively easy to harvest and having a good success rate. RFFFs can provide the appropriate size and thickness, but they are free flaps, making the surgical procedure more challenging and time-consuming. Additionally, both of the above-mentioned flaps are strong candidates for future neck reconstructions, so they were not used to preserve them for potential future procedures.

As of now, the use of a DP flap for TCF closure has only been reported by Li, et al.[15] in 2020. However, their approach differed from ours in that they first placed a tracheal stent and then used a turnover flap to reconstruct the tracheal defect, using the DP flap for only skin defect reconstruction.

As mentioned earlier, various types of local flaps and regional flaps have been employed for the closure of TCF. Local flaps, at times, prove to be a useful method for closing TCF that cannot be achieved through primary closure. However, local flaps have limitations in closing TCF beyond a certain size. Additionally, a significant portion of patients developing TCF has a history of prior radiation therapy. In such cases, as the tissues around the TCF have already been exposed to radiation, local flaps may exhibit slower or ineffective healing and even lead to breakdown.

In comparison to local flaps, the regional flap known as the DP flap involves a slightly more time-consuming and com-

plex surgical procedure, incurring some additional costs. However, the advantage of the DP flap lies in its superior resilience, given that it consists of fresh tissue not exposed to radiation. Furthermore, the DP flap allows for obtaining flaps larger than 10 cm, making it advantageous for closing large TCFs that cannot be covered by local flaps.

In contrast to other regional flaps, the DP flap exhibits several advantages. In studies reported to date, regional flaps such as the RFFF and the PMMC have been prominent in large TCF closure.[9,11,13,14] As mentioned earlier, the DP flap, similar to RFFF, possesses suitable conditions for TCF closure, including appropriate thickness, flatness, and size. However, the DP flap offers the advantage of a relatively simpler surgical procedure compared to RFFF, resulting in significant time and cost savings. While PMMC has a less complex surgical procedure, its bulky nature compared to the DP flap may make meticulous handling challenging and may not be suitable than DP flaps except very large TCF closures. Therefore, even in comparison to other regional flaps, the DP flap appears to be a competitive candidate.

In our case, successful TCF closure was achieved using an island DP flap only, without the need for additional flaps, conchal cartilage, or a tracheal stent. This method is considered simpler, faster, and more cost-effective. Additionally, the incidence of complications affecting the donor and recipient sites is relatively low, and the success rate is high.

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None

Author Contribution

Conceptualization: Hye-Bin Jang, Joon Kyoo Lee. Data curation: all authors. Formal analysis: Hye-Bin Jang, Joon Kyoo Lee. Investigation: Joon Kyoo Lee. Methodology: Hye-Bin Jang, Joon Kyoo Lee. Project administration: Joon Kyoo Lee. Resources: all authors. Software: In Seok Kang, Hyeong Seok Lee. Supervision: Joon Kyoo Lee. Validation: Hye-Bin Jang, Joon Kyoo Lee. Visualization: Joon Kyoo Lee. Writing—original draft: Hye-Bin Jang. Writing—review & editing: Joon Kyoo Lee.

ORCIDs

Hye-Bin Jang https://orcid.org/0000-0001-6174-5557
In Seok Kang https://orcid.org/0009-0003-5505-1120
Hyeong Seok Lee https://orcid.org/0009-0004-9190-671X
Joon Kyoo Lee https://orcid.org/0000-0002-7542-9616

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