



Delayed reconstruction of pharyngeal and pharyngoesophageal defects in patients with malignant neoplasms of the larynx and laryngopharynx after laryngectomy

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Abstract

Aim of the review – to investigate the current surgical approaches and complications of delayed reconstruction of pharyngeal and pharyngoesophageal defects in patients with malignant neoplasms of the larynx and laryngopharynx after laryngectomy using different reconstructive materials.

The most frequent complication after delayed reconstructive surgery was anastomosis incompetence with subsequent formation of fistula and stricture. The causes of this complication in the presence of viability of reconstructive plastic material included postradiation changes, inflammatory process in the

tissues in the defect area, weakened nutritional status of the patient and a number of other reasons.

When planning delayed reconstruction of pharyngeal defects, a personalized approach is necessary in each clinical case in choosing the timing and type of plastic material.

Keywords: greater pectoral muscle flap; radial forearm flap; plastic material; anterolateral thigh flap.

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Abbreviations

PM – plastic material; PMCC flap – pectoralis major myocutaneous flap.

RFFF – radial forearm free flap; ALT flap – anterolateral thigh flap.

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Отсроченные реконструкции фарингеальных и фарингоэзофагеальных дефектов у пациентов со злокачественными новообразованиями гортани и гортаноглотки после ларингэктомии

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Аннотация

Цель обзора – изучить существующие хирургические подходы и осложнения при отсроченной реконструкции фарингеальных и фарингозофагеальных дефектов у пациентов со злокачественными новообразованиями гортани и гортаноглотки после ларингэктомии с применением различного реконструктивного материала.

Наиболее частыми осложнениями после отсроченных реконструктивных операций являются несостоятельность анастомоза с последующим формированием свища и стриктуры. К причинам возникновения данных осложнений при наличии жизнеспособности реконструктивного пла-

стического материала можно отнести постлучевые изменения, наличие воспалительного процесса в тканях в области дефекта, ослабленный нутритивный статус пациента и ряд других причин.

Таким образом, при планировании отсроченной реконструкции дефектов глотки в выборе сроков и вида пластического материала необходим персонализированный подход в каждом клиническом случае.

Ключевые слова: лоскут большой грудной мышцы; лучевой лоскут предплечья; пластический материал; переднелатеральный лоскут бедра.

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Список сокращений

БГМ – большая грудная мышца; ЛЛП – лучевой лоскут предплечья;

ПМ – пластический материал; ПЛБ – переднелатеральный лоскут бедра.

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■ BACKGROUND

Laryngeal cancer is the most common localization among malignant neoplasms of the head and neck organs. The incidence of malignant growths of the larynx and laryngeal section of the pharynx is growing over time in Russia; e.g., in 2021 it was 29.1 and 12.8 per 100,000 population [1]. The detection rate of laryngeal and hypopharyngeal cancer at stages three and four in 2021 was 58% and 83%, respectively [2]. Unfortunately, failure to seek medical help in a timely manner leads to advanced stages of laryngeal and hypopharyngeal cancer. In cases of localized cancer of the larynx and hypopharynx, clinical recommendations entail chemo- or chemoradiation therapy. In cases of regional cancer of the larynx and hypopharynx, the presence of constriction and dysphagia requires extensive combined surgeries that include removal of the larynx with resection of the pharynx, esophagus and tissues of the oropharyngeal region [3]. Patients with localized cancer of the larynx and hypopharynx after combined and combined extensive surgeries are not always recommended single-stage grafting of the formed defects of the pharynx and the esophagus due to the weakened nutritive status; quite often thin may lead to formation of pharyngeal or pharyngo-esophageal defects in the post-surgery period [3]. These defects may include a pharyngostoma, pharyngo-esophagostoma, tracheostoma, constant salivation, feeding through a nasogastric tube, and significantly deteriorate the quality of the patient's life contributing to a psychological trauma. This necessitates a search of new approaches towards surgical rehabilitation and treatment of such patients. One of the major tasks to restore the lost or weakened functions in patients is the reconstruction of the digestive tract [4]. There are numerous plastic methods of reconstructing the pharyngeal and pharyngo-esophageal defects; unfortunately, post-radiation complications and the aggressive environment of the mouth cavity and the pharynx

concurrent with suppression of reparative processes in the weakened cancer patients significantly exacerbate the post-surgery period and result in anastomotic leakage and formation of pharyngostoma or pharyngo-esophagostoma. Therefore, the process of selection of the plastic material (PM) for each patient requiring the defect reconstruction, should be personalized to avoid complications [4, 5].

■ AIM

To investigate the current surgical approaches and complications of delayed reconstruction of pharyngeal and pharyngo-esophageal defects in patients with malignant neoplasms of the larynx and laryngopharynx after laryngectomy using different reconstructive materials.

■ TYPES OF DEFECTS

In modern literature, there are various classifications of pharyngo-esophageal defects, in which it is necessary to focus on the shape, size and structure of the pharyngeal defect. The classification that is most frequently used in the selection of plastic materials for the reconstruction of pharynx defects is the Blackwell and Urken classification. It identifies the following types of pharyngo-esophageal defects: type 0 – small defects closed primarily without the introduction of tissue; type 1 – non-circumferential defects that preserve a viable strip of mucosa from the hypopharynx to the cervical esophagus; type 2 – circumferential defects extending from the vallecula, i.e. the depression between the root of the tongue and the lingual surface of the epiglottis, to the thoracic inlet; type 3 – circumferential defects that extend from the level of the vallecula cranially to the oropharynx; type 4 – extensive defects that extend below the clavicles to the thoracic esophagus [5, 6]. In the work of M.V. Ratushny, this classification was systematized, and three types of defects were proposed. The first type is formed after

laryngectomy with the wall of the hypopharynx preserved. The second type is formed after laryngectomy without preservation of the hypopharynx walls. The third type is formed after multi-organ resections [6–8].

METHODS OF DELAYED RECONSTRUCTION OF PHARYNGEAL AND PHARYNGO-ESOPHAGEAL DEFECTS

In case of Blackwell and Urken Type 0 defects, local plastic material is used, i.e. tissues near the defect. This is a simple yet efficient technique available to majority of surgeons; it may be performed in a smaller less sophisticated operating room. Nevertheless, this type of plasty entails frequent formation of post-operative fistulae and strictures. Besides, this method is applicable to close only minor defects due to small quantities of plastic material [8, 9]. However, N. Süslü et al. (2016) showed in 602 patients that the early enteral feeding may be started even if local tissue is used as plastic material. In these patients, early enteral feeding was started within three days after the operation, and the incidence of fistulae was approx. 11% [9]. With this type of defect, complications are usually related with radiotherapy or severe concurrent pathologies.

In case of Blackwell and Urken Type 1 defects, it is possible to use deltopectoral, pectoral, thoracodorsal and radial flaps [5, 6, 9–11].

The 10-year “Swee Keong Kang” study included 73 patients (80% males) who had undergone the reconstruction of pharyngeal and pharyngo-esophageal defects with the use of the deltopectoral flap. 13 patients developed minor complications, such as leakages of anastomotic sutures, of which 10 were treated conservatively and 3 required additional reconstruction. In 13 patients, a pharynx to skin fistula developed, and in 6 patients, constriction of the ‘neopharynx’ [12]. The advantages of the deltopectoral flap include the technical simplicity of forming the large-size flap; thin and flexible structure that fits well the cover tissue of the head and the neck in texture and color; no muscular structures of the chest and the shoulder are affected in harvesting the flap; the donor area is not located in the open parts of the body and may be concealed under clothing. The disadvantages include deformation of cover tissue in the donor area, specifically, in women this may result is cicatricial deformation of the breast and the nipple, and in men, in an increased hairiness: growth of hairs in the reconstruction area might bring discomfort [13, 14].

Some authors used the thoracodorsal flap involving the latissimus dorsi, predominantly in women, to eliminate deformation of the breast and formation of cicatricial tissue in the thoracic wall that occur after the plasty with the pectoral flap. This method, however, involves a major disadvantage: the harvesting of the material requires changing of the patient’s position on the surgical table [15, 16].

One of the most frequently used flaps is the pectoralis major myocutaneous flap (PMCC flap). The study by G. Montemari et al. (2012) involved a retrospective analysis of 45 reconstructions of pharyngeal defects with the use of PMCC flap performed from February 1995 to February 2008. Post-surgery complications related to the use of the flap were seen in 6.7% of the cases. The frequency of complications that required surgical revision was 2.2%. Two minor complications were found: constriction of the ‘neopharynx’ and formation

of the fistula, both of these were rectified without surgical intervention. No complete or partial necrosis occurred in any of the cases. In the rest of the cases, the X-ray examination of the esophagus showed absence of fistulae and an adequate bore of the digestive tract. Eating through the mouth started on day 10–12 after the operation with no problems of swallowing of liquid or solid food. Post-surgery radiation therapy performed in 30 patients was accepted well [17, 18].

PMCC flap is a safe, reliable and often used material providing a good volume of tissue. It does not entail microvascular technique and significantly reduces the surgical intervention time as compared to free flap reconstruction. Significant disadvantages, however, include the bulkiness of the donor site and unsatisfactory functional results compared to free flaps, both in terms of speech and swallowing. Besides, there complications were reported in the donor site that could affect the movement amplitude in the upper extremity [18, 19]. An alternative method of tissue replacement in the pharyngeal and pharyngo-esophageal defects is the use of the radial forearm free flap (RFFF). It is considered to be safe, relatively easy to handle among other free flaps, flexible and reliable, with a rather long pedicle. The major drawback of this method of tissue reconstruction is the delicate nature of the donor site that requires a very careful elevation of the flap and that might result in post-surgery complications: these may seriously affect the function of the arm and, therefore, the quality of life. Besides, the RFFF requires a proper technical training on part of the surgeon, a large surgical crew, and a considerably long time of the surgery [20, 21].

In their study, Jerry W. Chao et al. (2015) reviewed the literature on delayed reconstruction of pharyngeal and pharyngo-esophageal defects with the use of PMCC and RFF flaps. The analysis of integrated data showed that in 301 patients after the restoration with PMCC flap, fistulae were found in 24.7% of the cases, and reintervention was required in 11.3% of the cases. In 605 patients for whom RFF flap as used as restorative material, fistulae were found in 8.9% of the cases, and reintervention was needed in 5.5% of the cases. There was no difference in the incidence of strictures and in the transition to normal diet when these flaps were used [22].

Patients with Blackwell and Urken Type 1 defects may experience complications with any kind of restorative material. The structure of complications has no visible differences. The onset of complications may be related to a number of factors, e.g. post-radiation changes in the tissue, severe concurrent conditions, weakened nutritive status, presence of inflammation and intoxication of the organism. However, there are no publications that assess the causes of post-surgery complications related to restorative material [23, 24].

In cases of Blackwell and Urken Types 2, 3 and 4 defects after the circumferential resection of the hypopharynx and the cervical esophagus, a more radical approach towards reconstructive surgery is needed. Restoration of these kinds of defects widely involve visceral flaps, viz. jejunal flap, and gastroepiploic flap [25, 26]. Rachel J. Walker et al. (2014) performed a retrospective analysis of complications in 104 patients after reconstruction of pharyngo-esophageal defects with the use of the jejunal flap. Out of the 104 patients, early complications involving the use of the flap were identified in 14 (13%) patients, but the survival of the flap was 97%. 11 (11%)

patients developed a fistula on average in 15 days following the surgery, and 11 (11%) patients had minor complications in the donor site. A total of 95 (91%) patients were able to resume oral alimentation at the time of discharge [27]. The jejunal flap has a long vascular pedicle of an adequate diameter that allows for the use of the flap in case of large defects while providing low complication rate. The flap also retains some peristaltic action; however, it does not coordinate with other tissues, which might cause problems with swallowing.

In their study, J.M. Viñals Viñals et al. (2017) performed a retrospective analysis of clinical cases of patients who had undergone pharynx and esophagus reconstruction with the use of the gastroepiploic free flap after laryngopharyngectomy for pharynx or larynx cancer in the period from 1992 to 2012. In two cases, abdominal evisceration was observed, whereas other patients experienced no abdominal complications. In 3 (11.5%) of patients, total necrosis of the flap was observed. In 20 patients, the post-surgery period had no complications [28].

The gastroepiploic flap contains quite a bit of vascularized omentum by means of which it is possible to cover the anastomosis and the major blood vessels of the area. It has a long vascular pedicle, which allows for a wider area of usage of microsurgical anastomoses. However, it requires a longer operation, which may increase surgical risks. Last, but not least is that the flap is susceptible to the same abdominal complications as the jejunal flap [29].

The RFF flap and the anterolateral thigh flap (ALT flap) are the two of the most frequently used free flaps that are harvested circumferentially to cover the defect. The RFF flap is considered a safe, relatively easy, flexible and reliable flap with a rather long vascular pedicle that can be used to reconstruct the circumferential defect of the pharynx. However, the incidence rate of fistulae and constrictions is higher when compared to the ALT flap. Other downsides of using the RFF flap include worse functional outcomes, presence of hair, mismatch of skin color and complications in the donor site. The ALT flap is a widely used flap that has become an alternative to the radial forearm flap in the reconstruction of the pharyngeal area. It may be used in various forms, as can be the forearm flap, to reconstruct both the extensive and

partial defects. Just as the radial forearm flap, it is a reliable and safe flap with a similarly low perioperative mortality and flap necrosis occurrence. The incidence rate of transcutaneous fistulae and constrictions is also lower than is the case with the radial forearm flap [30–32].

The study of N.C. Tan et al. (2015) analyzed complications and compared the incidence rate of fistulae and strictures among ALT and RFF flaps, and flaps from the tissue of the jejunum in cases of circumferential reconstruction of the pharynx and the esophagus. In 40 patients, only one leakage of the ALT was found. The incidence of fistulae was 33%, 50% and 30% in the ALT, RFF, and jejunal flap groups, respectively. The incidence of strictures was 38.1%, 57.1% and 0% in the ALT, RFF, and jejunal flap groups, respectively [33].

Thus, the use of visceral and free flaps in defects of types 2, 3 and 4 also entails the risk of complications in the post-surgery period [34]. Various factors associated with the weakened status of the patient, post-radiation and inflammatory changes can lead to a complicated course of the postoperative period [35].

CONCLUSION

Delayed reconstruction of pharyngeal and pharyngo-esophageal defects in oncology patients involves the use of various reconstructive tissues: covering tissues, tissues on axial blood supply (deltopectoral, pectoral, thoracodorsal material), free flaps (RFF, ALT) and visceral flaps from the gastrointestinal tract allowing for restoration of the integrity and the slit of the pharynx [36, 37]. With all types of plastic surgery, complications may develop in the postoperative period.

As the analysis of scientific literature has shown, the most frequent complications after delayed reconstructive surgeries are anastomotic failure with subsequent formation of fistula and stricture [38]. The causes of these complications, given the viability of the reconstructive material, may be the post-radiation changes, presence of an inflammatory process in the tissues in the defect area, weakened nutritive status of the patient, and some others [39, 40]. Therefore, planning of delayed reconstruction of pharyngeal defects, as far as time frame and type of reconstructive material are concerned, necessitate a personalized approach in each clinical case. ■

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REFERENCES / ЛИТЕРАТУРА

1. *Malignant neoplasms in Russia in 2021 (morbidity and mortality)*. Eds. by Kaprin AD, Starinsky VV, Petrova GV. M., 2021. (In Russ.). [Злокачественные новообразования в России в 2021 году (заболеваемость и смертность)]. Под ред. Каприна А.Д., Старинского В.В., Петровой Г.В. М., 2021].
2. *State of Cancer Care in Russia in 2021*. Eds. by Kaprin AD, Starinsky VV, Petrova GV. M., 2021. (In Russ.). [Состояние онкологической помощи населению России в 2021 году. Под ред. Каприна А.Д., Старинского В.В., Петровой Г.В. М., 2021].
3. Kravtsov SA, Reshetov IV, Ratushny MV. Choice of upper respiratory and digestive tract reconstruction option. *Head and Neck*. 2013;3;36-43. (In Russ.). [Кравцов С.А., Решетов И.В., Ратушный М.В. Выбор варианта реконструкции верхних отделов дыхательных и пищеварительных путей. *Голова и шея*. 2013;3;36-43].
4. Polyakov AP, Reshetov IV, Ratushny MV, et al. Restoration of the upper parts of the digestive tract and vocal function in patients after laryngectomy. *Russian otorhinolaryngology*. 2017;2;64-71. [Поляков А.П., Решетов И.В., Ратушный М.В., Маторин О.В., Ребрикова И.В., Филюшин М.М. Восстановление верхних отделов пищеварительного тракта и голосовой функции у пациентов после ларингэктомии. *Российская оториноларингология*. 2017;2;64-71]. DOI: [10.18692/1810-4800-2017-2-64-71](https://doi.org/10.18692/1810-4800-2017-2-64-71)
5. Kozhanov AL. Modern aspects of treatment and rehabilitation of patients with laryngeal cancer. *Head and Neck*. 2016;2;17-24. [Кожанов А.Л. Современные аспекты лечения и реабилитации больных при раке гортани. *Голова и шея*, 2016;2;17-24]. DOI: [10.17650/2222-1468-2016-6-2-17-24](https://doi.org/10.17650/2222-1468-2016-6-2-17-24)
6. Ratushny MV, Reshetov IV, Polyakov AP, et al. Reconstructive pharyngeal surgery in cancer patients. *Journal of Oncology. P.A. Herzen*. 2015;4(4):5763. [Ратушный М.В., Решетов И.В., Поляков А.П., и др. Реконструктивные операции на глотке у онкологических больных. *Онкология. Журнал им. П.А. Герцена*. 2015;4(4): 5763]. DOI: [10.17116/onkolog20154457-63](https://doi.org/10.17116/onkolog20154457-63)
7. Mohammad M, et al. Laryngeal and Pharyngeal Reconstruction: A Worldwide Review of the Current Guidelines and Standards of Practice. Does a Universal Reconstruction Algorithm Exist? *Clinical Medical Reviews and Case Reports*. 2022;9:409. DOI: [10.23937/2378-3656/1410409](https://doi.org/10.23937/2378-3656/1410409)
8. Yu P. One-stage reconstruction of complex pharyngoesophageal, tracheal, and anterior neck defects. *Plast Reconstr Surg*. 2005;116(4):949-56 DOI: [10.1097/01.prs.0000178042.26186.c1](https://doi.org/10.1097/01.prs.0000178042.26186.c1)
9. Süslü N, Şefik Hoşal A. Early oral feeding after total laryngectomy: Outcome of 602 patients in one cancer center. *Auris Nasus Larynx*. 2016;43:546-550. DOI: [10.1016/j.anl.2016.01.004](https://doi.org/10.1016/j.anl.2016.01.004)
10. Chang BA, Asarkar AA, Horwich PM, et al. Regional pedicled flap salvage options for large head and neck defects: the old, the new, and the forgotten. *Laryngoscope Investig Otolaryngol*. 2022;8(1):63-75. DOI: [10.1002/lio2.983](https://doi.org/10.1002/lio2.983)
11. Ki SH, Choi JH, Sim SH. Reconstructive Trends in Post-Ablation Patients with Esophagus and Hypopharynx Defect. *Arch Craniofac Surg*. 2015;16(3):105-113. DOI: [10.7181/acfs.2015.16.3.105](https://doi.org/10.7181/acfs.2015.16.3.105)
12. Kang SK, Qamar SN, Khan IM, et al. 10-Year Experience with the Modified Pectoralis Major Flap: The Use of the Deltopectoral Flap to Reduce Skin Tension. *Indian J Otolaryngol Head Neck Surg*. 2022;8:1-8. DOI: [10.1007/s12070-022-03154-6](https://doi.org/10.1007/s12070-022-03154-6)
13. Balasubramanian D, Subramaniam N, Rathod P, et al. Outcomes following pharyngeal reconstruction in total laryngectomy – Institutional experience and review of Literature. *Indian Journal of Plastic Surgery*. 2018;51(02):190-195. DOI: [10.4103/ijps.IJPS_79_17](https://doi.org/10.4103/ijps.IJPS_79_17)
14. Lasso JM, Castellano M, Pinilla C, et al. Circumferential Pharyngoesophageal Reconstruction and Total Larynx Preservation with Extra-anatomical Free Flaps. *Plastic and Reconstructive Surgery – Global Open*. 2008;6(11):e2008. DOI: [10.1097/GOX.00000000000002008](https://doi.org/10.1097/GOX.00000000000002008)
15. Park SI, Choi SY, Baek Ch-H, et al. Comparisons of clinical and functional outcomes of different reconstructive methods for the hypopharyngeal defect. *Oral Oncol*. 2019;94:26-31. DOI: [10.1016/j.oraloncology.2019.05.003](https://doi.org/10.1016/j.oraloncology.2019.05.003)
16. Bouhadana G, Azzi AJ, Gilardino MS. The ideal flap for reconstruction of circumferential pharyngeal defects: A systematic review and meta-analysis of surgical outcomes. *JPRAS*. 2021;74(8):1779-1790. DOI: [10.1016/j.bjps.2021.03.042](https://doi.org/10.1016/j.bjps.2021.03.042)
17. Montemari G, Rocco A, Galla S, et al. Hypopharynx reconstruction with pectoralis major myofascial flap: our experience in 45 cases. *Acta Otorhinolaryngol Ital*. 2012;32(2):93-7. DOI: [10.15373/2249555x/dec2012/49](https://doi.org/10.15373/2249555x/dec2012/49)
18. Mura F, Bertino G, Occhini A, Mevio N, Scelsi D, Benazzo M. Advanced carcinoma of the hypopharynx: functional results after circumferential pharyngolaryngectomy with flap reconstruction. *Acta Otorhinolaryngol Ital*. 2012;32(3):154-7. PMID: [22767979](https://pubmed.ncbi.nlm.nih.gov/22767979/); PMCID: [PMC3385061](https://pubmed.ncbi.nlm.nih.gov/PMC3385061/)
19. Escandón JM, Santamaría E, Prieto P, et al. Reconstruction of Pharyngolaryngeal Defects with the Ileocolon Free Flap: A Comprehensive Review and How to Optimize Outcomes. *Arch Plast Surg*. 2022;49(3):378-396. DOI: [10.1055/s-0042-1748652](https://doi.org/10.1055/s-0042-1748652)
20. Costantino A, Festa BM, Kim S-H, et al. Complications of pectoralis major myo-cutaneous flap, anterolateral thigh flap and radial forearm free flap after total laryngectomy with partial pharyngectomy: A systematic review and network meta-analysis. *Microsurgery*. 2023;43(3):286-296 DOI: [10.1002/micr.30977](https://doi.org/10.1002/micr.30977)
21. Balasubramanian D, Subramaniam N, Rathod P, et al. Outcomes following pharyngeal reconstruction in total laryngectomy – Institutional experience and review of literature. *Indian Journal of Plastic Surgery*, 2018;51(2):190-195. DOI: [10.4103/ijps.IJPS_79_17](https://doi.org/10.4103/ijps.IJPS_79_17)
22. Chao JW, Spector JA, Taylor EM, et al. Pectoralis major myocutaneous flap versus free fasciocutaneous flap for reconstruction of partial hypopharyngeal defects: what should we be doing? *J Reconstr Microsurg*. 2015;31(3):198-204. DOI: [10.1055/s-0034-1395417](https://doi.org/10.1055/s-0034-1395417)
23. Dedivitis RA, Aires FT, Cernea CR, Brandão LG. Pharyngocutaneous fistula after total laryngectomy: Systematic review of risk factors. *Head & Neck*. 2015;37(11):1691-1697. DOI: [10.1002/hed.23804](https://doi.org/10.1002/hed.23804)
24. Watts TL. The pectoralis major myocutaneous flap. *Operative Techniques in Otolaryngology*. 2019;30(2):134-137. DOI: [10.1016/j.otot.2019.04.008](https://doi.org/10.1016/j.otot.2019.04.008)
25. Fatani B. Radial Forearm Free Flap for Head and Neck Defect Reconstruction: An Up-to-date Review of the Literature. *Cureus*. 2023;15(3):e35653. DOI: [10.7759/cureus.35653](https://doi.org/10.7759/cureus.35653)
26. Ragbir M, Brown JS, Mehanna H. Reconstructive considerations in head and neck surgical oncology: United Kingdom national multidisciplinary guidelines. *J Laryngol Otol*. 2016;130(2). DOI: [10.1017/s0022215116000621](https://doi.org/10.1017/s0022215116000621)
27. Walker RJ, Parmar S, Praveen P, et al. Jejunal free flap for reconstruction of pharyngeal defects in patients with head and neck cancer-the Birmingham experience. *Br J Oral Maxillofac Surg*. 2014;52(2):106-10. DOI: [10.1016/j.bjoms.2013.11.005](https://doi.org/10.1016/j.bjoms.2013.11.005)
28. Viñals Viñals JM, Rodrigues TAG, Lopez CC, et al. Outcomes of Gastro-omental Free Flap Reconstruction for Salvage Laryngopharyngectomy for Pharyngeal and Laryngeal Cancer After

- Concurrent Chemoradiotherapy. *Ann Plast Surg.* 2017;79(4):e20-e24. DOI: [10.1097/SAP.0000000000000298](https://doi.org/10.1097/SAP.0000000000000298)
29. Pegan A, Rašić I, Košec A, et al. Type II hypopharyngeal defect reconstruction – a single institution experience. *Acta Clin Croat.* 2018;57(4):673-680. DOI: [10.20471/acc.2018.57.04.10](https://doi.org/10.20471/acc.2018.57.04.10)
30. Ho MW, Houghton L, Gillmartin E. Outcomes following pharyngolaryngectomy reconstruction with the anterolateral thigh (ALT) free flap. *The British Journal of Oral & Maxillofacial Surgery.* 2012;50(1):19-24. DOI: [10.1016/j.bjoms.2010.10.004](https://doi.org/10.1016/j.bjoms.2010.10.004)
31. Ooi ASH, Teven CM, Inbal A, Chang DW. The utility of the musculocutaneous anterolateral thigh flap in pharyngolaryngeal reconstruction in the high-risk patient. *Journal of Surgical Oncology.* 2017;115(7):842-847. DOI: [10.1002/jso.24577](https://doi.org/10.1002/jso.24577)
32. Somuk BT, Ciftci O, Aygenc E. Evaluation of cases who underwent reconstruction through pectoralis major myocutaneous flap after laryngopharyngectomy. *Turkish Archives of Otorhinolaryngology.* 2016;54(2):58-62. DOI: [10.5152/tao.2016.1603](https://doi.org/10.5152/tao.2016.1603)
33. Tan NC, Linh P-Y, Kuo P-J, et al. Objective comparison of the incidence of fistulas and strictures among the anterolateral femur, radial forearm, and free tissue of the jejunum in circular reconstruction of the pharynx and esophagus. *Microsurgery.* 2015;35(5):345-349. DOI: [10.1002/micr.22359](https://doi.org/10.1002/micr.22359)
34. Yabe T, Ashford B. Reconstruction of Pharyngeal Defects. *IntechOpen.* 2021. DOI: [10.5772/intechopen.94191](https://doi.org/10.5772/intechopen.94191)
35. Clark JR, Gilbert R, Irish J, et al. Morbidity after flap reconstruction of hypopharyngeal defects. *Laryngoscope.* 2006;116(2):173-81. DOI: [10.1097/01.mlg.0000191459.40059.fd](https://doi.org/10.1097/01.mlg.0000191459.40059.fd)
36. Nouraei SA, Dias A, Kanona H, et al. Impact of the method and success of pharyngeal reconstruction on the outcome of treating laryngeal and hypopharyngeal cancers with pharyngolaryngectomy: A national analysis. *J Plast Reconstr Aesthet Surg.* 2017;70(5):628-638. DOI: [10.1016/j.bjps.2016.12.009](https://doi.org/10.1016/j.bjps.2016.12.009)
37. Khalid FA, Saleem M, Yousaf MA, et al. Oropharyngeal, Hypopharyngeal and Cervical Esophageal Reconstruction: An Experience of Pedicle Flaps. *J Coll Physicians Surg Pak.* 2019;29(2):168-172. DOI: [10.29271/jcpsp.2019.02.168](https://doi.org/10.29271/jcpsp.2019.02.168)
38. van Brederode TD, Halmos GB, Stenekes MW. Functional outcome after one-stage flap reconstruction of the hypopharynx following tumor ablation. *Eur Arch Otorhinolaryngol.* 2017;274(2):969-976. DOI: [10.1007/s00405-016-4279-8](https://doi.org/10.1007/s00405-016-4279-8)
39. Park SI, Choi SY, BaekCh-H, et al. Comparisons of clinical and functional outcomes of different reconstructive methods for the hypopharyngeal defect. *Oral Oncol.* 2019;94:26-31. DOI: [10.1016/j.oraloncology.2019.05.003](https://doi.org/10.1016/j.oraloncology.2019.05.003)
40. Chan JYu-W, Lau GISK. Effects of Radiotherapy on Pharyngeal Reconstruction After Pharyngo-Laryngectomy. *Frontiers in Radiation Oncology.* 2013. DOI: [10.5772/56604](https://doi.org/10.5772/56604)