

The Value of the “Papillon” Anterolateral Thigh Flap for Total Pharyngolaryngectomy Reconstruction: A Retrospective Case Series

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Purpose: The tubed, buried anterolateral thigh (ALT) flap is a popular reconstruction method for total pharyngolaryngectomy defects. The “papillon”-designed ALT flap, described by Hayden et al, offers an alternative method of using the ALT flap in this situation. We report our early experience with the papillon ALT flap in a patient cohort.

Patients and Methods: On retrospective review, all patients who underwent reconstruction of circumferential total pharyngolaryngectomy defects with the papillon ALT flap from February 2012 to February 2015 were identified from our departmental database. Demographic and clinical data, operative details, and complications were analyzed from the records.

Results: Seven patients were included in this study. The mean length of hospital stay was 15 days (range, 10 to 32 days). Acute complications occurred in 5 of 7 patients, namely, partial flap loss managed by a pectoralis flap (1 of 7 [14%]); an early pharyngocutaneous fistula (4 of 7 [57%]) managed by simple repair, wound packing, or delayed repair; and a donor-site hematoma (1 of 7 [14%]). At follow-up (range, 2 to 24 months), there was 1 stricture formation, but no chronic fistula. All patients were able to swallow orally.

Conclusions: Early results using the papillon ALT flap suggest that this technique is a viable alternative to the standard tubed ALT flap design. The advantages of this design include the following: 1) it offers simultaneous vascularized skin to resurface anterior neck skin deficiency without resorting to additional tissue elsewhere; 2) direct monitoring of the ALT flap is possible; and 3) any pharyngocutaneous fistula is exteriorized to the surface without compromising the internal neck structures and can be easily identified and repaired directly in the office.

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Total pharyngolaryngectomy (TPL) is a viable surgical option in the setting of advanced-stage primary and salvage laryngopharyngeal squamous carcinoma.¹ Anatomically, the surgical defect results in a permanent tracheal stoma with a circumferential discontinuity extending from the oropharynx to the cervical esophagus. Substantial tissue loss may be exacerbated when simultaneous adjacent muscle and overlying skin tis-

sues are resected en bloc to obtain oncologic clearance (Fig 1). TPL is often reserved for the salvage situation after failed chemoradiotherapy, and when combined with a history of chronic tobacco use or malnutrition, it can render tissues to have altered vascularity and a lower wound-healing potential.¹ As a result, TPL reconstructions are at higher risk of substantial complications such as infections and wound breakdown.

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FIGURE 1. Previous laryngectomy with recurrence including the overlying skin with planning for total pharyngectomy with the overlying skin and reconstruction with a papillon anterolateral thigh flap.

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Reconstruction of TPL defects with free tissue transfer has yielded good treatment outcomes,¹⁻³ and numerous donor sites have been described.⁴⁻⁷ The advantages of the anterolateral thigh (ALT) flap for TPL reconstruction include a large skin paddle, vascular pedicle reliability, and minimal donor-site morbidity with superior swallowing and voice outcomes.⁸⁻¹¹ When used to reconstruct circumferential pharyngolaryngectomy defects, the ALT flap is frequently fashioned in a tube to re-create continuity of the digestive tract, where the cutaneous surface forms the inner lining of the tube. This results in a “buried free flap,” making flap monitoring difficult, as well as requiring either secondary locoregional flaps, skin grafting, or excess vastus lateralis muscle harvesting in cases of substantial anterior neck skin loss.⁸ To overcome the need for additional tissue to resurface the reconstructed neopharynx, Hayden et al¹² described the “papillon” design with an ALT flap for reconstruction after TPL.

The purpose of this retrospective study was to evaluate our early results using the papillon flap design with respect to its ability to re-create a neopharynx, resurface the overlying neck skin, and re-establish

swallowing and voice function in this difficult patient cohort.

Patients and Methods

We performed a retrospective chart review to identify all patients who underwent reconstructive surgery for TPL defects by the papillon technique from February 2012 to February 2015 within the Department of Oral and Maxillofacial Surgery, University of Maryland Oncologic/Reconstructive database; the identified patients were included in this study. A 2-team approach was used, with the surgical resection being carried out by the Department of Otorhinolaryngology-Head and Neck Surgery and the surgical vascularized flap reconstruction being performed by the Department of Oral and Maxillofacial Surgery. Data collected included patient demographic characteristics, pathology findings, operative details, and postoperative complications. Specific questions regarding the rate of fistula formation, swallowing function, voice rehabilitation, need for further corrective procedures, and methods to improve on surgical technique or avoidance of complications were to be analyzed.

This retrospective chart review was approved by the University of Maryland Institutional Review Board for ethical human research.

Results

PATIENT DEMOGRAPHIC DATA AND PERIOPERATIVE DETAILS

Ten patients who underwent TPL with ALT flap reconstruction were identified from the database. Seven patients with circumferential defects managed with a papillon ALT flap were eligible for this study. Three patients were excluded because a non-papillon ALT design was used to reconstruct the defect. There were 6 men (86%) and 1 woman (14%), with a mean age of 61 years (range, 42 to 77 years). The clinical diagnosis was primary ($n = 3$) or recurrent ($n = 4$) squamous cell carcinoma. All recurrent cases had received previous radiation (with or without chemotherapy), and 3 cases also underwent prior surgical intervention. Five patients underwent bilateral selective neck dissection, and 1 patient underwent unilateral radical neck dissection. Follow-up ranged from 2 to 24 months after surgery (Table 1).

SURGICAL TECHNIQUE FOR RECONSTRUCTION OF PHARYNX AND ESOPHAGUS

The ALT skin perforators are identified using a handheld Doppler device, and an elongated hexagonal-shaped skin paddle is marked out incorporating the perforators (Fig 2). The ALT flap harvest has previously been described elsewhere.¹³ It is our practice to use the perforator technique during flap harvest when musculocutaneous perforators are present. A small cuff of vastus lateralis muscle is harvested around the perforators to protect the perforators and avoid vessel kinking. The motor branches of the femoral nerve are preserved whenever possible. Thinning of the ALT flap was not required in these cases.

The papillon design to reconstruct circumferential pharyngolaryngectomy defects as described by Hayden et al¹² is performed as follows: The ALT flap is laid on the prevertebral fascia oriented horizontally, with the skin surface facing upward (Fig 3). The central aspect of the flap superiorly is sutured to the posterior oropharynx, whereas the central portion of the flap inferiorly is sutured to the posterior esophagus. Suturing using simple interrupted No. 3-0 polyglactin sutures is performed meticulously with the knots placed on the cutaneous side of the flap. The flap is then tubed anteriorly as the sutures are placed circumferentially, until the two sides meet. At this point, an almost completely tubed structure is created. Where the two sides meet, a 2- to 3-cm strip is de-epithelialized from the superior to the inferior margin of both the left and right sides of the skin flap. This

enables anterior closure of the tubed neopharynx around a nasogastric tube (used as a guide), from the orostome superiorly to the esophagostome inferiorly, with the de-epithelialized ALT skin flap being sutured to itself (Fig 4). The remaining left and right portions of the ALT flap now radiate back to the left and right sides of the neck, akin to the wings of a butterfly, replacing the anterior neck skin. The additional fasciocutaneous tissue also provides closure of any dead space in the neck, additional waterproofing at the superior orostome and inferior esophagostome sutures, and bulk protection to major vessels in the neck. At the inferior end, the skin edges of the butterfly wings are sutured to the tracheostoma to complete the reconstruction (Fig 5). When possible, the tracheostoma is sutured to a separate horizontal incision within the inferior neck skin flap to help decrease the risk of a fistula at this site.

Vascular anastomoses are performed after partial flap inseting (suspended superiorly at the orostome/tongue base and secured inferiorly at the inferior esophagostome) to reduce flap ischemia time. Surgical drains are placed at wound closure, with Penrose drains usually being preferred to suction drains. The nasogastric tube is retained for feeding after surgery unless a gastrostomy tube is already present. Salivary bypass tubes are not customarily used. The ALT donor site was reconstructed with split-thickness skin graft in all cases.

POSTOPERATIVE CARE

All patients are admitted to the intensive care unit, where they are sedated overnight and gradually weaned the next day. Prophylactic antibiotics are prescribed in the first 48 hours postoperatively. A feeding tube is placed via percutaneous gastrostomy preoperatively or a nasogastric tube is placed intraoperatively to provide nutritional requirements, frequently starting on the first postoperative day. Free flap monitoring is easily performed with the use of a venous flow coupler (Synovis Micro Companies Alliance, Birmingham, AL), which is used for all venous anastomoses, along with direct visualization of the externalized flap wings (allowing for external arterial Doppler examination and the scratch test). An esophagram is obtained before oral feeding is attempted at 1 to 2 weeks postoperatively unless a salivary leak is identified clinically during hospitalization. If a clinical or radiographic leak or fistula is identified, wound care and repair are undertaken according to the site of the problem (Fig 6).

SWALLOWING AND VOICE REHABILITATION

Patients are evaluated by the speech and language pathology department during their hospital stay and in the outpatient setting. Transesophageal puncture

Table 1. CLINICAL DETAILS OF TOTAL PHARYNGOLARYNGECTOMY RECONSTRUCTED WITH PAPILLON ANTEROLATERAL THIGH FLAP

Case No.	Diagnosis	Site of Recurrence	pTNM	Flap Size (cm)	Anastomosis			Donor-Site Closure	Early Complications	Treatment	Days in Hospital	Swallow and Speech at Discharge	Status at Last FU
					Artery	Venous 1	Venous 2						
1	Recurrent SCC of larynx	Neopharynx	T3N0M0	20 × 11	ECA	VC to EJV	None	SSG	PCF	Repair of leak in office	10	Nothing by mouth, NGT	A&DF
2	Recurrent SCC of supraglottis	Hypopharynx	T3N0M0	20 × 11	TCA	VC to IJV	VC to IJV	SSG	PCF	Delayed repair in OR	14	Nothing by mouth, NGT	A&DF
3	SCC of larynx	NA	T4aN1M0	15 × 8	FA	VC to CFV	None	SSG	Partial flap necrosis	Salvage flap and pectoralis major flap	32	Nothing by mouth, Gtube	A&DF
4	SCC of larynx	NA	T4aN2cM0	15 × 10	FA	VC to IJV	VC to IJV	SSG	None	NA	20	Oral diet, VP	AWD
5	SCC of supraglottis	NA	T4aN2cM0	15 × 10	FA	VC to CFV	VC to IJV	SSG	None	NA	10	Nothing by mouth, Gtube	A&DF
6	Recurrent SCC of larynx	Larynx	T4aN0M0	15 × 10	FA	VC to IJV	None	SSG, VAC	PCF	Packing of leak and late bleed with re-exploration	14	Nothing by mouth, NGT	AWD
7	Recurrent SCC of larynx and tongue	Supraglottis	T4aN0M0	16 × 8	TCA	VC to IJV	None	SSG, VAC	PCF, hematoma at donor site	Repair of leak in office; evacuation of hematoma	8	Nothing by mouth, Gtube	AWD

Abbreviations: A&DF, alive and disease free; AWD, alive with disease; CFV, common facial vein; ECA, external carotid artery; EJV, external jugular vein; FA, facial artery; FU, follow-up; Gtube, gastrostomy tube; IJV, internal jugular vein; NA, not applicable; NGT, nasogastric tube; OR, operating room; PCF, pharyngocutaneous fistula; SCC, squamous cell carcinoma; SSG, split-thickness skin graft; TCA, transverse cervical artery; VAC, wound suction device; VC, vena comitans; VP, voice prosthesis.

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FIGURE 2. The skin paddle resembles an elongated hexagon with the perforators located in the center of the paddle.

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is performed selectively, and major consideration is given to prior treatment received. We prefer to delay transesophageal puncture or voice prosthesis use for at least 6 to 8 weeks to prevent potential wound breakdown at the suture lines from the high pressures generated when the voice prosthesis is in use.

PATIENT OUTCOMES

The mean hospital stay was 15 days (range, 10 to 32 days). There were no perioperative deaths, and there was 1 case of partial flap loss on a lateral wing of the papillon design, due to venous congestion, requiring flap salvage surgery on postoperative day 2. This was reconstructed with a pedicled pectoralis flap. In 1 patient a donor-site hematoma developed and was evacuated before hospital discharge.

A pharyngocutaneous fistula (PCF) occurred in 4 previously radiated patients. In 2 cases the PCF was seen at the suture line of the papillon tube inferiorly at the junction above the tracheostoma and confirmed on postsurgical esophagrams. The PCFs were easily

repaired in the office with the patients under local anesthesia. In the third case, the PCF was identified clinically at 6 days postoperatively and was successfully managed by local wound care over a period of 2 weeks. In this patient a postoperative bleed developed at 1 month at the site of packing and required re-exploration. In the fourth patient, 2 fistulae developed from the proximal end of the neopharynx and were confirmed on a modified barium swallow study on postoperative day 13. The patient was kept on tube feeding and returned 1 month later to have the fistulae directly closed under general anesthesia.

One patient was discharged home on a soft oral diet and received a voice prosthesis. All 6 other patients were exclusively on tube feeding (nasogastric in 3 and gastrostomy in 3) and had a Blom Singer laryngectomy tube (Inhealth Technologies, Carpinteria, CA) in situ. Further radiotherapy treatment was required in 4 of 7 patients, and this treatment was delayed in 1 patient because of delayed closure of the PCF.

On subsequent outpatient follow-up (range, 2 to 24 months), 4 patients are alive and disease free and 3

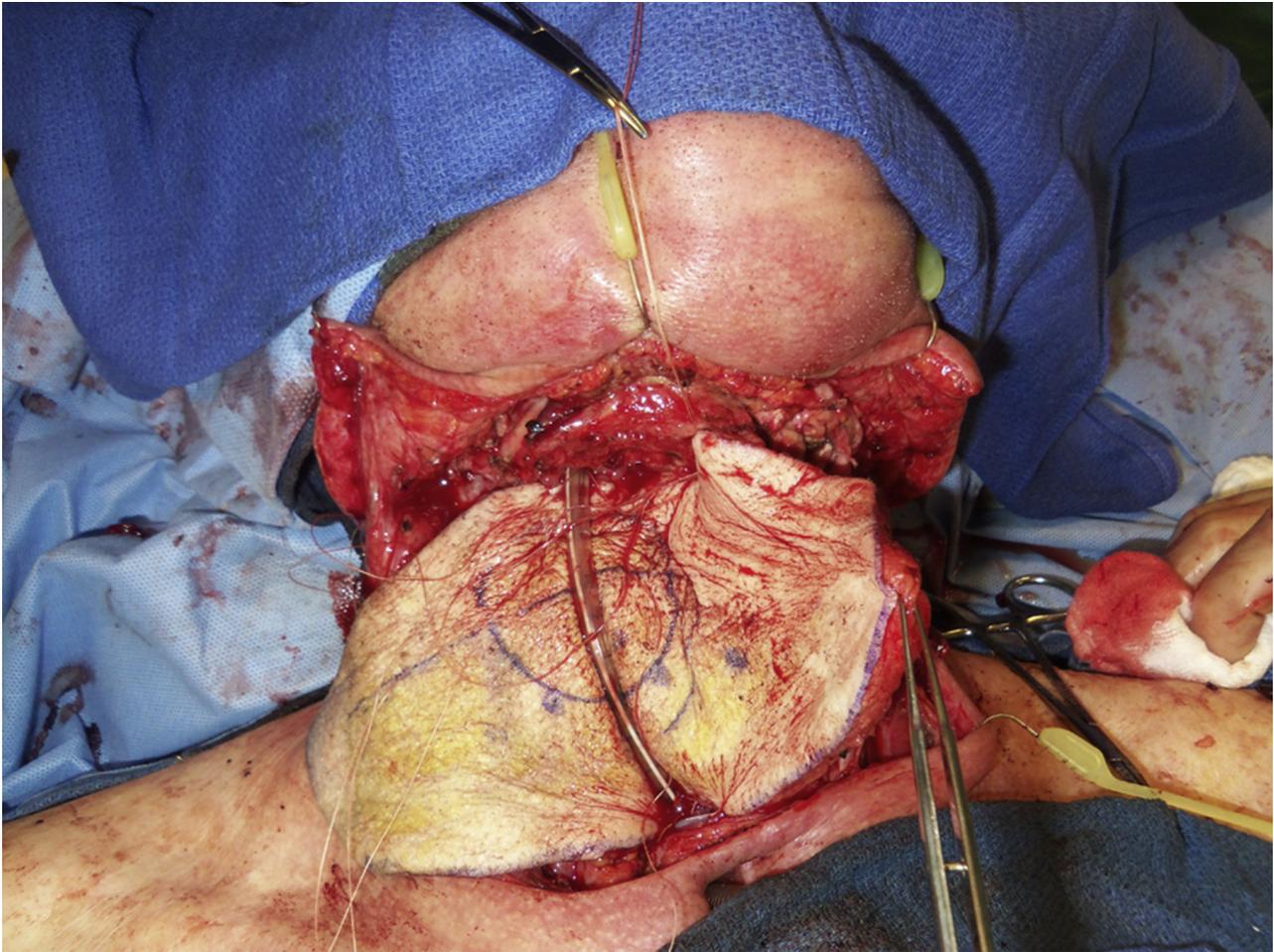


FIGURE 3. Papillon anterolateral thigh flap inseting: At the superior part of the defect, the central aspect of the flap is sutured to the posterior oropharynx, whereas the central portion of the flap inferiorly is sutured to the posterior esophagus before vascular anastomoses. The nasogastric tube is used as a guide.

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patients are alive with disease. All 7 patients are tolerating an oral diet. One patient required neopharyngeal dilation for a late stricture at the site of a previous PCF. Two patients were using an electrolarynx for speech, and 2 patients were using a voice prosthesis.

Discussion

The goal of circumferential pharyngolaryngectomy defect reconstruction is to re-establish a passive intact conduit from the oropharynx to the cervical esophagus.^{9,14} Several designs have been used with the ALT flap,¹⁰ but the most frequently used design is the buried, tubed ALT flap.^{2,11,15-17}

Hayden et al¹² originally described the papillon-designed ALT flap. There are 3 major advantages of the papillon-designed ALT flap for circumferential pharyngolaryngectomy reconstruction. First, the “wings” of the papillon flap enable direct, synchronous resurfacing of the external skin defect, without

the need for a second flap, especially in cases of loss of external skin because of disease or reduced skin laxity that causes difficulty in neck skin closure (eg, irradiated tissue). Second, the externalized skin paddle allows for direct monitoring of flap viability without relying on implantable devices. Third, the main vertical suture line of the neopharynx is placed externally, thereby enabling any potential leak to be drained outward. This avoids the likelihood of any infection collecting in the deep neck or mediastinum. The externalized leaks can be easily repaired under direct vision even in the ambulatory setting.

We highlight some technical points based on our early experience using the papillon-designed ALT flap. The shape of the skin paddle resembles an elongated hexagon (Fig 2). The vertical (caudal-cranial) dimension of the skin paddle considers the amount required to enable circumferential folding in of the skin paddle according to the diameter of the proximal end of the defect, as well as the amount of neck skin



FIGURE 4. Papillon anterolateral thigh flap inseting: At the point where the 2 sides meet, a 3-cm strip is de-epithelialized from the superior to the inferior margin of both the left and right sides of the skin flap. This enables anterior closure of the tubed neopharynx around the nasogastric tube. The closure is performed in 2 layers (ie, luminal surface and external skin surface).

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that needs to be resurfaced. When one is closing the vertical part of the neopharynx, a slightly wider lumen is provided to accommodate for postoperative contracture. Taking the circumference of the proximal defect to be approximately 9.5 to 12.5 cm (diameter of 3 to 4 cm $\times \pi$) plus a 2- to 3-cm strip of de-epithelialized area to accommodate the vertical suture line, the surgeon harvests the remaining vertical length of the skin paddle (ie, the papillon wings) to adequate length to enable resurfacing of the neck skin defect. There is relatively more skin paddle in the inferior end of the neck for resurfacing because the diameter of the cervical esophagus is smaller than the proximal end (diameter of 1.6 to 2.4 cm).¹⁸ The horizontal skin paddle dimension accounts for the vertical height of the defect (approximately 10 to 12 cm), from the level of the base of the tongue to the cervical esophagus.

The ALT flap vascular pedicle is generally noted for its length and caliber. As in all microvascular flap surgical

procedures, care must be taken to ensure proper configuration of the pedicle and perforators to avoid any kinking or twisting resulting in vascular compromise.

Some studies have reported a reduced incidence of PCFs with the placement of a salivary bypass stent or use of a reinforced layer of flap fascia in the conventional tubed ALT.^{2,8,11,15,17,19} In our series a salivary bypass tube was not used because it was believed that it could place undue pressure on the suture line. Redundant fascia provided in the papillon design was used to reinforce the proximal site (tongue base or piriform sinus), a known high-risk site for PCF development.^{8,16,19} Regardless of technique, PCF remains a common complication after TPL. Although multifactorial in etiology, an important predictive factor for PCF is exposure to radiotherapy.^{20,21} The use of vascularized tissues may improve the wound-healing capacity of irradiated tissues.² A recent large multicenter outcome study of fistula occurrence after salvage laryngectomy



FIGURE 5. Final wound closure. The remaining left and right portions of the anterolateral thigh flap radiate back to the left and right sides of the neck, akin to the wings of a butterfly, replacing the anterior neck skin. At the inferior end, the skin edges of the butterfly wings are sutured to a small bridge of tissue above the tracheostoma. A Penrose drain was used on the side of the vascular anastomoses, whereas a suction drain was used on the contralateral side.

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suggested that the use of vascularized flaps does not completely diminish the incidence of PCF, but simply reduces the time it takes for the PCF to heal.²² This also is reflected in the observation that PCF in the presence of vascularized tissues can spontaneously heal during chemoradiation.⁸

In our series PCFs occurred in 4 of 7 patients (57%), all previously radiated. This rate is similar to that reported with the papillon ALT flap (3 of 6 [50%]), which was comparable with the tubed flap group (4 of 8 [50%]) reported by Hayden et al.¹² Although 43% to 50% PCF rates are higher than those reported with other conventionally tubed ALT flaps (8.3% to 50%), the total number of papillon ALT cases is comparatively smaller ($n = 13$) than that of conventionally tubed ALT cases ($n = 227$).^{2,8,10-12,15-17} Despite this slightly higher rate of PCF, the outcome was not negatively affected because the papillon design allowed for easy identification, externalization of the leak, and repair. Two patients underwent repair in

the ambulatory office setting, and one patient healed with local wound care alone. Only 1 patient required repair under general anesthesia. Late PCFs were not observed in our series despite being reported in conventionally tubed ALT cases.^{8,15}

All patients had commenced normal oral feeding and speech rehabilitation by 9 months. The cautious approach to early oral feeding undertaken by us has been observed in other series, in which oral intake was withheld until a modified barium swallow study was undertaken at 2 to 6 weeks after surgery.^{8,11} Interestingly, late stricture formation was observed in 1 patient (14%) at 20 months postoperatively. An early leak developed in this patient, requiring office-based repair as well as receiving subsequent reirradiation for recurrent disease. Swallowing improved with a secondary dilational procedure. The low rate of strictures also may be related to the suture technique during the folding method during flap inset at both the proximal and distal ends of the neopharynx. Our

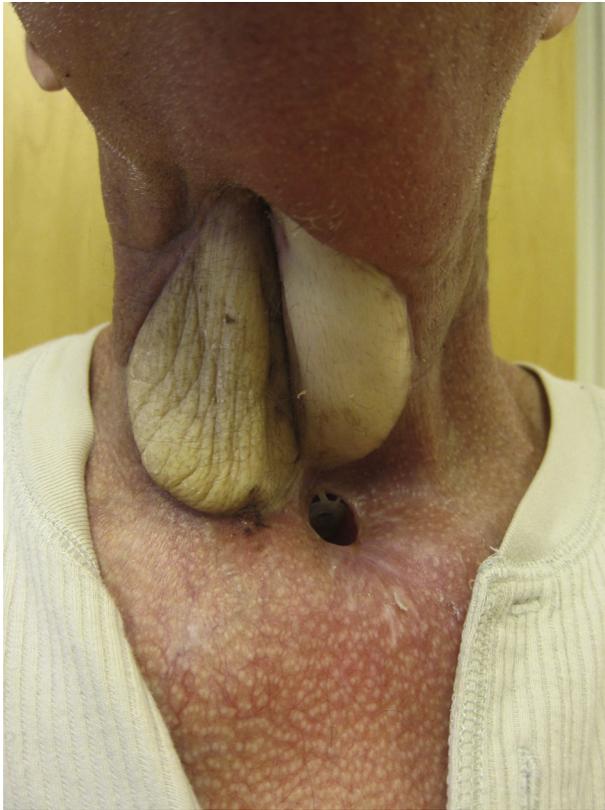


FIGURE 6. An early pharyngocutaneous fistula occurred in the vertical section of the neopharynx, and the leak was externalized. This was repaired in the clinic with the sutures left in situ on day 45 postoperatively. Complete healing was achieved on day 57 postoperatively (as shown in the photograph), with the primary transesophageal puncture and voice prosthesis in place.

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stricture outcomes will be clearer with longer-term follow-up and with the results of an ongoing prospective outcome study of pharyngolaryngectomies at our institution.

The weaknesses of this study include its small sample size and retrospective nature. Further improvements can be made with longer-term follow-up and a prospective trial comparing the conventional tubed vascularized ALT flap with the papillon ALT technique.

The papillon-designed ALT flap for a total circumferential pharyngolaryngectomy defect is a viable alternative to the conventional tubed ALT flap. The main technical point of the papillon design is the method of flap in-folding during flap inseting to create a neopharynx, which forms the central body of a butterfly in the midline of the neck, with the wings of the butterfly being located laterally. The main advantage of this design is that it allows for simultaneous resurfacing of neck skin defects, direct monitoring of the flap, and externalization of the vertical suture line of the neopharynx directed externally.

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