



ORIGINAL ARTICLE

Laryngeal and Pharyngeal Reconstruction: A Worldwide Review of the Current Guidelines and Standards of Practice. Does a Universal Reconstruction Algorithm Exist?

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Abstract

Introduction: The reconstruction of hypopharynx and larynx post ablative surgery has been always a demanding challenge. Not only the restoration of the anatomy and achieving robust wound healing, but also the complexity of function in the area for the airway and upper digestive tract not to be compromised. Moreover, the age of this group of patients and perioperative radiotherapy adds to the existing obstacles in reconstruction.

The evolution of microsurgery and free tissue transfer replacing the previous gold standard pedicled flaps revolutionized the head and neck reconstruction.

It became a necessity to elicit how far the head and neck reconstruction practice has gone around the globe and what is considered the gold standard technique for reconstruction of each of the defects encountered at the present time.

We performed a systematic review appraising the current head and neck reconstruction practice around the world aiming at concluding the gold standard methods of reconstruction of the defects in this area.

Methods: Search strategy: Medline using the PubMed interface on 1st of October 2020.

Results and search outcome: 236 papers were found. Of which 66 publications in the last 10 years were shortlisted reflecting the most recent practice. 20 of these were identified addressing the reconstructive approach [Figure 1](#).

Conclusions: Various reconstructive methods are reliably used in certain indications with comparable results around the globe. We present an unprecedented evidence-based universal algorithm for post ablative surgery reconstruction for the laryngeal and pharyngeal defects.

Keywords

Exp larynx reconstruction, Pharynx reconstruction, Tumour, Oncology

Discussion

In the field of reconstructive plastic surgery one of the most technically challenging and demanding topics following oncological resection is the hypopharynx and laryngeal reconstruction. Laryngeal and hypopharyngeal defects following ablative procedures can result in complex deficits with possible detrimental effects from a medical and a social point of view. Larynx is the second most common site of upper aerodigestive tract malignancies in which cases wide excision of the local structures is required, resulting in clinically significant defects of varying extent [1]. A variety of techniques have been utilized to provide the adequate result. Modern advances in reconstructive plastic surgery have significantly improved the options in the armamentarium of the surgeon to offer the most suitable and functional result. These include both free and local flaps. However, each form of reconstruction apart has its own advantages and disadvantages which can affect the final choice of reconstruction depending on the deficit and the patient.

Small pharyngeal defects with remnant pharyngeal mucosa width of > 3.5 cm can be effectively dealt



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Author, date and country	Patient group	Level of evidence	Outcomes	Key results	Study weaknesses
Ragbir M, Brown JS, Mehanna H 2016 May UK.	Patients with Post tumor ablative surgery in head and neck require reconstruction	UK Guidelines Level 1	Vascularized flap reconstruction decrease PCF rates after salvage TL.	Free flaps should be the first reconstructive option in most defects especially circumferential pharyngo-oesophageal reconstruction.	Needs auditing against global guidelines.
van Brederode TD ¹ , Halmos GB ² , Stenekes MW ³ . 2017 Feb The Netherlands.	64 58 patient from 1992 to 2014 underwent hypo pharyngeal reconstruction for laryngeal/pharyngeal carcinoma using pedicle pectoralis major, radial forearm free flap and free ALT flaps, were reviewed 1 year post-operative for food passage assessment	56 Observational Study Level 3	— 51 patients survived the 1 year follow up. 25% returned to solid diet. 40% returned to semisolid diet. 20% remained feeding tube dependent. 35% developed pharyngeocutaneous fistula	Free flaps are superior to pectoralis major pedicle flap. Near circumferential defects, higher MBI and absence of co-morbidities yielded better functional outcome.	Follow up limited to 1 year only. Relatively small cohort of patients. Consider only ALT, Free Radial forearm flap and pedicle pectoralis major flaps.
Li CJ ¹ , Cheng L ¹ , Wu H ² , Tao L ¹ , Zhou L ¹ . 2017 Jan China	15 male patients post standard and non-standard laryngectomy (epiglottis conserved) had a neoglottis reconstruction using sternohyoid muscle on upper tracheal orifice	Not clear	14 patients achieved satisfactory result 4 patients had severe complications including aspiration erroneous deglutition The neoglottis had to be closed in 3 patients The stomach catheters were removed successfully in 11 patients	Sternohyoid muscle can be used successfully to reconstruct the neoglottis and restore satisfactory voice function post laryngectomy	Small cohort of patients Unclear study protocol. No details of patients comorbidities.
Rovó L ¹ , Bach Á ¹ , Sztanó B ¹ , Matievics V ¹ , Szegedi I ² , Castellanos PF ³ . 2017 May Hungary, USA	4 patients post low grade laryngeal chondrosarcoma had rotational thyro-tracheopexy reconstruction post cricoidectomy to restore a complete functional cartilaginous ring +endoscopic arytenoid abduction lateropexy were followed up for subjective and objective assessment.	Retrospective study Level 3	Tumour-free margins were obtained. Voice function was satisfactory for social communication in the four patients. Oral feeding was achieved in three patients. Decannulation in all four patients successfully after 3 weeks.	Total and subtotal cricoidectomy can substitute laryngectomy in cricoid cartilage chondrosarcomas with adequate airway functions restoration including breathing, voice and swallowing with good control of oncology.	Small cohort group. Limited indication to cricoid only lesions. Low grade chondrosarcoma only included. More details required if pharynx is involved.
Süslü N ¹ , Şefik Hoşal A ² . 2016 Oct Turkey	602 patient post laryngectomy+/- partial pharyngectomy with primary closure of the pharyngeal defects between 1990-2014	Retrospective study Level 3	12% had pharyngeocutaneous fistula. Nasogastric tube was not used in 99.8% Oral feeding commenced	Early oral feeding is safe and does not increase the risk of PCF formation post total laryngectomy	Limited to small pharyngeal defects that was primarily repaired. Excluded patients who had radiotherapy/chemotherapy.

	excluding patients more complex reconstruction techniques and patients with radiotherapy/chemotherapy history were reviewed for the incidence of pharyngeocutaneous fistula formation and relation to early oral feeding		within 3 days post-surgery in 95.7% of the patients. 11.8% of patients who did not have NGT had PCF compared to 15% of patients who had NGT in place.		
Wu Y ¹ , Li D ² , Li Z ¹ , Liu W ¹ , Wang X ¹ , Xu Z ¹ . 2015 Sep China	56 cases of cervical oesophagus +/- hypopharynx cancer had pharyngo-gastric anastomosis using pulled-up stomach + free jejunal transfer or laryngo-tracheal flap if pulled-up stomach cannot reach the	Case series Level 4	PDF in one case where laryngo-tracheal flap was used which healed conservatively in 2 weeks. 1 case died 3 years later due to metastasis who had laryngo-	Post hypopharynx and cervical oesophagus excision, reconstruction can be achieved through pulled-up stomach + free jejunal transfer or laryngo-tracheal	Unclear study protocol. Unclear patient comorbidities. No clear mention of complications of free jejunal combined reconstruction group
	oropharynx from 6/2010-6/2014		tracheal flap. 1 case had laryngotracheal flap had cervical LN recurrence after 2 years.	flap if the pulled-up stomach could not reach the oropharynx	
Man P, Chen J, Huang W, Bao R, Li J, Wang J, Xie L, Zhong W, Zhang H. 2015 Aug China	38 patients with hypo pharyngeal cancer reconstructed with submental island flap.	Retrospective study Level 3	100% flap survival 52% 5 year patient survival rate. 7 patients died of another primary cancer. 11 died of recurrence.	Submental flap is an easier reliable option with less comorbidity for hypopharynx reconstruction with laryngeal function preservation.	Level of evidence Patient comorbidities documentation. Unclear mentioning about the extent of the hypo pharyngeal carcinoma.
Ye F, Fu M, Chen G, Xu J, Kang H. 2015 Apr China	13 patient with near circumferential hypopharynx cancer following excision with laryngeal function unpreserved had reconstruction with submental flap	Case series Level 4	100% flap survival rate. 2 cases had PCF. All patients had normal swallowing function. 3 cases had cervical LN recurrence. 3Cases survived post 3 years.	Submental flap is reliable option for reconstruction of near circumferential defects of the hypopharynx	Unclear study protocol. No mention of patient's comorbidities.
Zhang W, Li M, Liu N, Chen F, Meng Q. 2015 Apr China	22 patients had larynx/pharynx cancer had reconstruction using pectoralis major pedicle flap supercharged by thoracoacromial and lateral thoracic vessels.	Prospective study Level 2	100% flap survival rate. 2 cases had PDF treated conservatively. 21 cases had post-operative radiotherapy with no secondary flap necrosis. 1 case of anastomotic stenosis. 1 case out of 13 had	Double pedicle pectoralis major flap is reliable reconstruction operation for laryngeal and pharyngeal defects	Unclear study protocol. Unclear defect size, location documentation. Donor site comorbidities not mentioned

				laryngeal function preserved had tube wearing. Extubation rate was 92.3%	
Kucur C ¹ , Durmus K ² , Ozer E ² . 2015 Apr Turkey, USA	67 year old female with pharyngeal and floor of the mouth cancers with preoperative radiotherapy prevented local ipsilateral reconstructive solutions had	Case report # Level 4	Flap survived	When local tissue is not suitable as recipient or donor sites, supraclavicular flap can be easy feasible and reliable option that can reach the contralateral	Limited literature available. Low evidence.
Li W, Yang L, Chen M, Zhu J, Yuan L, Gu D. 2014 Dec China	contralateral side supraclavicular island flap 11 cases of hypopharynx cancer with cervical oesophagus involved had post resection reconstruction using laryngo-tracheal flap if the circular structure was preserved and was combined with pectoralis major flap when only part of the pharynx/larynx was preserved (8/11)	Prospective study Level 2.	1 case of PCF 1 case of Chylous fistula. No anastomotic stenosis. 5 patients had metastasis in 3 year follow up. 54.5% survival rate.	pharynx/larynx defects. Laryngo-tracheal flap is recommended to reconstruct the hypopharynx and oesophageal cancer after resection	Unclear study protocol. No patient comorbidities documentation.
Tsai WC ¹ , Yang JM ² , Liu SC ¹ , Chu YH ¹ , Lai WS ^{1,3} , Lin YS ⁴ , Lee JC ^{5,6} . 2015 Dec Taiwan	36 patients with cancer in the head and neck area including 8 in the pharynx, 2 in the larynx had post resection reconstruction with submental myocutaneous flap	retrospective study Level 3	All donor sites were closed primarily. 2 cases of flap marginal necrosis	Reliable pedicle. Minimal donor site morbidity. Ideal for small-medium size defects in head and neck areas.	Low evidence. Unsuitable for large defects.
Yan D ¹ , Zhang B ² , Li D ¹ , Li Z ¹ , Liu W ¹ , Xu Z ¹ . 2014 Jul China	13 patients had SCC of posterior wall of hypopharynx, 1 had submental flap, 1 had supraclavicular flap, 1 had skin graft, 1 had ALT, and 3 cases had free radial forearm flap for laryngopharyngeal reconstruction.	Retrospective case review Level 3	51.6% survival rate. 3 PDF 1 SSI 1 wound effusion. 100% decannulation rate. 100% achieved oral feeding.	Different flaps can reconstruct larynx/pharynx after posterior wall hypopharyngeal SCC excision with satisfactory function and quality of life.	Unclear size of the defect and flap choice parameters.
Zeng Z ¹ , Xiao S ² , Zhao E ¹ , Qin Y ¹ , Wang Q ¹ , Shen H ¹ . 2014 Jul China	20 patient with SCC of the hypopharynx had function preserving total/subtotal hypopharyngectomy +/- partial laryngectomy and post-operative Radiotherapy	Retrospective case review Level 3	80% tracheal tube removal within 60 days. Speech function remained in all patients	In advanced hypopharynx cancer, patient can maintain speech and swallowing function through total/subtotal hypopharyngectomy +/- total subtotal laryngectomy	Low cohort. No documentation of reconstruction approached used. No clear definition of staging of the advanced carcinomas included

				and functional reconstruction	
Jin T ¹ , Li X, Lei D, Liu D, Yang Q, Li G, Pan X. 2014 Jun China	485 patients had hypopharynx cancer. 337 treated with laryngeal functional preservation techniques (237	Comparative retrospective review	Patients with LF preserving had better overall survival rate and lower mortality	Preserving LF when possible improves quality of life and decreases morbidity and mortality rates.	Many bias including staging of the tumours allowing for LF preserving or not and affecting the survival rate.
complete and 100 partial preservation) and 148 without preserving it.		Level 3			
Timmermans AJ ¹ , Lansaat L, Theunissen EA, Hamming-Vrieze O, Hilgers FJ, van den Brekel MW. 2014 Mar Netherlands	217 patients had total laryngectomy charts were reviewed to identify incidence of PCF and risk factors associated with it and its value as prognostic factor on overall survival rate.	Retrospective chart review	PCF overall Incidence was 26.3%. Post primary TL PCF incidence was 17.1%. After salvage TL, the incidence was 25.5%. After TL for a second primary was 37.5%. After TL for a dysfunctional larynx was 44%.	Predictive risk factors for PCF: Hypo pharyngeal cancer. Hypoalbuminemia. Previous chemotherapy. Extended resection. Pharyngeal reconstruction. 2 years overall survival was 48% in patients with PCF compared to 57 in patients without PCF.	No documentation of the tumour staging could be bias in the mortality and morbidity results.
Shen H ¹ , Zhao EM, Xiao SF, Qin Y, Jing ZB, Li TC. 2013 Jul China	24 cases of pharyngeal anterior wall had transhyoid approach and pectoralis major pedicle flap, radial forearm free flap and sternohyoid	Prospective study	Tumour clearance obtained in all cases. 3 patients had PCF. Tracheostomy tube was	In anterior wall tumours, the transhyoid approach is an effective approach.	Limited cohort. Limited reconstructive approached documentation.
myocutaneous flap reconstruction were recruited to reconstruct the tongue, skin and lateral pharyngeal walls.		Level 2			
removed in 1-6 months in 16 out of 17 cases. Good voice and swallowing function. Survival rate was 72.6% after 3 years.					
Lee JC ¹ , Lai WS, Kao CH, Hsu CH, Chu YH, Lin YS. 2013 Oct Taiwan	22 patients had submental flap reconstruction for head and neck post tumour resection defects were blindly reviewed with respect to donor site morbidities. Review parameters included Aesthetic, neck extension, beard look, smiling and whistling.	Retrospective study.	Average score rating was 8 on a scale from 0-9.	Submental flap has low donor site morbidity with high patient satisfaction	Relatively low cohort. Needs to be compared with other reconstructive techniques.
		Level 3			
Rothmeier N ¹ , Hoffmann TK, Lehnerdt G, Lang S, Mattheis S. 2013 Apr Germany	16 patients with recurrent T4a SCC of the larynx/pyriform sinus had salvage laryngectomy.	Prospective study	38% had fistula which required surgical intervention	Sandwich technique is effective in persistent fistula management.	Low cohort. Unclear study protocol.
		Level 2	Successful		

	Persistent fistulas were treated		closure of all persistent	
	surgically by sandwich technique using pectoralis major myofascial flap then LD or Deltopectoral skin flap on top.		cases after sandwich technique.	
Perez-Smith D ¹ , Wagels M, Theile DR. J Plast Reconstr Aesthet Surg. 2013 Jan Australia	368 Consecutive free jejunum reconstructions were performed for pharyngolaryngectomy defects between 1977 and 2010.	Retrospective review Level 3	Perioperative mortality was 3.8% and flap failure occurred in 2.98%. The incidence of anastomotic leak was 8.2% and stricture occurred in 10.9%. A full oral diet was maintained by 91.6% of patients by day 12 on average. 70.6% underwent primary tracheo-oesophageal puncture and of these 78.1% had effective speech.	The strengths of the JFF reconstruction are the capacity to maintain an oral diet, low stricture and leak rates and the versatility to reconstruct long segment defects.

Figure 1: Relevant papers.

with primary closure [2-4]. The simple yet effective technique does not require microsurgical skills and can be performed in a setting of smaller and less equipped hospital [3,5]. However high rates of pharyngocutaneous fistula and stricture are associated with this type of repair. Early enteral feeding however can be initiated as show by a study by Suslu, et al. in 602 patients, in the 582 of the group early enteral feeding was initiated within 3 days of surgery with fistula rates at approximately 11% [6].

When defects are larger and primary closure of pharyngeal deficit is not possible, then flap based reconstruction is indicated. One of the most commonly used flaps is the pedicled myocutaneous flaps is the pectoralis major pedicled flap. This particular flap is a safe, reliable and commonly used solution, providing a good bulk of tissue while requiring only one team approach without the need for microvascular experience in a significantly lower operative time compared to free flap reconstruction [7-9]. However, the bulkiness of the donor site [7,9,10] and the resulting poor functional outcomes compared to free flaps [11-13] both in terms of speech and swallowing are major disadvantages. Furthermore, its higher rate of stenosis and fistula compared to other means of flap reconstruction [14,15] as well as the donor site complications which can affect the range of movements of the upper extremity and the

chest wall expansion [9]. The radial forearm flap offers another good alternative for pharyngeal reconstruction for such deficits. It is considered a safe, relatively simple, pliable and reliable flap with a sufficiently long pedicle [9,14,16]. The main disadvantage of the radial forearm flap is the delicate nature of the donor site which requires meticulous flap elevation and can result in post-operative complications that can have severe impact on the hand function and therefore the quality of life. Also, the colour mismatch and the hair bearing skin of the donor area can create a suboptimal aesthetic outcome [9,10,14].

In cases of more extensive defects where less than 1 cm pharyngeal mucosa remains, a more radical approach is required. Free jejunal transfer is a useful technique when the gastropharyngeal anastomosis cannot be utilised due to inability of the stomach to reach up to the pharynx [17]. The ability of replacing the hypopharyngeal defect with an already tubed flap from another part of the digestive tract has been one of its main advantages. Moreover, it has a long pedicle with adequate diameter which can support an equally long length of flap with low flap failure rates. Also the flap maintains its peristaltic activity however this is not coordinated with the remaining tissues which can cause swallowing problems. Furthermore, the commonly reported "gargly" and "moist" character of

the voice [17-20]. A study of Perez, et al. [19] however showed high rates of maintained oral diet up to 90 % and effective speech results up to 78.1% in 368 patients. Another major disadvantage is the associated need for abdominal approach and the potential life threatening perioperative and post-operative donor area complications. The abdominal visceral can offer another free flap, the gastro-omental free flap [2,21]. The flap offers a significant amount of vascularised omentum to be used for coverage of the anastomosis, the dead space and the main blood vessels of the area which makes it ideal for complicated surgical sites. Just like the jejunum flap it can gap lengthy defects due to its long and reliable pedicles [21]. However, the flap has high stricture rates [14] and the flap requires a far more extensive operation which can increase the operative risks. Last but not least the flap is subject to the same intraabdominal complications as the jejunal flap.

The free fasciocutaneous flaps form another important weapon in the armamentarium of the reconstructive surgeon. Radial forearm and anterolateral thigh flap consist of the two most commonly used free flaps which are fabricated in a circumferential fashion to cover the deficit. Radial forearm as previously discussed it is considered a safe, relatively simple, pliable and reliable flap with a sufficiently long pedicle which can be tubed over a salivary bypass tube for better results. However, the rate of fistulas and stenosis are higher compared to ALT flap. Other disadvantages include poorer functional outcomes, the hair bearing skin, the colour mismatch and the donor site complications as previously mentioned. ALT flap is a very common and popular flap [10,22,23] it has become an alternative reconstructive option to the radial forearm flap regarding hypopharyngeal reconstruction. It can be used in many forms similarly to radial forearm flaps for both extended and partial deficits. As the radial forearm flap it's a reliable and safe flap with equally low perioperative mortality and flap failure rates [14,22,24]. The rates of percutaneous fistulas and stenosis are also lower than the radial forearm's. The donor site complication rates are approximately at 7% with minimal effect on the mobility of the patient. The flap can offer large skin islands which can be utilized for simultaneous resurfacing of the skin defects in the area. The distal area of donor site facilitates a two-team approach which can help shortening the operative time, as well as the constant and reliable pedicle which provides a straightforward harvesting of the flap.

Also the functional results in terms of speech and swallowing are shown to be equal or even better than of other fasciocutaneous or jejunal flaps [22,25,26,27] with better quality of voice and high rates of achieving tracheoesophageal speech. The advantages make the flap also adequate for previously untreated cases as tubed flap. The main disadvantage of the flap is the bulkiness of the flap compared to other flaps, especially

in cases of obesity. This necessitates a time-consuming thinning of the flap which can endanger the suprafascial vascular plexus and therefore the flap viability [10,24,28].

In cases of salvage procedures (post radiation or chemotherapy) a greater amount of soft tissue is required to allow adequate coverage of the deficit. Gastro-omental free flap is considered to be a reliable solution to this situation. The flap offers a big amount of well vascularised omentum to allow coverage of all the exposed structures with a lower rate of percutaneous fistulas compared to the jejunal flaps [21,29,30,31]. Furthermore, it is a long flap that can bridge defects up to 30 cm, it offers good plasticity of the gastric antrum and the greater omentum for simultaneous coverage of the deficit and the exposed structures which is also thinner compared to the more bulkier ALT flap and a good vessel calibre [29-32]. These advantages make it a good option for cases of an unfavourable recipient site. However, the flap necessitates a good general health in order to tolerate the required laparotomy and the surgically more complicated intraabdominal procedure. Furthermore, the possible complications from the donor site along with the perioperative mortality associated with such complications are some of its disadvantages that must be taken into consideration. The flap can be combined with skin resurfacing with an ALT flap in cases when further resurfacing is required with the disadvantage of an even more prolonged and demanding operation [29-32].

If the deficit is too long and the length of the available flaps is not sufficient to cover the deficit of a required oesophagectomy, gastric pull through can be utilized to replace the oesophagus. Its advantages include a one stage procedure which can gap extensive deficits and it requires only one anastomosis to be performed. The disadvantages are similar to gastro-omental flap and are associated with the necessary intraabdominal operation plus the morbidity and mortality of the operation. The gastric pull through combined with the use of a jejunal free flap it can be used to bridge deficits up to the oropharynx as described by Wu, et al. A similar technique is the colon transposition flap that offers the advantage of having a higher reach compared to other visceral flaps but due to the high complication rates it uses is mostly limited to cases where the gastric pull up technique is unavailable due to concurrent malignancy or previous surgery in the area.

In cases of percutaneous fistula, vascularised tissue from outside the irradiated area is recommended and can significantly reduce the rate of such complications, but at the cost of an additional procedure. Rothmeier, et al. [23] described the use of sandwich technique for managing persistent fistula cases by using multiple flaps and providing the area with a muscle layer and epithelium that act as a secure barrier and therefore reduce the chances of further fistula creation.

Last but not least the submental flap offers a good local flap alternative. It is easily harvested, pliable and reliable flap that can be utilized for smaller deficits. It has a low rate of complications as shown by Lee, et al. in a retrospective analysis of 22 patients. However, the flap although pliable cannot be utilized in cases of larger deficits or in cases of previous radiotherapy [28,32,33].

Summary

Meta-analysis of the literature showed marked evolution in the hypopharynx and larynx reconstruction approaches post oncological ablative surgery. The traditional usage of pedicle regional flaps such as pectoralis major was combined with robust free flaps

such as ALT and free radial forearm flap along with new evolving submental flaps enhancing the speech and swallowing function restoration and decreasing associated comorbidities such as aspiration and persistent PCF.

New evolving horizons in surgical techniques means that allotransplantation has become a possibility for complex defects providing like for like replacement of tissues and potentially aiming at normal functional outcomes, both for voice and swallowing as Grajek M, et al. showed in their pioneering First Complex Allotransplantation of Neck Organs: Larynx, Trachea, Pharynx, Esophagus, Thyroid, Parathyroid Glands, and Anterior Cervical Wall [34] [Table 1].

Table 1: Conclusion.

Defect size	Reconstruction	Pros	Cons
pharyngeal mucosal width remaining > 3.5 cm	Primary closure [1]	simple	Risk of stricture
< 3.5cm and > 1cm	Pectoralis major myocutaneous pedicle flap	Reliable. Versatile workhorse flap. Resistant to radiotherapy.	Donor site co-morbidity. Bulkiness
	Radial forearm free flap	Thin. Long pedicle	Donor site poor cosmetic appearance. Colour mismatch. Hair bearing skin Complex procedure
< 1cm	Completion circumferential reconstruction		
Circumferential defect			
Lower anastomosis above the clavicle	Free Jejunal transfer	Useful in case the pulled-up stomach cannot reach the Pharynx	Laparotomy required Anastomosis stricture Swallowing problems due to hyperperistalsis. Wet sounding voice
	Gastro omental free flap		Anastomosis stricture Requires laparotomy Complex procedure. Marked comorbidities
	Tubed radial forearm free flap.	Long pedicle Thin flap Better if tubed over a salivary bypass	High rate of leakage and stricture. Poor function (swallowing & speech) Hair bearing skin Colour mismatch Donor site comorbidity
	Tubed ALT	Large skin/fascia paddle Long pedicle Thin flap	Poor function (swallowing & speech) Hair bearing skin Colour mismatch
Previously untreated cases	Tubed ALT over a salivary bypass tube	Advantages of ALT plus lowest rate of leakage and stenosis with more satisfactory voice and swallow function rehabilitation	

Post chemo/radiotherapy (Salvage) Procedures	GFFs	Omentum can be wrapped around the anastomosis to decrease risk of leakage and fistula	Requires laparotomy Marked comorbidities Complex surgery
	Additional Free flap (ALT)	Resurface the skin in case of extensive radiotherapy damaged skin	Complex surgery Prolonged theatre time
Circumferential defect	Gastric pull through	Higher reach Can reach oropharynx	5-15% mortality 30-55% morbidity 3-23% fistula rate
Lower anastomosis below the clavicle	Colonic transposition flap		
Pharyngeocutaneous fistula (PCF)	Vascularized tissue transfer from outside the irradiated area	Decreased PCF rate from 30% by half	Additional surgical procedure
	Sandwich technique	Manage resistant PCF	
Small to medium size defects	Submental flap	Reliable	Not suitable for larger defects
		Minimal donor site morbidity Non complicated procedure	May be not feasible if post radiotherapy

Conflict of Interest

The authors have no conflict of interest to declare.

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