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Closure of tracheocutaneous fistula using prefabricated conchal bowl cartilage and a supraclavicular flap

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Short Communication

Dr N Mundi takes responsibility for the integrity of the content of the paper

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Abstract

Background. Tracheocutaneous fistula represents one of the most troublesome complications of prolonged tracheostomy. Simple closure of a fistula can be ineffective, particularly in the context of prior surgery and adjuvant radiation. As such, modes of repair have expanded to include locoregional flaps and even free tissue transfers.
Objective. This paper describes a case of persistent tracheocutaneous fistula in an irradiated patient who had undergone previous unsuccessful attempts at repair.
Method and results. The use of regional fasciocutaneous supraclavicular flap with prefabricated conchal bowl cartilage resulted in successful closure of the tracheocutaneous fistula.
Conclusion. This represents a novel technique for closure of such fistulas in patients for whom previous attempts have failed. This mode of repair should be added to the surgeon's repertoire of reparative techniques.

Introduction

Tracheostomy is indicated in selected patients undergoing treatment of head and neck cancers, either at the time of surgery or during irradiation. Patients who have received prior multimodality therapy are at an increased risk of persistent tracheocutaneous fistula, and simple closure of the tracheocutaneous fistula can be ineffective in a subset of this patient population.[1]

This report focuses on a 54-year-old male with a history of tumour–node T_4N_1 stage squamous cell carcinoma of the mandible, treated with primary surgery and free flap reconstruction (including tracheostomy). Following surgery, he was treated with adjuvant radiation of a standard dose and duration, and was decannulated with appropriate closure of the tracheostomy site by secondary intention. His recovery was complicated by mandibular plate extrusion and prolapse of the lower lip. He also strongly desired implant-based dental rehabilitation, for which his original fibula provided insufficient bone stock. As such, he underwent a second surgical procedure to reconstruct the mandible with a free fibular osseocutaneous tissue transfer, which also included a tracheostomy. His in-patient postoperative course was uneventful and he was decannulated prior to discharge.

At follow up, the patient was observed to have a persistent tracheocutaneous fistula. He was taken back to the operating theatre for repair of the tracheocutaneous fistula. The tracheal defect itself was closed. Bilateral, pedicled sternohyoid rotational flaps were used to bolster the repair. Unfortunately, the patient suffered a surgical site infection. This led to a breakdown of the repair and the trachea itself, leaving a 3 cm tracheocutaneous fistula (Figure 1). A return to the operating theatre was then planned, for staged repair using conchal bowl cartilage and a supraclavicular flap.

Materials and methods

During the first stage of repair, a 2 cm × 3.5 cm conchal bowl cartilage graft was harvested from the patient's left ear (Figure 2). The right transverse cervical artery was then identified with Doppler ultrasound, and traced over the clavicle and acromioclavicular joint. A 5 cm × 5 cm wedge-shaped area at the distal aspect of the planned supraclavicular flap was then elevated (Figure 3). The cartilage graft was then placed within this tissue pocket with the convex side down, and was fixed to the underlying fascia using monofilament suture. Closure of the skin was then performed.

The second stage of repair took place three weeks later. This entailed the harvest of a 2 cm × 3 cm section of septal mucosa. Next, the course of the right transverse cervical artery was traced using Doppler ultrasound. The supraclavicular flap was partially raised and the cartilage was located by palpation. The mucosal graft was then centred over the cartilage graft and secured into place with monofilament sutures. A bolster dressing was subsequently placed over the surgical site.

The third and final stage of repair occurred after a further three weeks had passed. The patient was taken to the operating theatre and intubated transorally. Once again, the

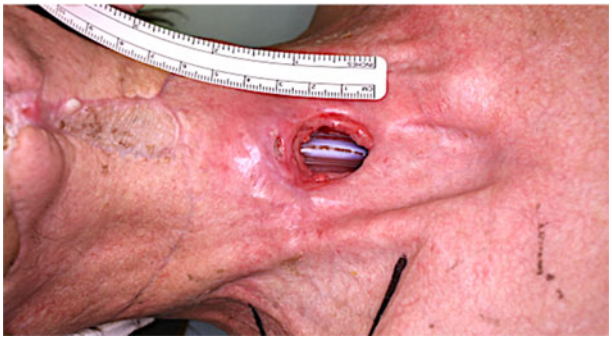

Fig. 1. Persistent tracheocutaneous fistula.

Fig. 2. Conchal bowl cartilage graft.

course of the transverse cervical artery was traced out and marked. The supraclavicular flap containing the conchal cartilage and septal mucosa graft was then elevated from distal to proximal, with care taken to preserve its blood supply (Figure 4).

A subcutaneous tunnel was then created between the proximal portion of the flap and the site of the tracheocutaneous fistula. Once the edges of the tracheocutaneous fistula were freshened, the cartilage graft was sutured into place, with the septal mucosa and concave surface facing inwards, achieving watertight closure (Figure 5).

A split thickness skin graft from the thigh was used to cover the de-epithelialised portion of the flap. The supraclavicular donor site was closed primarily. The patient was transferred to the intensive care unit, where he was kept anaesthetised and intubated for 7 days. Extubation was carried out successfully at the end of this period.

Results

The patient's post-operative course was uneventful. The follow-up visits over the two years since surgery have revealed

Fig. 3. Tissue pocket to house conchal bowl cartilage graft. *Partially elevated supraclavicular flap; **acromioclavicular joint; ***trapezius muscle

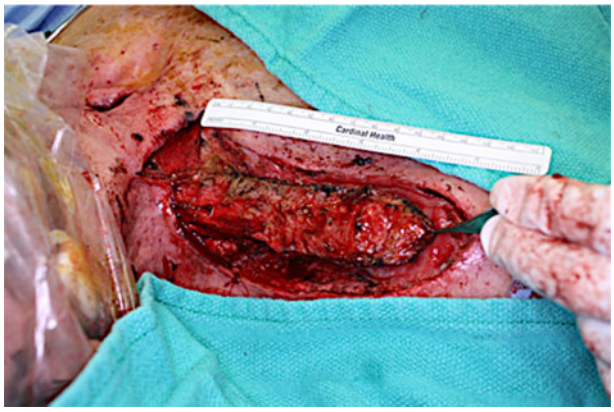

Fig. 4. De-epithelialised supraclavicular flap with conchal bowl cartilage and septal mucosa graft visualised at distal edge.

no dehiscence of the tracheocutaneous fistula repair and no signs of persistent fistulisation (Figure 6). The supraclavicular donor site has healed well, with no residual effect on shoulder function.

Discussion

Tracheocutaneous fistula rates in the paediatric population range from 11 to 43 per cent after decannulation.[2–4] However, this is not the case in adults, as most tracheostomy sites do heal without a persistent tracheocutaneous fistula. Small tracheocutaneous fistulas can be managed conservatively with excision of the fistulous tract, followed by simple or multi-layered closure with local rotational flaps including sternocleidomastoid, sternohyoid, platysma and skin flaps. When a large portion of the anterior tracheal wall is missing, a cartilage graft may be used for closure and support. In a patient such as ours, with multiple previous tracheostomies and irradiation to the head and neck, local tissue healing is often ineffective, leading to frequent wound breakdowns.

One of the options for repair of a tracheocutaneous fistula is to excise the tract and complete an end-to-end anastomosis of the tracheal ends.[5,6] In patients who have undergone previous irradiation and have demonstrated poor wound healing, this is a high-risk surgical option. For the same reasons, local flaps often fail in these patients.

Jackson and Babcock, in 1934, described a lined, bipedicled flap reinforced with conchal cartilage for tracheocutaneous fistula.[7] Since then, there have been various reports of using

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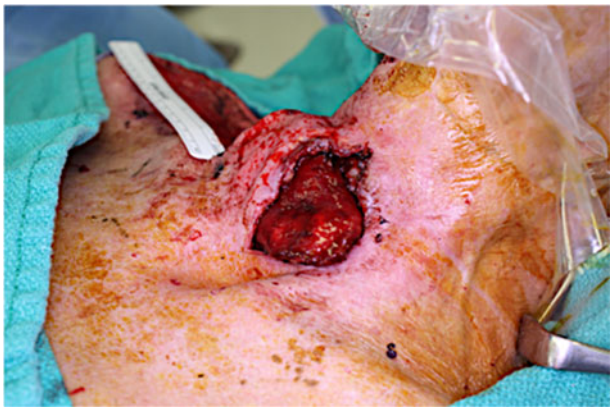

Fig. 5. Inset of supraclavicular flap with cartilage and septal graft (on deep surface) into tracheocutaneous fistula site.

Fig. 6. Photograph of patient at post-operative follow up.

a combination of local or free flaps with or without cartilage for repair of tracheocutaneous fistula.[8–14]

Fasciocutaneous flaps with prefabricated cartilage to provide anterior wall support have been described. Shinohara *et al.* first described the use of a deltopectoral flap with costal cartilage and a palatal mucosal graft for the repair of tracheal stenosis. In the two cases they presented, the patients did not undergo irradiation, and the exact defect size was unclear but was at least 35 mm. Riedel *et al.* described the use of a deltopectoral flap with auricular cartilage.[14] Their series included two patients who had previously undergone irradiation, in whom the tracheocutaneous fistula was successfully closed with the deltopectoral flap. Royer *et al.* described the use of a radial forearm free flap with conchal cartilage and buccal mucosa for tracheocutaneous fistula closure.[11] The patient had undergone previous irradiation to the neck, but the vascular anatomy was unaltered, thus allowing for a free flap.

Costal cartilage has also been used previously to support the anterior tracheal wall in the closure of large tracheocutaneous fistulas. As outlined by Royer *et al.*, costal cartilage for a short segment defect is not ideal as it does not have the natural curve of the native tracheal cartilage. Additionally, harvesting costal cartilage has associated potential complications, including pneumothorax, hemothorax and post-operative pain, resulting in atelectasis and pneumonia.

Here, we describe a novel technique using a supraclavicular flap with prefabricated conchal cartilage for the closure of a tracheocutaneous fistula in a previously irradiated patient. Additionally, the patient had undergone two previous free tissue transfers; as such, he had depleted neck vasculature, making an additional free tissue transfer challenging. The fistulous tract was excised, followed by a watertight tracheal repair. The curve of the conchal cartilage was oriented to support the anterior tracheal wall, with the concave aspect facing the interior aspect of the trachea. Use of conchal cartilage also avoided the use of costal cartilage, thus avoiding its associated complications. Given the widespread use and reliability of the supraclavicular flap, we believe this technique can be readily adopted for this rare problem.

Competing interests. None declared

References

1 White AK, Smitheringale AJ. Treatment of tracheocutaneous fistulae in children. *J Otolaryngol* 1989;**18**:49–52
2 Joseph HT, Jani P, Preece JM, Bailey CM, Evans JN. Paediatric tracheostomy: persistent tracheo-cutaneous fistula following decannulation. *Int J Pediatr Otorhinolaryngol* 1991;**22**:231–6
3 Mahadevan M, Barber C, Salkeld L, Douglas G, Mills N. Pediatric tracheotomy: 17 year review. *Int J Pediatr Otorhinolaryngol* 2007;**71**:1829–35
4 Tasca RA, Clarke RW. Tracheocutaneous fistula following paediatric tracheostomy--a 14-year experience at Alder Hey Children's Hospital. *Int J Pediatr Otorhinolaryngol* 2010;**74**:711–12
5 Rob CG, Bateman GH. Reconstruction of the trachea and cervical oesophagus; preliminary report. *Br J Surg* 1949;**37**:202–5
6 Grillo HC. Tracheal replacement: a critical review. *Ann Thorac Surg* 2002;**73**:1995–2004
7 Jackson C, Babcock W. Plastic closure of tracheocutaneous fistula. *Surg Clin North Am* 1934;**14**:199–221
8 Drezner DA, Cantrell H. Surgical management of tracheocutaneous fistula. *Ear Nose Throat J* 1998;**77**:534–7
9 Fujiwara T, Nishino K, Numajiri T. Tracheal reconstruction with a prefabricated and double-folded radial forearm free flap. *J Plast Recon Aesth Surg* 2009;**62**:790–4
10 Riedel F, Reinhart Goessler U, Grupp S, Bran G, Hormann K, Verse T. Management of radiation-induced tracheocutaneous tissue defects by transplantation of an ear cartilage graft and deltopectoral flap. *Auris Nasus Larynx* 2006;**33**:79–84
11 Royer AK, Royer MC, Ting JY, Weisberger EC, Moore MG. The use of a prefabricated radial forearm free flap for closure of a large tracheocutaneous fistula: a case report and review of the literature. *J Med Case Rep* 2015;**9**:251
12 Tatekawa Y, Yamanaka H, Hasegawa T. Closure of a tracheocutaneous fistula by two hinged turnover skin flaps and a muscle flap: a case report. *Int J Surg Case Rep* 2013;**4**:170–4
13 Teng MS, Malkin BD, Urken ML. Prefabricated composite free flaps for tracheal reconstruction: a new technique. *Ann Otol Rhinol Laryngol* 2005;**114**:822–6
14 Shinohara H, Yuzuriha S, Matsuo K, Kushima H, Kondoh S. Tracheal reconstruction with a prefabricated deltopectoral flap combined with costal cartilage graft and palatal mucosal graft. *Ann Plast Surg* 2004;**53**:278–81

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