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19 Regional Pedicled Flaps for Skull Base Reconstruction

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19.1 Introduction

Among other structural functions, the skull base serves to separate the anterior, middle, and posterior cranial fossae from the sinonasal cavity. Restoring this separation is a key element of any reconstructive technique. Advances in endoscopic endonasal surgery have led to the creation of large dural and skull base defects, requiring the development of appropriate skull base reconstructive methods to prevent postoperative cerebrospinal fluid (CSF) leak and meningitis [1]. While free grafting may be adequate for small low CSF flow defects, vascularized reconstruction with local, regional, or free flap techniques has become a mainstay in reconstruction of larger high CSF flow settings [2–4]. The most commonly utilized vascularized tissue transfer is the nasoseptal flap (NSF) [5–7]. However, in the setting of a malignancy requiring oncologic resection of the nasal septum or loss of its integrity or blood supply from previous surgery, an NSF or alternative intranasal flap may not be available, necessitating the use of alternative reconstructive techniques [8]. A regional pedicled flap may be a viable reconstruction option for a sizable skull base defect if a NSF is unavailable. The most commonly utilized regional pedicled flaps include the pericranial and temporoparietal fascia flaps (TPFF). Additional regional flaps include the occipital, palatal, facial buccinator, pedicled buccal fat pad, and salpingopharyngeus flap [9]. In this chapter, we will describe the anatomy, technique, and reported outcomes with each of these regional pedicled flap options.

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19.2 Trans-frontal Pericranial Flap

The pericranial flap has been utilized to reconstruct skull base defects long prior to the advent of endoscopic techniques [10]. This flap, supplied by the ipsilateral supratrochlear and supraorbital

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arteries, can readily cover defects of the anterior skull base, anteroposteriorly from the frontal sinus to the sella turcica, and laterally from orbit to orbit [11]. Length of the flap necessary has been estimated at 11–12.5 cm to cover the defects of the anterior skull base, 14–15.5 cm for parasellar defects, and 18–20.5 cm for clival defects [12]. While it may be feasible to reach a purely posterior skull base defect, one should consider its potential impact on olfaction rather than when using an alternative reconstructive option [11]. During open craniofacial resections, the pericranial flap is easily delivered through inferior aspect of the supraorbital bar or craniotomy (i.e., below the bone grafts). Multiple techniques have been described for delivering the pericranial flap through the frontal sinus into the anterior skull base when the tumor resection is performed via an endoscopic technique (i.e., trans-frontal pericranial flap). These variations include the "mailbox slot," "money box approach," or nasion window [9, 13, 14]. Although traditionally harvested through a coronal incision, harvesting the pericranial flap through an endoscopic assisted technique has been reported [12, 15, 16].

To harvest a pericranial flap through a coronal incision, the patient is placed in a supine position, and the head is positioned on a horseshoe or fixated with a three-pin Mayfield clamp. The hair is shaved or parted at the intended coronal incision site. If parted, the hair is displaced anterior and posterior to the incision with lubricating jelly, and it is fixed in position with staples. The head and face are then prepped with iodoform solution and draped in standard fashion.

An incision through the dermis, galea, and pericranium from temporal line to temporal line is carried with a 10 blade extending laterally over the superficial layer of the deep temporal fascia down to the level of the auricle. A scalpel, rather than electrocautery, is used for the incisions and dissection to reduce the risk of alopecia. We prefer to raise the flap in a subperiosteal plane and harvest the pericranial flap off the galea after the resection is completed. This helps to keep the pericranial flap from desiccating during the remainder of the operation and yields a thicker flap. However, we recognize that others prefer raising the scalp in a subgaleal plane leaving the pericranium over the cranium and then elevating it off the bone before the craniotomy [17]. To increase the pericranial flap length, the scalp posterior to a coronal incision carried through the galea may be elevated posteriorly in a subgaleal plane prior to incising the pericranium.

As the subperiosteal dissection is brought anteriorly, the supraorbital and supratrochlear neurovascular bundles are identified and are released from the respective notches. However, in the presence of a complete foramen, its inferior aspect is opened in an inverted V fashion using a 2–4 mm osteotome. This allows the inferior mobilization of the neurovascular bundles. After dural reconstruction has been performed, the pericranial flap is mobilized through the median frontal sinus respecting the drainage pathways of the frontal sinus (for endoscopic resection and reconstruction) or beneath the orbital or cranial bone grafts (for a subcranial resection). The pericranial flap reconstruction may also be reinforced with additional grafts such as a fascia lata graft or bolstered with packing inserted through the nasal cavity.

The pericranial flap is generally regarded as a robust regional flap with good outcomes. One study including 16 patients undergoing skull base reconstruction with a pericranial flap noted no flap failures [16]. Another study including 10 patients undergoing pericranial flap reconstruction noted no evidence of postoperative cerebrospinal fluid (CSF) leak and; furthermore, 8/10 patients underwent radiation therapy without subsequent flap complications [10]. A third study of 26 patients undergoing anterior skull base reconstruction noted partial or total flap necrosis in three patients and one case of minor CSF accumulation under the scalp [18]. Lastly, another report described a patient with delayed radionecrosis of the pericranial flap after proton therapy, corticosteroids, hyperbaric oxygen, and bevacizumab resulting in a CSF leak, meningitis, and frontal lobe herniation through the original skull base defect [19].

To minimize postoperative pericranial flap complications (trans-frontal technique), it has been suggested that the medial border of the flap should not extend past the midline. Furthermore, a Draf III sinusotomy is important to avoid mucocele formation [16].

19.3 Temporoparietal Fascia Flap

The temporoparietal fascia flap (TPFF), based on the superficial temporal artery and vein and delivered through a transpterygoid approach, is another regional flap option ideal for middle or posterior cranial fossa defects [20, 21]. An alternative corridor to the anterior skull base through a supraorbital epidural approach has also recently been reported [22]. A length of 15 cm is generally regarded as the minimum required length to reconstruct most defects; however, a longer flap length may be necessary to reach the defects of the craniocervical junction [21].

An ipsilateral endoscopic transpterygoid approach is often performed prior to harvesting a TPFF. An incision is made through the dermis with a 10 blade and ultimately extended laterally down to the auricle (Fig. 19.1a). A scalpel is utilized to perform this incision as well as the subsequent dissection in lieu of electrocautery to reduce the risk of alopecia. The galea (medially) or temporoparietal fascia (laterally) are identified with sharp dissection. The dissection then continues superficial to this plane, and deep to the hair follicles and subcutaneous fat, with sharp dissection (Fig. 19.1b). Sharp dissection is performed both in an anterior as well as a posterior direction so as to harvest adequate tissue for reconstruction. Anteriorly, one must consider the location of the frontal branch of the facial nerve; thus, the flap is usually elevated posterior to the hairline. After this has been completed, an incision is made medially through the galea and pericranium down to the frontal bone. We prefer harvesting and incorporating both the layers in order to increase the robustness of the flap. The flap is then raised off the bone with a periosteal elevator from a medial to lateral direction (Fig. 19.1c). As the dissection proceeds laterally, the superficial layer of the deep temporal fascia is identified, and raising the flap continues superficial to this layer. The superficial temporal artery and vein are identified and preserved, and dissection continues until the pedicle has been appropriately optimized for rotation through the infratemporal fossa. An incision is then made through the superficial layer of the deep temporal fascia, which is then dissected from the muscle following a plane posterior to the zygomatic arch and into the infratemporal fossa (Fig. 19.1d). Occasionally, a lateral canthotomy may be necessary to release the temporalis muscle from the lateral orbital wall to allow for optimal transfer of the flap into the nasal cavity. A guide wire is introduced into the sinonasal cavity and a percutaneous tracheostomy dilators utilized to distend the corridor through the infratemporal fossa (Fig. 19.1e). After this has been achieved, the flap is tied to the guide wire, which is pulled through the infratemporal fossa and into the sinonasal cavity as the flap is guided externally (Fig. 19.1f). The flap can then be accommodated to reconstruct the skull base defect (Fig. 19.1g).

There are few studies analyzing the outcomes of the TPFF for skull base reconstruction. One study including seven patients (presenting four chordomas and three nasopharyngeal cancers) noted no TPFF failures [16]. The TPFF is commonly used for a wide range of other reconstructive purposes as a pedicled or free flap including auricular, orbital, laryngeal, and cutaneous oncologic defect repair [23–25]. A retrospective study of 82 cases of TPFF in 71 patients for a range of reconstructive purposes reported no significant complications and a partial necrosis in only 2 of 82 flaps [26]. It is important to note that for skull base reconstruction, kinking or damage to the superficial artery or vein during rotation through the infratemporal fossa will lead to flap death. Additionally, a prior temporal artery biopsy or injury to the superficial artery or vein may compromise its vascular flow. Additional risks of the TPFF harvest include alopecia, given the plane of dissection near the hair follicles. Injury to the frontal branch of the facial nerve or the internal maxillary artery can also occur with this approach [16]. Use of an endoscopic harvest of a temporoparietal fascia flap has also been reported in an effort to improve donor site morbidity [27].

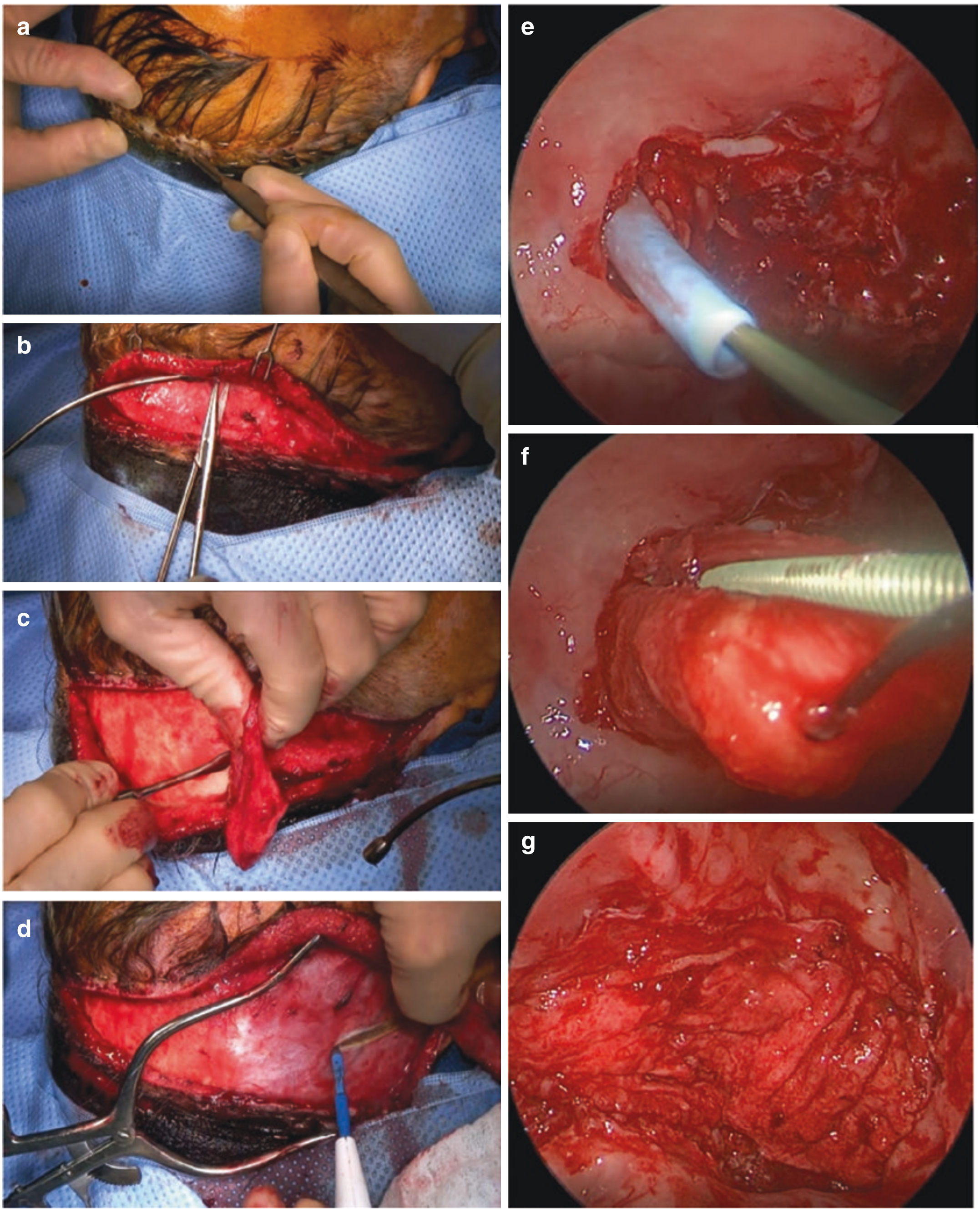

Fig. 19.1 (**a**) The hair is parted and reinforced with staples. Incision is made with a 10 blade. (**b**) The flap is raised in an anterior and posterior direction using sharp dissection. (**c**) After the pericranium is raised from the frontal bone, the flap is transitioned to superficial to the superficial layer of the deep temporal fascia. (**d**) Incision is made in the superficial layer of the deep temporal fascia to allow for transposition of the flap into the infratemporal fossa. (**e**) A percutaneous tracheal dilator is utilized to enlarge the corridor through the infratemporal fossa. (**f**) The TPFF is secured to a guide wire and introduced into the sinonasal cavity. (**g**) The TPFF is then optimally placed to reconstruct the defect

19.4 Occipital Flap

The occipital flap has been described for multiple head and neck reconstructive purposes including the pharynx, lateral temporal bone, and scalp [28–30]. This flap, based on the occipital artery and with an average pedicle length of 8 cm, may be advantageous in regard to not be compromised by previous skull base surgery or radiation due to its distant location from the skull base [31]. The occipital flap may be ideal for the reconstruction of clival or middle cranial fossa defects [16, 31].

A transverse incision is made along the mastoid process, and the vascular pedicle is exposed after transecting the sternocleidomastoid, splenius capiti, and longus capiti muscles [31]. One must be vigilant for a large tributary vein at the mastoid tip joining the transverse segment which if present must be carefully ligated so as not to injure the pedicle [16, 31]. The pedicle is traced and the galea-pericranium is incised. Some have suggested that in order to minimize the risk of damaging the pedicle, the dissection should proceed to a level that allows adequate rotation without kinking of the pedicle and that tracing the pedicle all the way to the external carotid artery is unnecessary and places the vein at risk [16, 31]. Once the flap is harvested, it may then be introduced into the sinonasal cavity through a transpharyngeal, transpterygoid, or prevertebral corridor [16, 31, 32]. In a large series of 330 skull base reconstructions, the occipital flap was used only once [16].

19.5 Oliver Palatal Flap

The palatal flap, based on the descending palatine artery, has been classically used for cleft palate reconstruction; however, the palatal flap can also be used for the reconstruction of defects of the planum, sella, and clivus [16, 33]. The Oliver flap is raised in a subperiosteal plane, and the greater palatine foramen is enlarged with a high-speed drill [33, 34]. A wide maxillary antrostomy is created and the posterior maxillary wall removed. The descending palatine artery is mobilized from the pterygopalatine canal and the palatal flap is then passed through the enlarged greater palatine foramen into the sinonasal cavity [33]. The flap is considered a last option in skull base reconstruction due to its complexity and the potential for oronasal fistula [16, 34]. However, one study reported the use of the flap in two patients with successful results [16].

19.6 Facial Buccinator Flap

The facial buccinator flap is based on a modification of the facial artery musculomyomucosal (FAMM) and buccinator flaps and can be used for reconstruction of defects of the anterior skull base [35]. First, the parotid duct is identified and not incorporated into the flap [36]. The anterior margin of the flap is approximately 1cm from the oral commissure and the posterior margin near the retromolar trigone [36]. The flap incorporates the mucosa, submucosal tissue, and a portion of the buccinator muscle [36]. To allow mobilization into the sinonasal cavity, the proximal facial artery is ligated, and blood supply for the flap is derived from reverse flow from the angular artery [16]. The flap may then be pivoted at the superior gingivobuccal sulcus and delivered into the sinonasal cavity through a maxillary window [35, 36]. Utilization of this flap has been reported for a patient with osteoradionecrosis and resultant anterior cranial fossa CSF leak [16, 36].

19.7 Pedicled Buccal Fat Pad Flap

The buccal fat pad flap, pedicled on the internal maxillary artery (IMA), may be harvested endoscopic endonasal after removing the posterior wall of the maxillary sinus. Alternatively, it may be harvested via a skin incision or a buccal mucosal incision (pedicle based on the TFA and FA). It can be used to reconstruct moderate size defects such as sellar and clival defects and the middle cranial fossa [37].

19.8 Salpingopharyngeus Flap (Dicle Flap)

The Dicle flap (named after Dicle University in Turkey) is a pedicled myomucosal flap supplied by branches of the ascending pharyngeal artery. The salpingopharyngeus muscle originates from the lateral lamina of the Eustachian tube (torus tubarius) and descends at the anterior margin of the fossa of Rosenmüller to form the salpingopharyngeal fold. Its inferior aspect inserts into the palatopharyngeal muscle and the superior edge of the thyroid cartilage. It can be used to reconstruct the defects of the inferior clivus and craniovertebral junction, and for the protection of the petrous and paraclival segments of internal carotid artery. Caveats of this flap include the need for secondary healing of the donor site, potential Eustachian tube dysfunction, and dysphagia [38].

19.9 Conclusions

The most commonly used vascularized tissue flap for reconstruction of skull base defects is the NSF. However, in the setting of malignancy or previous surgery, an alternative regional flap reconstruction may be necessary. While the pericranial and TPFF are the most commonly utilized extranasal regional flaps, additional options including the occipital, palatal, facial buccinator, pedicled buccal fat, and salpingopharyngeus flap have been utilized. The pericranial and facial buccinator flaps are classically described for anterior skull base defects while the TPFF, occipital, and salpingopharyngeus flaps are ideally situated for reconstruction of posterior or clival defects. The palatal flap may also be used for clival defects as well as for reconstruction of the sella turcica and planum. Many of these flaps are technically challenging, and the morbidity compared to alternative options should be weighed when selecting these techniques.

Conflict of Interest The authors have no relevant conflicts of interest to disclose.

References

1. de Lara D, Ditzel Filho LF, Prevedello DM, Carrau RL, Kasemsiri P, Otto BA, et al. Endonasal endoscopic approaches to the paramendian skull base. World Neurosurg. 2014;82(6):121–9. https://doi.org/10.1016/j.wneu.2014.07.036.
2. Clavenna MJ, Turner JH, Chandra RK. Pedicled flaps in endoscopic skull base reconstruction: review of current techniques. Curr Opin Otolaryngol Head Neck Surg. 2015;23(1):71–7. https://doi.org/10.1097/MOO.0000000000000115.
3. Hachem RA, Elkhatib A, Beer-Furlan A, Prevedello D, Carrau R. Reconstructive techniques in skull base surgery after resection of malignant lesions: a wide array of choices. Curr Opin Otolaryngol Head Neck Surg. 2016;24(2):91–7. https://doi.org/10.1097/MOO.0000000000000233.
4. Kang SY, Eskander A, Hachem RA, Ozer E, Teknos TN, Old MO, et al. Salvage skull base reconstruction in the endoscopic era: vastus lateralis free tissue transfer. Head Neck. 2018;40(4):E45–52. https://doi.org/10.1002/hed.25094.
5. Hadad G, Bassagasteguy L, Carrau RL, Mataza JC, Kassam A, Snyderman CH, et al. A novel reconstructive technique after endoscopic expanded endonasal approaches: vascular pedicle nasoseptal flap. Laryngoscope. 2006;116(10):1882–6.
6. Reuter G, Bouchain O, Demanez L, Scholtes F, Martin D. Skull base reconstruction with pedicled nasoseptal flap: technique, indications, and limitations. J Craniomaxillofac Surg. 2019;47(1):29–32. https://doi.org/10.1016/j.jcms.2018.11.012.
7. Shastri KS, Leonel LCPC, Patel V, Charles-Pereira M, Kenning TJ, Peris-Celda M, et al. Lengthening the nasoseptal flap pedicle with extended dissection into the pterygopalatine fossa. Laryngoscope. 2019;130:18–24. https://doi.org/10.1002/lary.27984.
8. London NR, Ishii M, Gallia G, Boahene KDO. Technique for reconstruction of large clival defects through an endoscopic-assisted tunneled retropharyngeal approach. Int Forum Allergy Rhinol. 2018;8(12):1454–8. https://doi.org/10.1002/alr.22187.
9. Kim GG, Hang AX, Mitchell C, Zanation AM. Pedicled extranasal flaps in skull base reconstruction. Adv Otorhinolaryngol. 2013;74:71–80. https://doi.org/10.1159/000342282.
10. Patel MR, Shah RN, Snyderman CH, Carrau RL, Germanwala AV, Kassam AB, et al. Pericranial flap for endoscopic anterior skull-base reconstruction: clinical outcomes and radioanatomic analysis of preoperative planning. Neurosurgery. 2010;66(3):506–12. https://doi.org/10.1227/01.NEU.0000365620.59677.FF.
11. Tang IP, Carrau RL, Otto BA, Prevedello DM, Kasemsiri P, Ditzel L, et al. Technical nuances of commonly used vascularised flaps for skull base reconstruction. J Laryngol Otol. 2015;129(8):752–61. https://doi.org/10.1017/S002221511500167X.

12. Klatt-Cromwell CN, Thorp BD, Del Signore AG, Ebert CS, Ewend MG, Zanation AM. Reconstruction of skull base defects. Otolaryngol Clin N Am. 2016;49:107–17.
13. Majer J, Herman P, Verillaud B. "Mailbox slot" pericranial flap for endoscopic skull base reconstruction. Laryngoscope. 2016;126(8):1736–8. https://doi.org/10.1002/lary.25686.
14. Santamaria A, Langdon C, López-Chacon M, Cordero A, Enseñat J, Carrau R, et al. Radio-anatomical analysis of the pericranial flap "money box approach" for ventral skull base reconstruction. Laryngoscope. 2017;127(11): 2482–9. https://doi.org/10.1002/lary.26574.
15. Zanation AM, Snyderman CH, Carrau RL, Kassam AB, Gardner PA, Prevedello DM. Minimally invasive endoscopic pericranial flap: a new method for endonasal skull base reconstruction. Laryngoscope. 2009;119(1):13–8. https://doi.org/10.1002/lary.20022.
16. Patel MR, Taylor RJ, Hackman TG, Germanwala AV, Sasaki-Adams D, Ewend MG, et al. Beyond the nasoseptal flap: outcomes and pearls with secondary flaps in endoscopic endonasal skull base reconstruction. Laryngoscope. 2014;124:846–52. https://doi.org/10.1002/lary.24319.
17. Chakravarthi S, Gonen L, Monroy-Sosa A, Khalili S, Kassam A. Endoscopic endonasal reconstructive methods to the anterior skull base. Semin Plast Surg. 2017;31:203–13. https://doi.org/10.1055/s--0037-1607274.
18. Yano T, Tanaka K, Kishimoto S, Lida H, Okazaki M. Reliability of and indications for pericranial flaps in anterior skull base reconstruction. J Craniofac Surg. 2011;22(2):482–5. https://doi.org/10.1097/SCS.0b013e318207b714.
19. Battaglia P, Turri-Zanoni M, Castelnuovo P, Prevedello DM, Carrau RL. Brian herniation after endoscopic transnasal resection of anterior skull base malignancies. Neurosurgery. 2015;11:457–62. https://doi.org/10.1227/NEU.0000000000000859.
20. Fortes FS, Carrau RL, Snyderman CH, Kassam A, Prevedello D, Vescan A, et al. Transpterygoid transposition of a temporoparietal fascia flap: a new method for skull base reconstruction after endoscopic expanded endonasal approaches. Laryngoscope. 2007;117(6):970–6.
21. Veyrat M, Verillaud B, Herman P, Bresson D. How I do it. The pedicled temporoparietal fascia flap for skull base reconstruction after endonasal endoscopic approaches. Acta Neurochir. 2016;158(12):2291–4.
22. Ferrari M, Vural A, Schreiber A, Mattavelli D, Gualtieri T, Taboni S, et al. Side-door temporoparietal fascia flap: a novel strategy for anterior skull base reconstruction. World Neurosurg. 2019;126:e360–70. https://doi.org/10.1016/j.wneu.2019.02.056.
23. Collar RM, Zopf D, Brown D, Fung K, Kim J. The versatility of the temporoparietal fascia flap in head and neck reconstruction. J Plast Reconstr Aesthet Surg. 2012;65(2):141–8. https://doi.org/10.1016/j.bjps.2011.05.003.
24. Mavropoulos JC, Bordeaux JS. The temporoparietal fascia flap: a versatile tool for the dermatologic surgeon. Dermatol Surg. 2014;40:113–9. https://doi.org/10.1097/dss.0000000000000114.
25. Baujat B, Struk S, Lesnik M, de Crouy CO, Barbut J, Lefevre M, et al. Fascia temporalis free flap for cricotracheal reconstruction: a novel approach. Ann Thorac Surg. 2017;104(3):1040–6. https://doi.org/10.1016/j.athoracsur.2017.02.078.
26. Mokal NJ, Ghalme AN, Kothari DS, Desai M. The use of the temporoparietal fascia flap in various clinical scenarios: a review of 71 cases. Indian J Plast Surg. 2013;46(3):493–501. https://doi.org/10.4103/0970-0358.121988.
27. Yano H, Fukui M, Yamada K, Nishimura G. Endoscopic harvest of free temporoparietal fascial flap to improve donor-site morbidity. Plast Reconstr Surg. 2001;107(4):1003–9.
28. de Magalhães RP, Brandão LG, Magalhães MG, Ferraz AR. Galeal pedicle flap of the occipital region for pharynx reconstruction: anatomic and clinical considerations. Plast Reconstr Surg. 1998;102(6): 2124–8.
29. Kwon H, Kim HJ, Yim YM, Jung SN. Reconstruction of scalp defect after Moyamoya disease surgery using an occipital pedicle V-Y advancement flap. J Craniofac Surg. 2008;19:1075–9.
30. Moore MG, Lin DT, Mikulec AA, McKenna MJ, Varvares MA. The occipital flap for reconstruction after lateral temporal bone resection. Arch Otolaryngol Head Neck Surg. 2008;134(6):587–91. https://doi.org/10.1001/archotol.134.6.587.
31. Rivera-Serrano CM, Snyderman CH, Carrau RL, Durmaz A, Gardner PA. Transpharyngeal and transpterygoid transposition of a pedicled occipital galeopericranial flap: a new flap for skull base reconstruction. Laryngoscope. 2011;121(5):914–22. https://doi.org/10.1002/lary.21376.
32. Durmaz A, Fernandez-Miranda J, Snyderman CH, Rivera-Serrano C, Tosun F. Prevertebral corridor: posterior pathway for reconstruction of the ventral skull base. J Craniofac Surg. 2011;22(3):848–53. https://doi.org/10.1097/SCS.0b013e31820f7d86.
33. Oliver CL, Hackman TG, Carrau RL, Snyderman CH, Kassam AB, Prevedello DM, et al. Palatal flap modifications allow pedicled reconstruction of the skull base. Laryngoscope. 2008;118(12):2102–6. https://doi.org/10.1097/MLG.0b013e318184e719.
34. Zanation AM, Thorp BD, Parmar P, Harvey RJ. Reconstructive options for endoscopic skull base surgery. Otolaryngol Clin N Am. 2011;44(5):1201–22. https://doi.org/10.1016/j.otc.2011.06.016.
35. Rivera-Serrano CM, Oliver CL, Sok J, Prevedello DM, Gardner P, Snyderman CH, et al. Pedicled facial buccinator (FAB) flap: a new flap for reconstruction of skull base defects. Laryngoscope.

2010;120(10):1922–30. https://doi.org/10.1002/lary.21049.
36. Farzal Z, Lemos-Rodriguez AM, Rawal RB, Overton LJ, Sreenath SB, Patel MR, et al. The reverse-flow facial artery buccinator flap for skull base reconstruction: key anatomical and technical considerations. J Neurol Surg B Skull Base. 2015;76(6):432–9. https://doi.org/10.1055/s-0035-1551669.
37. Markey J, Benet A, El-Sayed IH. The endonasal endoscopic harvest and anatomy of the buccal fat pad flap for closure of skull base defects. Laryngoscope. 2015;125(10):2247–52.
38. Gun R, Oyama K, Kapucu B, Wang L, Al Qahtani AA, Otto BA, et al. Salpingopharyngeus myomucosal flap. J Craniofac Surg. 2014;25(6):1967–70.