

Original Article

Surgical Outcomes of Using Temporoparietal Fasciocutaneous and Temporoparietal Pedicle Flap for Auricular Reconstruction

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BACKGROUND: Temporoparietal fasciocutaneous and temporoparietal fascial pedicle flaps play an important role among many techniques for auricular reconstruction. Because of their unique characteristics, the flaps based on the superficial temporal artery may be used for various types of reconstruction.

METHODS: In this article, we present several applications of the temporoparietal fasciocutaneous and temporoparietal fascial pedicle flaps in the reconstruction of defects after ear resection, including the use of the sandwich flap.

RESULTS: Our experiences presented in this case series confirm the reconstructive potential of the flaps, also in patients in whom the Vistafix® system was used for reconstruction of the ear.

CONCLUSIONS: In all cases described herein, the use of the pedicle flaps resulted in optimal healing and satisfactory cosmetic and functional outcomes.

KEYWORDS: Auricular cancer, ear cancer, ear surgery, otology, temporal bone, temporoparietal facial flap

INTRODUCTION

A consequence of radical oncological resection or scar tissue formation in the facial region may be a deficiency of the skin and supporting tissues, causing difficulties with primary closure. One of the best reconstructive options in such cases is the use of regional flaps. Among the latter, temporoparietal pedicle flap (TPF) seems to be the most feasible option. The advantages of the TPF include its consistent anatomy, in 90% of the cases based on the superficial temporal artery (STA) and veins, adequate blood supply, proximity to the recipient sites, and presence of a long, thin, pliable, and resistant vascular peduncle which provides wide arc of rotation, with the possibility of up to 12-cm translocation of the flap.¹ The color of the TPF skin island flap is similar to the skin of the recipient site. Its excellent blood supply provides resistant to infections. Given the anatomical division of the STA, 2 skin island flaps based on its frontal and parietal branches can be used. Further, Benlier reported on the use of reverse TPF with the utilization of reverse blood flow from an anastomotic network of the supratrochlear and supraorbital arteries to the frontal branch and anastomotic connection between the occipital artery and the parietal branch.^{2,3} Due to all the characteristics mentioned above, the TPF has a high survivability rate and can provide an optimal blood supply for other transplanted tissues.⁴⁻⁶

Surgical Technique

The STA can be identified using Doppler imaging or through palpation, underneath the skin covering the zygomatic arch or 2 cm superiorly and anteriorly from the external auditory canal. Following the identification and marking of the vessel, the lines of skin incisions and the borders of the skin flaps are planned. The vertical incision is made from the root of the helix toward the superior temporal line. The incision is continued toward the posterior margin of the flap if the latter is planned to be based on the frontal branch of the STA or toward its anterior margin if based on the parietal branch. Usually, the STA is accompanied by 1 or 2 veins that run above the artery and should be spared.¹ During the incision, an injury to the temporal branch of the

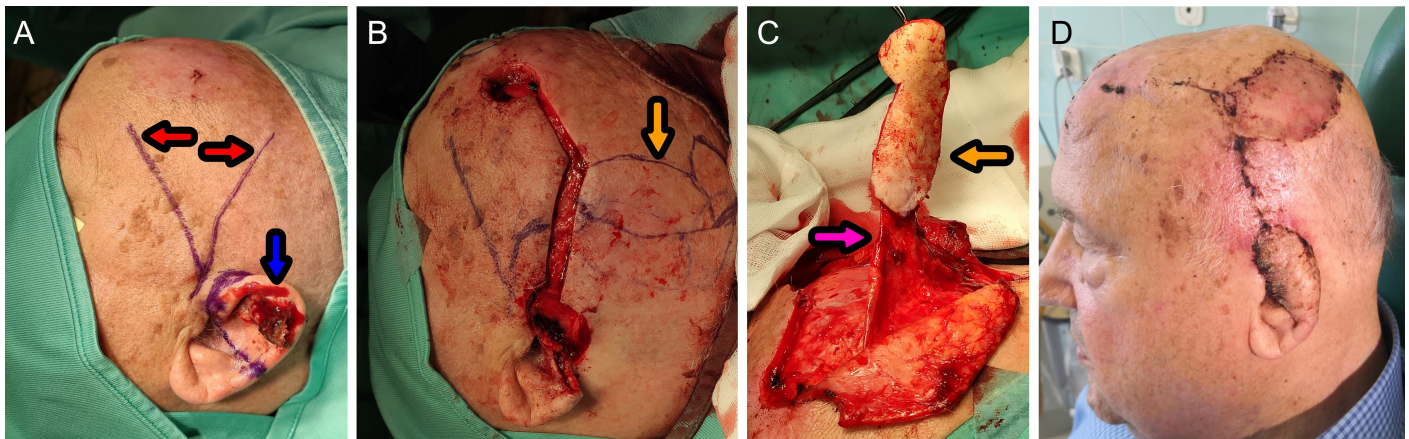


Figure 1. A-D. The use of TPFC “sandwich” flap for upper part of the left auricle reconstruction. (A) Range of resection and flap planning before surgery. Tumor—blue arrow, frontal and parietal branches of the superficial temporal artery—red arrow; (B) view after tumor resection, preparing the flap—orange arrow; (C) skin island—orange arrow, pedicle—rose arrow; (D) patient 2 weeks after surgery. TPFC, temporoparietal fasciocutaneous.

facial nerve should be avoided as well. At the level of the zygomatic arch, the temporal branch gives off 2-4 ramifications that run underneath the TPF, 12-14 mm anteriorly to the articular eminence of the zygoma.^{7,8} The anterior scalp flap is elevated through the meticulous sharp dissection in the subdermal plane. It is essential to continue the dissection slightly below the hair follicles to leave a thin layer of subcutaneous fibrofatty tissue and, hence, to prevent local alopecia. The STA is identified 0.5-1 cm anteriorly from the root of the helix and then the dissection is continued peripherally along the vessel. Once the planned skin island has been reached, a circular incision is tailored around it. The island receives blood supply from the STA via perforator vessels. It is crucial to tailor the skin flap around the STA, located in the layer underneath. Then, the skin island is raised caudally together with the TPF, released from loose areolar tissue, trimmed to the required size with sparing the vascular pedicles, and tailored inferiorly, down to the parotid gland. Finally, the TPFC flap is rotated to the recipient site. If the TPF is used, it can be covered with a split skin graft, which may be meshed. If the reconstruction extends to the posterior part of the external auditory canal, the flap is stabilized using a cotton pledge with antibiotic ointment, maintained for up to 3 weeks.

MATERIAL AND METHODS

We presented and analyzed group of 8 patients, from 41 to 84 years old (mean 70), who underwent ear reconstructive procedure with use of TPF or TPFC flap. Six of them were male and 2 females. All procedures performed in studies involving human participants were in accordance with the ethical standards. For this type of study, formal consent of ethic committee is not required. All study participants provided informed written consent prior to medical treatment and study enrollment.

Case 1

A 64-year-old man with a history of squamous cell carcinoma (SCC), arising from the triangular fossa and crura of the antihelix and invading the upper third of the left ear, underwent a hemiresection of the auricle with subsequent reconstruction using the TPFC “sandwich” flap (Figure 1). The auricle was reconstructed by bending the flap composed of 2 skin islands. Additionally, 2 other foci of basal cell carcinoma were resected from the same side of the head. The skin defect was covered by a split skin graft taken from the femur. Complete reception of the flap was achieved with good healing and satisfactory cosmetic outcome.

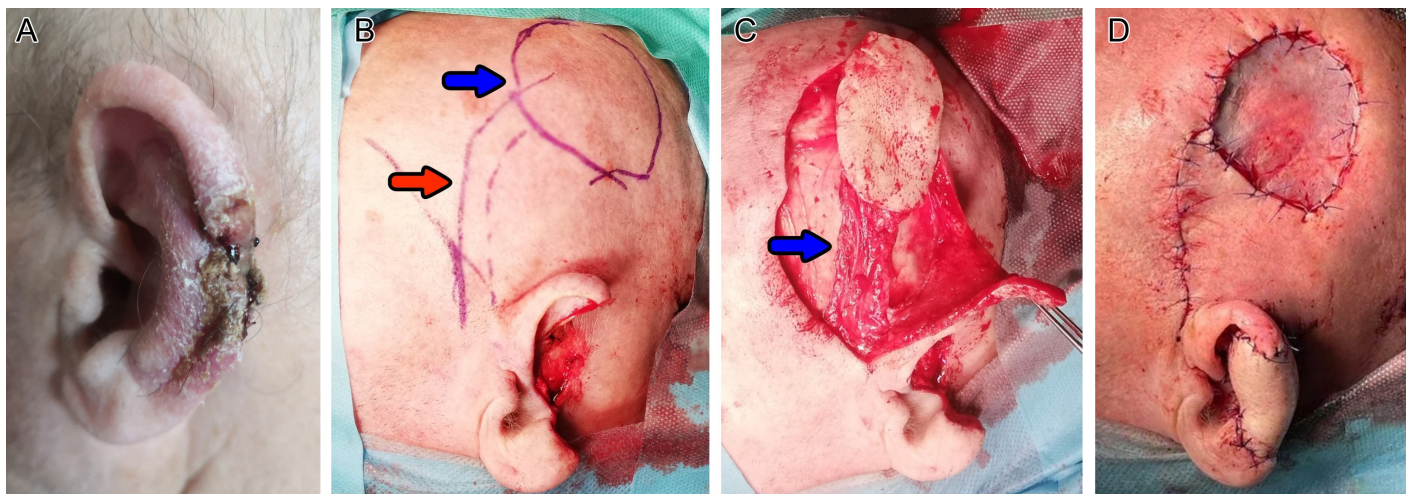


Figure 2. A-D. The use of TPFC “sandwich” flap for middle third of left auricular defect reconstruction. (A) Tumor; (B) flap planning—blue arrow, STA parietal branch red arrow; (C) raised flap, pedicle blue arrow; (D) final result with flap translocation. TPFC, temporoparietal fasciocutaneous; STA, superficial temporal artery.

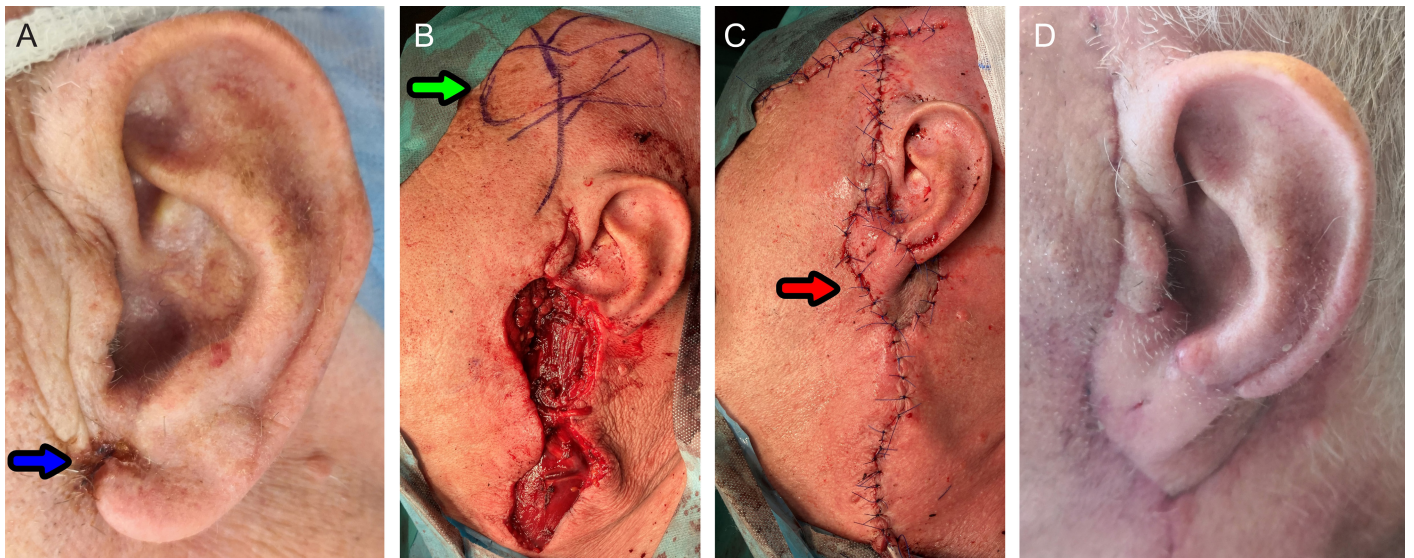


Figure 3. A-D. The use of TPFC “sandwich” flap for lower third of left auricular reconstruction. (A) Before surgery, tumor—blue arrow; (B) TPFC flap planning—green arrow; (C) final result after surgery, rotated flap—red arrow; (D) patient 2 weeks after surgery. TPFC, temporoparietal fasciocutaneous.

Case 2

A 65-year-old man was admitted to our clinic with a history of malignant lesions of the left external ear, SCC. Tumor involved middle third of the auriculae with helix erosion (Figure 2). Triangle subtotal excision of the primary lesion with a 1-cm margin of macroscopically healthy tissue was performed above antitragus to the triangular fossa leaving helical root and crus. Histologically controlled excision was performed until the margins were pathohistologically free. Partial auricular reconstruction with the defect coverage using the TPFC “sandwich” flap was done. The flap completely healed, and cosmetic result was acceptable.

Case 3

A 78-year-old man was admitted with an eroding metatypical SCC of the auriculae lobe. Magnetic resonance imaging of the neck confirmed cancer invasion from the left auriculae lobe attachment to the superficial lobe of the parotid gland. Resection of lower third of the auriculae downward from the level of external ear canal

en bloc with skin, subcutaneous tissue, superficial parotid fascia, and superficial parotid gland was performed. The auriculae was reconstructed using the TPFC “sandwich” flap based on frontal STA branch (Figure 3). The flap completely healed, and cosmetic result was very good.

Cases 4 and 5

A 66-year-old man was admitted with an invasive metatypical basal cell carcinoma of the right auricular concha (type IV according to Bukal).⁹ The round tumor, 7 mm in diameter, was resected along with the cartilage of the concha. The defect was reconstructed with the TPFC flap based on the frontal branch of the STA (Figure 4). The operated site healed well, and the patient considered cosmetic outcome acceptable and resigned from the flap thinning. The same technique of TPFC based on STA frontal branch was used for surgical treatment of the basal cell carcinoma (BCC) of the left auriculae concha in a 70-year-old woman. Good cosmetic results and complete skin island survival were achieved.

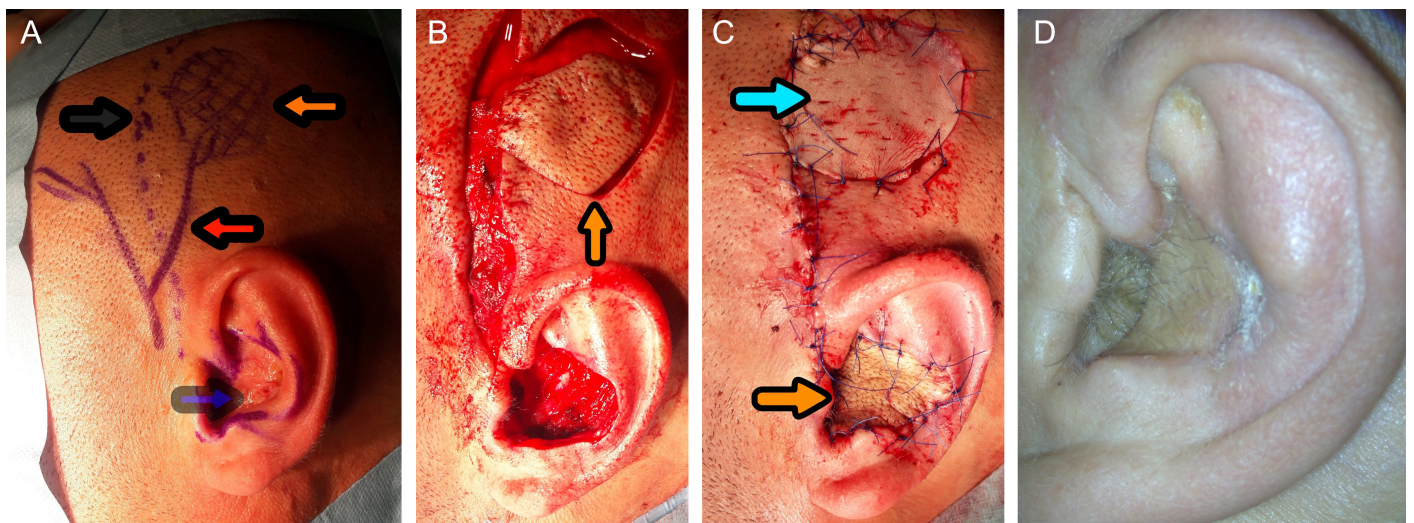


Figure 4. A-D. The use of TPFC for left auricular concha reconstruction. (A) Before surgery, tumor—blue arrow; (B) TPFC flap planning—orange arrow; (C) final result after surgery; (D) patient 2 weeks after surgery. TPFC, temporoparietal fasciocutaneous.

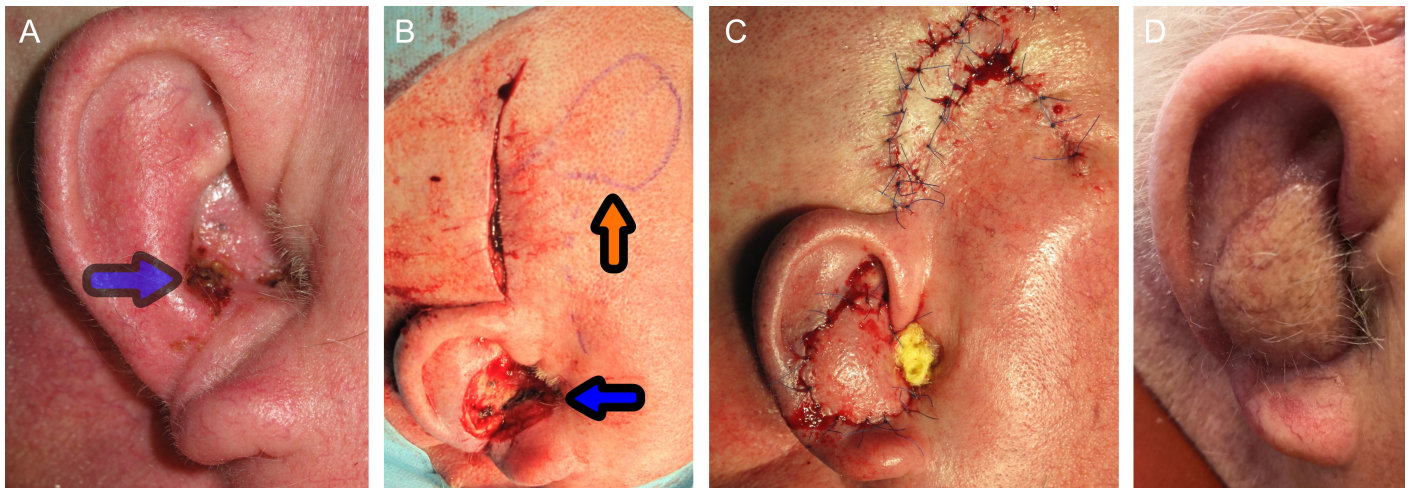


Figure 5. A-D. The use of TPFC for right auricular concha reconstruction. (A) Patient before surgery, tumor—blue arrow, flap planning—orange arrow, parietal branch of the STA red arrow; (B) skin flap—orange arrow, range of resection—blue arrow; (C) flap transferred and sutured in place; (D) patient 2 weeks after surgery. TPFC, temporoparietal fasciocutaneous; STA, superficial temporal artery.

Case 6

A 38-year-old man with an eroding oval metatypical BCC (5 mm × 7 mm) located in the right cavum concha underwent a full-thickness resection of the concha and intratragal notch, with the resection margin involving the antitragus, antihelix, antihelix inferior crura, crus of the helix, and posterior cartilaginous part of the external auditory canal. The retroauricular skin was sutured with the remaining postauricular skin raised from the antihelix fossa. The concha was reconstructed with the TPFC flap based on the parietal branch of the STA (Figure 5). A good cosmetic outcome was obtained, with no evidence of cancer recurrence during subsequent control visits.

Case 7

An 88-year-old man was admitted due to invasive recurrence of basalioma exulcerans diagnosed 6 months after Burrow's triangle resection of helical BCC in the left auricle. The patient underwent total

auricular resection with mastoidectomy and posterior wall resection. The mastoid was obliterated with the use of a temporal muscle flap based on the middle temporal artery (Hong Kong flap). Then, the whole postauricular surface was refined by the TPF and covered with a split-thickness mashed skin graft. The second split-thickness skin flap was inserted into the external auditory canal to reconstruct the posterior wall (Figure 6). Four weeks later, the surface was smooth enough to perform external ear reconstruction in preparation for the use of the Vistafix® system. No signs of carcinoma recurrence were observed during a 12-month follow-up, and the patient could eventually undergo the secondary reconstruction of the auricle with the prosthesis based on the Vistafix® system.

Case 8

A 60-year-old man was admitted with unilateral right-side microtia and a history of 20 previous auricular reconstructions. The patient

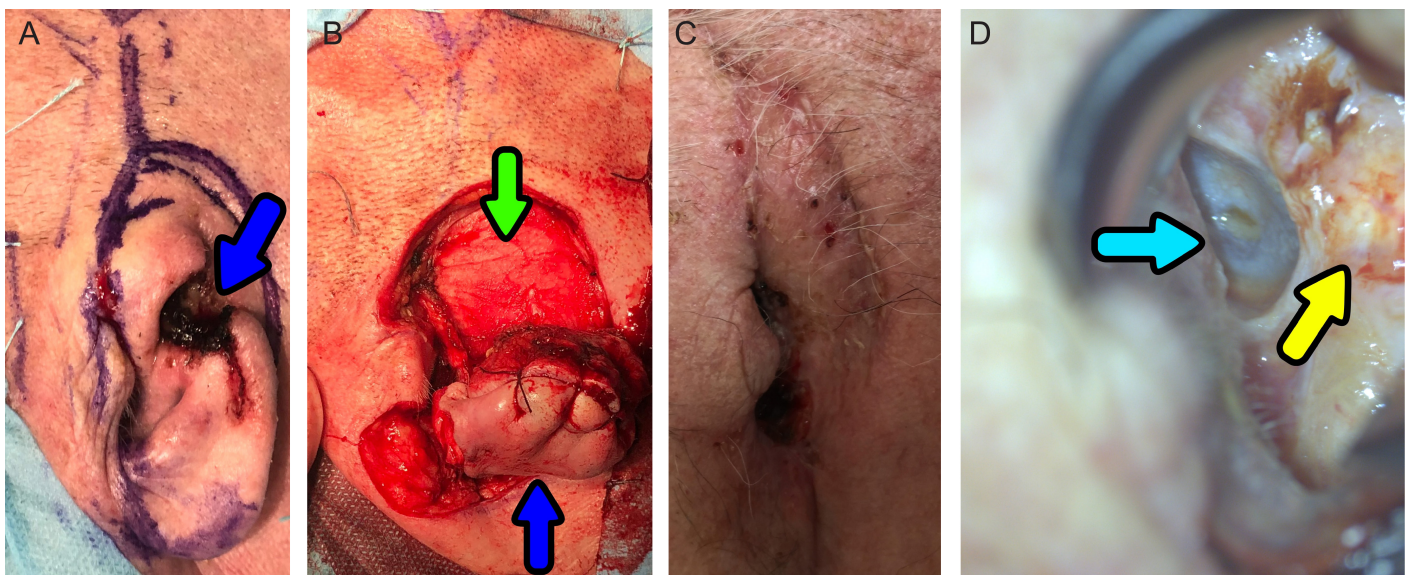


Figure 6. A-D. The use TPF flap for closing soft tissue defect after right auricular and temporal bone resection. (A) Range of resection, tumor—blue arrow; (B) TPF flap—green arrow, area of resection—blue arrow; (C) patient 2 weeks after surgery; (D) microscopic view 2 weeks after surgery—tympanic membrane—light blue arrow, mastoid obliterated by temporalis muscle flap and covered with split thickness skin graft—yellow arrow. TPF, temporoparietal fascial; STA, superficial temporal artery.

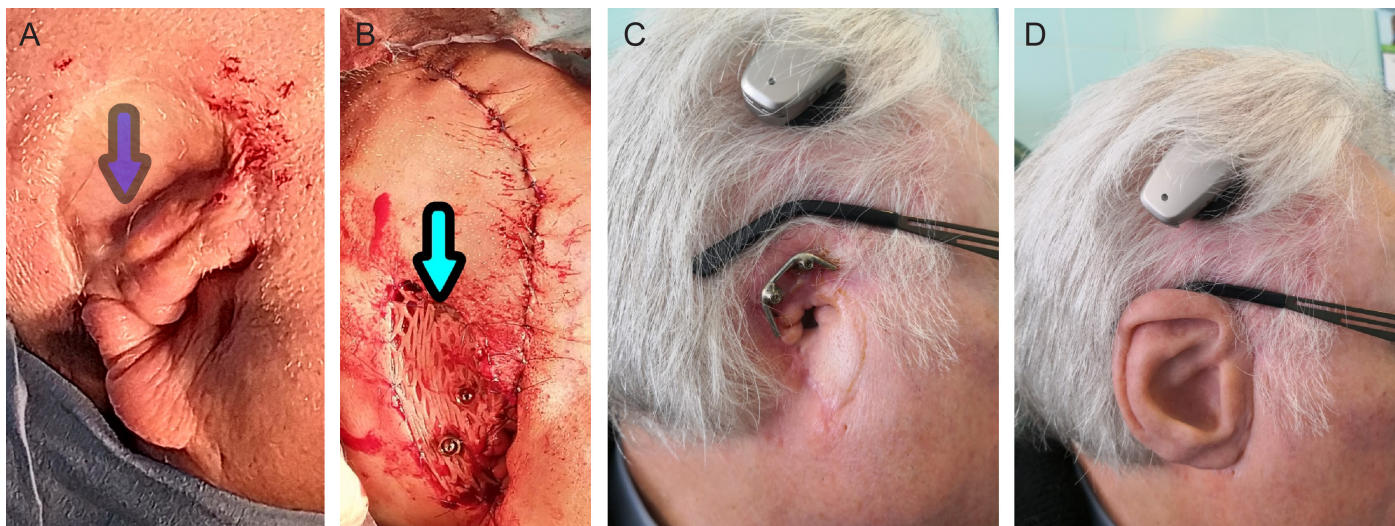


Figure 7. A-D. The use TPF flap for closing soft tissue defect after 20 unsuccessful auricular reconstructions. (A) Auricular and scar tissue—blue arrow; (B) split thickness meshed skin graft lays on TPF flap—light blue; (C) implants and attachment for epithesis; (D) fixed epithesis. TPF, temporoparietal fascial.

opted for the resection of scar tissue and residual cartilage be used for auricular reconstruction, but he was offered reconstruction with the Vistafix® system instead. All scar tissue and the remnants from previous unsuccessful reconstructions were removed. Then, 2 transcutaneous titanium osteointegrated implants were mounted into the temporal bone, and the whole surface was covered by the TPF and mashed split skin graft (Figure 7). During the same procedure, a magnetic implant system of the bone conductive hearing device was installed in the temporal bone. The TPF covered the bone and provided a thin protective layer and good vascular support for the mashed split skin graft. Good healing and smooth surface were achieved 6 weeks after the procedure, and the patient could undergo auricular reconstruction with epithesis connected to the Vistafix® system (Figure 8).

DISCUSSION

Surgical reconstruction of the ear still constitutes to be a challenge. To achieve a satisfactory outcome of auricular reconstruction both in terms of esthetics and function, the surgeon needs to transfer tissues from other areas. Given their proximity, versatile form without a skin island or with up to 2 islands, and excellent blood supply, the reconstruction with STA-based pedicle flaps seems to be an optimal solution.^{1,8,10}

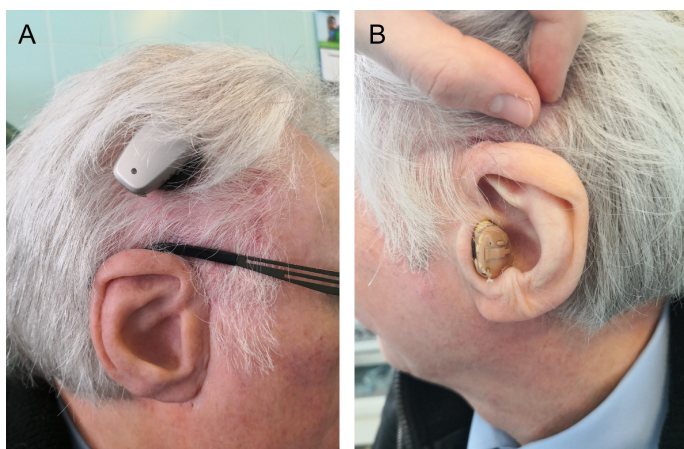


Figure 8. A,B. Comparison of the right auricular prosthesis (A) with left ear (B).

In the first case reported herein, the novel use of the TPFC sandwich flap provided a similar rigidity of the upper half of the reconstructed auricle as in the case of the reconstruction with molded cartilage or polypropylene (MEDPOR) covered by the skin. The cartilaginous incorporation for the reconstruction of the auricle was first described by Tanzer in 1959. However, the outcomes of this method were not entirely satisfactory due to the frequent occurrence of atrophy or cartilage remodeling.^{11,12} To overcome this problem, polypropylene (MEDPOR) was introduced by Reinisch, but according to many authors, this material was not superior to the cartilage.¹³⁻¹⁵ Although our patient has been wearing glasses, we did not need to use an additional framework to strengthen the reconstructed auricle. The rigid structure of the auricle was achieved by bending the flap, which, importantly, neither restricted the blood flow in the vascular pedicle nor impaired the blood supply of the reconstructed ear. The second case demonstrates the use of TPFC “sandwich flap” for middle part or the ear reconstruction. This reconstruction may be performed also with use of staged retroauricular advancement flap using a costal graft.¹⁶⁻¹⁸ Presented herein one stage surgery enables the faster implementation of adjuvant treatment. In the first two presented cases we achieved symmetrical projection from the head and the smooth curvature of the helix, the two most important characteristics of the ear.¹⁹ The third case presents reconstructive possibility of using TPFC flap for the lower part of the auricle reconstruction. This part of the auricle may be reconstructed by folded flap, 2 opposed flaps, double-crossed skin flap, or bilobed flap.^{16,20-23} These are great technics for post-traumatic ear lobe reconstruction, but in oncological cases, transposition of the skin pedicle flaps located near the tumor may lead to increase in recurrence rate of cancer. These limitations do not have a flap shifted from a more distant area. We described auricular concha reconstruction with the use of temporo-parietal fasciocutaneous flap in fourth and fifth cases. This reconstruction may also be done with use of postauricular island pedicle flap, preauricular translocation flap, or revolving door flap, but donor skin flap may be infiltrated by the cancer. However, these technics usually are useful for reconstruction of smaller defects.^{24,25}

We do not observe cancer recurrence in all our cases which indicates a high radicality of resection in the described cases combined

Table 1. Patients' Characteristics and Skin Island Dimension

Case No.	Patient	Gender	Age	Flap Type	Skin Flap Based on STA Branch	Skin Flap Dimension (mm)
1	ŚM	M	82	TPFC	Parietal	65 × 40
2	KP	M	73	TPFC	Parietal	46 × 44
3	MS	M	78	TPFC	Frontal	56 × 22
4	KM	M	41	TPFC	Parietal	50 × 44
5	TS	M	72	TPFC	Frontal	54 × 53
6	ŚW	F	70	TPFC	Parietal	26 × 24
7	GA	M	84	TPF	Parietal and frontal	-
8	KD	M	63	TPF	Parietal and frontal	-

TPFC, temporoparietal fasciocutaneous; TPF, temporoparietal fascial; STA, superficial temporal artery; M, male; F, female.

with adequate reconstruction and acceptance for patient cosmetic effects. In our experience, TPFC flap may be used for all parts of auriculae reconstruction, if defect is up to half size of the external ear. The biggest area of used skin island in our group was 26 cm³ (Table 1). Our experiences confirmed high effectiveness of flaps based on the frontal or parietal branches of the STA. (Table 1)

In all our patients who underwent auricular reconstruction with the TPFC, the redness of the skin flap was apparent a few days after the surgery; according to many authors, this is a sign of an excellent blood supply and fast healing of the tissue.^{2,4,5,10,26,27} Given the fast and uneventful healing, the patients after auricular reconstruction with regional flaps were relatively early eligible for adjuvant treatment, such as radiotherapy and chemotherapy. A minor disadvantage of the reconstruction with the TPFC is the necessity to shave the hair growing on the newly formed auricle. But this problem is also *present* in other flaps, for example, extended retroauricular advancement flap.¹⁸ Unwanted hair may be easily permanently removed with many types of lasers. Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser is especially recommended.²⁸

Not infrequently, despite multiple attempts and many reconstructive surgeries, the outcomes of whole auricular reconstruction and autologous repair are poor and the patient requires implantation of an auricular prosthesis. This procedure needs to be preceded by appropriate preparation of the surface to increase the likelihood of optimal fixation of titanium implants and good healing. Osteointegration is a gradual process characterized by the periodical appearance of various tissues, such as bloody corpuscles and trabecular bone. For the first 7 days, the interface between the implant and the bone is filled by aqueous cellular elements and lacks a mineralized matrix.²⁹ As a result, the resistivity of the interface is approximately 100 000 times lower than in the case of mature bone.³⁰ The technique used in 2 of our patients (Cases 6 and 7) stimulated healing and provided better stability for the transcutaneous implants and good adherence of the epithesis.

CONCLUSION

Because of their unique characteristics, the flaps based on the STA may be used for various types of auricular reconstruction. Depending on the application, the flaps can be thin and flexible or thick and rigid, or standalone or connected to a skin island. Regardless of the

form, the flaps retain their primary advantage, that is, constant and adequate blood supply, and hence can be used to cover other poorly perfused tissues or auricular implants, improving healing thereof and providing better stability. In this case series, we present good results obtained with TPFC pedicle flaps based on the temporal or parietal branch of the STA for all parts of auriculae reconstruction.

Moreover, we describe a new application of the TPFC flap for auricular reconstruction with epithesis connected to the Vistafix® system and simultaneous, sequential implantation of transcutaneous titanium screws. In these cases, we used the TPF to prepare a smooth scaffold for the split skin graft and to envelop the titanium implants. The TPF, the thinnest flap in the human body, provided excellent blood supply for adjacent tissues, promoted osteointegration of the implants, and prevented local infection, at the same time forming a smooth adhesive surface for the auricular prosthesis.

Informed Consent: This article describes the stage of the case at the time of treatment in accordance with current standards. Consent from the Ethics Committee was not required.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – A.Z.; Design – A.Z.; Supervision – A.Z.; Materials – A.Z., K.M.; Data Collection and/or Processing – A.Z., K.M.; Analysis and/or Interpretation – A.Z.; Literature Review – A.Z.; Writing – A.Z.; Critical Review – A.Z., K.M.

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