OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Reconstructive

The Use of Temporoparietal Fascia Flap for Surgical Treatment of Traumatic Auricle Defects

Ubaidullo Kurbonov, MD, PhD*†‡
Abdumalik Davlatov, MD, PhD*†
Sitora Janobilova, MD, PhD*†
Ziyodullo Kurbanov, MD, PhD*§
Massoud Mirshahi, MD, PhD†¶‖

Background: Auricular reconstruction is 1 of the biggest challenges of facial plastic surgery. The aim of this study was to evaluate the efficacy of 1-stage reconstruction of an auricle using a temporoparietal fascia flap (TPFF).
Methods: In this nonrandomized study, autologous auricle bodies with emergency condition and cartilaginous graft from projection of a costal arch from the VI–VII ribs were used. Temporal fascia sample with vascular pedicle (a temporal artery with the accompanying veins) by the Z-shaped incision of skin in temporal area for auricular reconstruction was extracted. Skin grafts were taken from the supraclavicular area or from the left or right flank. Grafts of partial auricle bodies (n = 8) along with cartilaginous framework from a costal arch (n = 21) were used for auricle reconstruction. The follow-up period studied after 6 months in 29 operated patients.
Results: The graft of partial auricle bodies or the graft of a cartilaginous framework from a costal arch presented a perfect auricular reconstruction. By avoiding a difficult microsurgery and its possible complications, the use of TPFF led to beneficial results in 75% and 90.4% of cases, respectively. Overall, no major complication (alopecia, hematoma, or necrosis) occurred, and further surgery was not required.
Conclusion: TPFF is a technique of choice for surgical treatment of traumatic auricle defects. *(Plast Reconstr Surg Glob Open 2018;6:e1741; doi: 10.1097/GOX.0000000000001741; Published online 2 May 2018.)*

INTRODUCTION

In addition to acoustic function, the ear plays an important aesthetic role, and an ear problem can negatively influence the psychological state.[1] Auricular reconstruction is 1 of the greatest challenges in facial plastic surgery and, with advances in surgical and biotechnological techniques, different options can be considered by surgeons and patients. Auricular reconstruction was initially described by various surgeons such as Converse,[2] Tanzer,[3] and Brent.[4] The technique was performed using costal cartilages, which was developed later by Nagata[5–7] and Firmin.[8] Many surgeons adopted the Nagata technique and used several different variations. These variants consist of a costal cartilage sampling, followed by cartilage sculpture that was placed under the skin of the auricular region.[9,10]

The temporoparietal fascia flap (TPFF) is a versatile tool that has been widely used in the management of a variety of defects in the region of the head and neck. It consists of pedicle leaf containing arteries and veins. Because of its thin and flexible structure, reliable vascular supply, and minimal morbidity at the donor site, the TPFF has great advantages over other regional flaps.[11] TPFF was first used in 1898, almost simultaneously for the reconstruction of an external ear,[12] and for that of the lower eyelid.[13] In 1983, Gillies[14] described the use of the pedicle leaf based on the superficial temporal artery for the reconstruction of lip and eyebrow defects. In the same year, Brent and Byrd[15] reported the successful use of the TPFF for ear reconstruction. Recently, an expanded TPFF technique was used for total auricular reconstruction,[16] and for congenital microtia[17] and criptotia[18] malformations.

*From the *Republican Scientific Center of Cardiovascular Surgery; †Avicenna Tajik State Medical University, Dushanbe, Tajikistan; ‡Khatlon State Medical University, Dushanbe, Tajikistan; §Institute of Postgraduate Education in the Field of Public Health of the Republic of Tajikistan, Dushanbe, Tajikistan; ¶DPIEM, Tajikistan Academy of Sciences, Dushanbe, Tajikistan; and ‖Sorbonne Paris Cité University - Paris Diderot, Lariboisiere Hospital, INSERM U965, Paris, France.*

Received for publication June 20, 2017; accepted February 7, 2018.

DOI: 10.1097/GOX.0000000000001741

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*

The aim of this study was to demonstrate 1-stage reconstruction of an auricle using a vascular supply flap of the temporal fascia for surgical treatment of traumatic defects of the auricle.

MATERIALS AND METHODS

Patients

Since 1996, a total 29 patients with traumatic auricular defects have undergone reconstructive surgery at the Avicenna Tajik State Medical University Department of Plastic, Reconstructive Microsurgery and Regenerative Medicine. All patients, before surgery, provided a written consent for study participation. The Ethics Committee of the Tajikistan Health Ministry approved the undertaking of this study and associated procedures, in accordance with the Helsinki declaration (Fascia plasty project, February 1996).

The age of participants ranged from 4 to 50 years. The majority (24 cases; 82.8%) of these patients were males. There were only 5 females in this study (17.2%). There were 18 cases of right auricular injury, and 11 cases of left auricular injury.

As presented in Table 1, traumatic etiologies were varied and the majority of cases observed resulted from human or animal bites. In this study, 8 patients (27.6%) presented to our hospital and were treated in the emergent setting, over a period ranging from 30 minutes to 36 hours following injury, and their numbers in each group are noted. Twenty-one patients (72.4%) presented to other hospitals and were treated electively at our facility, in a period ranging from 3 months to 5 years following injury. The follow-up period studied presented in this study were after 6 months in 29 operated patients.

Implants

A- Autologous auricle body: All patients who presented acutely to our facility brought their partially amputated auricle bodies with them. In each case, the cartilage of an amputated auricle body separated from its cover tissues was used.

B- Cartilaginous graft: In a projection of a costal arch, a short oblique section of the cartilaginous graft from the VI–VII ribs, a sample having the necessary size was taken. A single cartilaginous framework of the missing part of an auricle (a helix, an antihelix with its pedicles, an antitragus) was simulated by the graft.

C- TPFF sample: An Z-shaped incision of skin in the temporal area was performed and then TPFF identified behind subcutaneous tissue. A vascular pedicle (a temporal artery with its accompanying veins) of temporal fascia having the area necessary for auricular reconstruction was excised.

D- Skin graft: A full-thickness skin graft was taken from the supraclavicular area or from the left or right flank.

Table 1. Auricular Trauma Etiologies (between Parentheses, the Emergence Condition Showed for Each Category)

Traumatic	Total n = 29 (Emergence, n = 8)	%
Accidental	16 (2)	55.2
Animal bite	5 (4)	17.2
Altercation	8 (2)	27.6
Total	29	100

Auricular Reconstruction Procedure

The operation begins with creation of a flap from the temporal fascia and vascular pedicle, with a surface area at least 2.5 times greater than the area of the healthy contralateral auricle. The remains of a cartilaginous framework of a cult of an auricle are bared. The formed cartilaginous framework is taken into cult by an absorbable suture material. Above the frame thus caught is wrapped in the raised fascial flap, which is then secured in place by interrupted sutures. A full-thickness skin graft is taken from the supraclavicular area to cover the entire surface of the fascial flap is covered and sutured in place. Bandages are applied taking into account the convex parts of the auricle.

Observation Following Surgical Intervention

All patients were observed for 5–36 months following their surgical operation. Their prognosis was judged to fall into 1 of 3 categories: superior, satisfactory, and unsatisfactory. All auricular reconstruction cases in which the operated external ear had the same shape as the contralateral ear, without the major scars or deformation, were considered to be "superior." In this context, the helix, triangular fossa, antihelix, concha, and antitragus, all were well reconstructed. When 1 or 2 of these auricular anatomic criteria were not met and in the contralateral auricle, the results of surgical treatment were considered "satisfactory." When more than 3 of these auricular anatomic criteria were not met and in the contralateral ear, or in cases where severe infection and/or necrosis, the results were considered "unsatisfactory." Statistical significance was determined using the GraphPad Prism 6.0 software (Student's t test), and $P < 0.05$ was considered statistically significant.

RESULTS

The Graft of a Cartilaginous Framework from a Costal Arch

Figure 1 demonstrates a 1-stage method of reconstruction of an auricle using the temporal fascia on a vascular pedicle, a cartilaginous framework from a costal arch, and a full-thickness skin graft. For a subtotal defect of an auricle (a), the lifted flap of a temporal fascia on a vascular pedicle was used (b). Simulated single cartilaginous framework from a costal arch (c) expended as a cartilaginous autograft hemmed to a stump of cartilage of an auricle and covered by a temporal fascia supplied with blood (d). This frame was covered by a full-thickness skin graft (e). The result after follow-up in 3 years is presented in Figure 1F. Twenty-one (72.4%) of the patients were operated on utilizing this method.

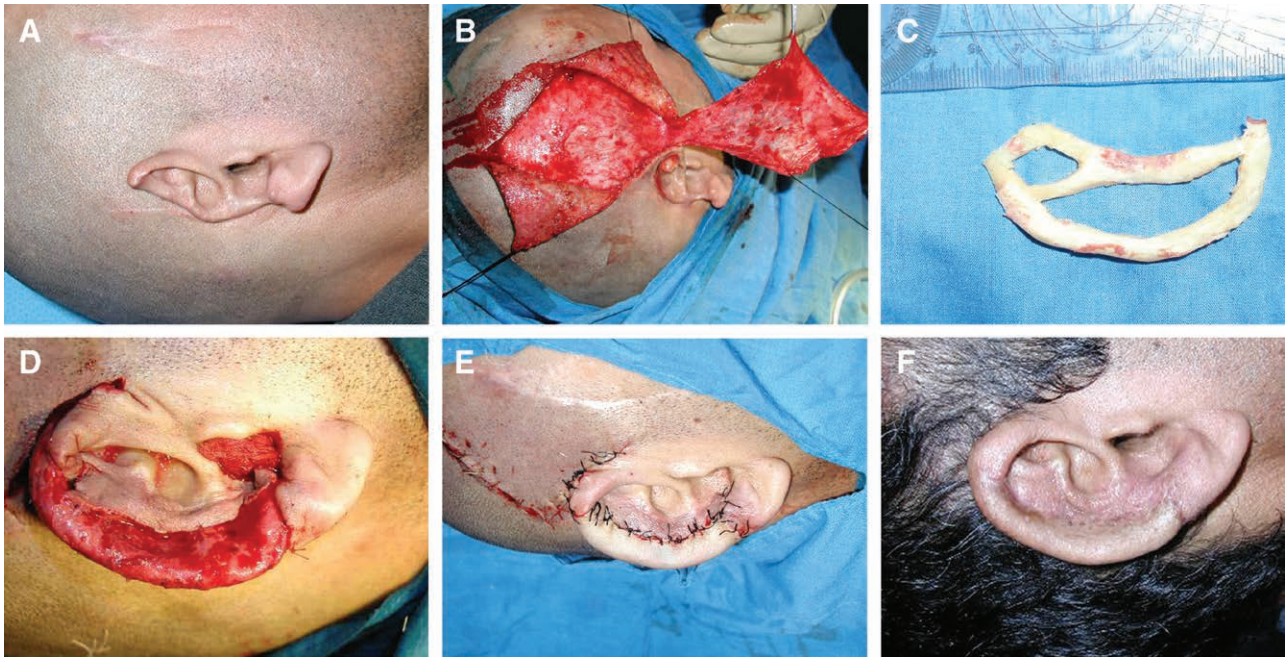

Fig. 1. Method of reconstruction of an auricle using of a temporal fascia: A, Subtotal defect of an auricle. B, Temporal fascia with a vascular pedicle. C, Cartilaginous framework from a costal arch. D, The cartilage of an auricle covered by a blood supplied temporal fascia. E, Cover of cartilage framework by a full-thickness skin graft. F, The follow-up result in 3 years.

Partial Graft of Auricle Bodies

In 8 cases, the use of an external leaf of fascia on a vascular pedicle allowed us "to reimplant" by "a nonstandard reimplantation" method, the torn-off auricle segments with success.

As presented in Figure 2, an auricle reimplantation with a flap of temporal fascia and its blood supply can be used in full traumatic ablation of a segment of an auricle (a). After the reimplantation of the cartilage of the amputated portion (b), the layer of a temporal fascia with the

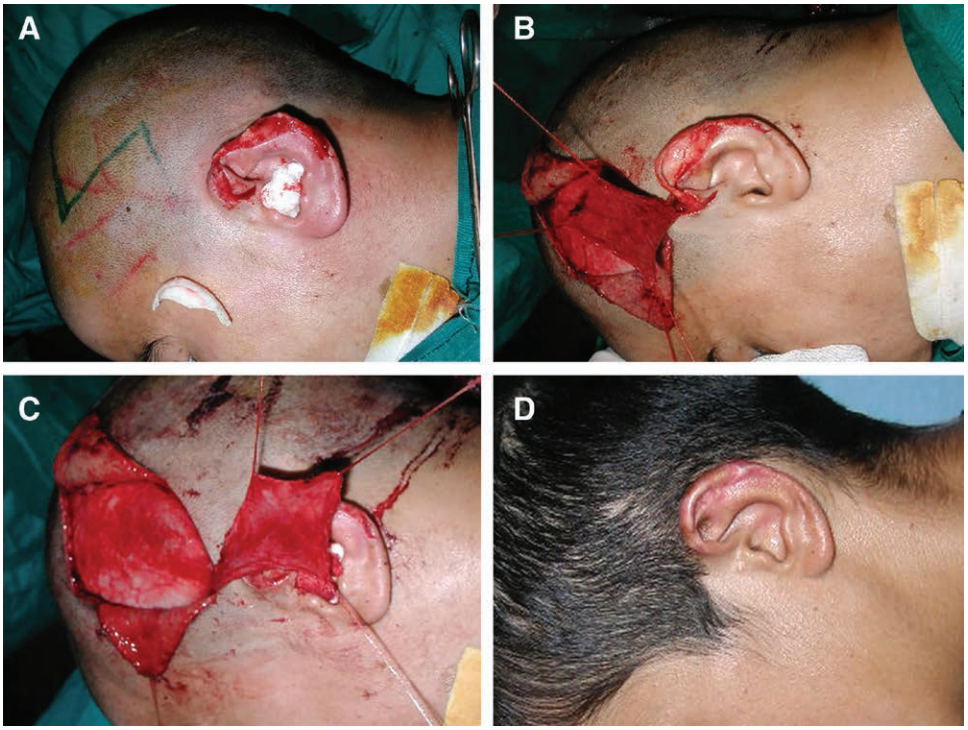

Fig. 2. An auricle replantation with applying of blood supply of flap of a temporal fascia. A, Full traumatic ablation of a segment of an auricle. B, The cartilage of amputate is sew to a stump. C, The lifted flap of a temporal fascia on a vascular pedicle. D, The follow-up result in 6 months.

Table 2. The Follow-up Results of Reconstruction of an Auricle Depend on Methods of Operation

Methods of Operations	Successful	Satisfactory (%)	Unsatisfactory
One-stage method with the use of a temporal fascia (n = 21)	19	2 (10.5)	0
Auricle replantation with applying of a temporal fascia (n = 8)	6	2 (33.3)	0
Total	25	4	0

neural and vascular pedicle (c) will cover it. The follow-up result at 6 months is presented in Figure 2D. The donor wound is sewn with dermal suture. Further, the skin of the amputated portion is cleared of its subcutaneous fat, and a full-thickness skin graft is placed over the temporal fascia.

The follow-up results in the period of 6 months to 5 years later in 29 operated patients were studied. The criteria of evaluation were the subjective assessment of the auricular condition of the patients, the objective assessment of the formed auricle's condition, and a comparative assessment based on anthropometric parameters from the healthy contralateral auricle.

As presented in Table 2, in this study, postoperative complications were observed in both methods. Two patients (10.5%) in the 1-stage method, 1 presenting a full-thickness skin-graft and alopecia of the scar line (measuring 1×3 cm) and the other, a hematoma in the graft zone. Using the auricle reimplantation procedure, 2 patients (33.3%) likewise showed postoperative complications such as hematoma and reduction in size of the reimplanted ear.

Overall, the results of short-term and long-term outcomes show that it is best of all to perform a reimplantation with application of a temporal fascia using 1-stage method ($P < 0.001$).

DISCUSSION

Optimal functional and aesthetic facial reconstruction is always a challenge in patients with innate or acquired facial malformations. For auricular reconstruction, several techniques, ear skin[19] using the mastoid zone, tissue expansion[20,21] using extra skin through controlled mechanical stress, free flap[22] using a free radial forearm flap, and using a postauricular fascial flap combined with an expanded skin flap[23] have been proposed. In all studies, the benefit obtained depended on the patient's state and trauma condition. By these methods, the creation of a well-vascularized tissue makes it possible to improve on the cartilaginous framework and the production of a well-defined auricle.

Here, we describe the use of a temporal fascial flap for surgical treatment of auricle traumatic defects in 21 patients using a cartilaginous framework from the costal arch and auricle bodies. This method allows avoidance of difficult microsurgery and possible complications leading to "safe" results in 90.4% of cases. We also demonstrated that aesthetic results of nonstandard reimplantation (n = 8) are minimally different from results of successful traditional reimplantation (75%). Overall, no major complications occurred and further surgery was not required.

Our experience shows that for total and subtotal defects of the auricle, the safest and most reliable procedure is the 1-stage method of reconstruction with application of a temporal fascial flap with attached blood supply along with full-thickness, autograft cartilage from a costal arch. The costal cartilaginous autograft is the best material in those cases where creation of a strong framework is necessary. In parallel studies, we performed a 2-stage method with creation of "prefabricated" ear frame, implantation of cartilage subcutaneously behind the aural area, and restoration of the auricle using cartilage from the amputated portion and local tissues with microsurgical replantation of an auricle (results not shown).

In recent years, we considered surgical tactics for reconstruction after full traumatic amputation of an auricle. Consequently, we suggest the idea of applying this flap on severed segments of auricles in cases which microsurgical reimplantation is not possible. The search for new ways to reconstruct an auricle in the posttraumatic situation leads us to pursue this 1-stage reconstruction with the use of a TPFF.

Massoud Mirshahi, MD, PhD
University of Sorbonne Paris Cité - Paris 7
Lariboisière Hospital, INSERM U965
41 Bd de la Chapelle
75010, Paris, France
E-mail: massoud.mirshahi@inserm.fr

ACKNOWLEDGMENTS

The authors thank Doctors Hamza Dodariyon and Shervin Mirshahi for their valuable assistance.

REFERENCES

1. Storck K, Staudenmaier R, Buchberger M, et al. Total reconstruction of the auricle: our experiences on indications and recent techniques. *Biomed Res Int.* 2014;2014:373286.
2. Converse JM. Construction of the auricle in unilateral congenital microtia. *Trans Am Acad Ophthalmol Otolaryngol.* 1968;72:995–1013.
3. Tanzer RC. Total reconstruction of the auricle. The evolution of a plan of treatment. *Plast Reconstr Surg.* 1971;47:523–533.
4. Brent B. The correction of mi-rotia with autogenous cartilage grafts: I. The classic deformity.? *Plast Reconstr Surg.* 1980;66:1–12.
5. Nagata S. Modification of the stages in total reconstruction of the auricle: Part I. Grafting the three-dimensional costal cartilage framework for lobule-type microtia. *Plast Reconstr Surg.* 1994;93:221–230; discussion 267.
6. Nagata S. Modification of the stages in total reconstruction of the auricle: Part II. Grafting the three-dimensional costal cartilage framework for concha-type microtia. *Plast Reconstr Surg.* 1994;93:231–242; discussion 267.
7. Nagata S. Modification of the stages in total reconstruction of the auricle: Part III. Grafting the three-dimensional costal cartilage framework for small concha-type microtia. *Plast Reconstr Surg.* 1994;93:243–253; discussion 267.
8. Firmin F. Ear reconstruction in cases of typical microtia. Personal experience based on 352 microtic ear corrections. *Scand J Plast Reconstr Surg Hand Surg.* 1998;32:35–47.

9. Moore EJ. Temporoparietal fascia flap. 2016. Available at http://emedicine.medscape.com/article/881374-overview.
10. Nagata S. Modification of the stages in total reconstruction of the auricle: Part IV. Ear elevation for the constructed auricle. *Plast Reconstr Surg.* 1994;93:254–266; discussion 267.
11. Mathes S, Nahai F. Regional flaps: anatomy and basic techniques head and neck section. *Reconstr Surg Princ Anat Tech.* 1997;1:367–385.
12. Brown W. Extraordinary case of horse-bite; the external ear completely bitten off and successfully replaced. *Lancet.* 1898;151:1533–1534.
13. Monks GH. The restoration of a lower eyelid by a new method. *Boston Med Surg J.* 1898;139:385–387.
14. Gillies HD. *Plastic Surgery of the Face.* New York, N.Y.: Gower Medical Publishing Ltd; 1983.
15. Brent B, Byrd HS. Secondary ear reconstruction with cartilage grafts covered by axial, random, and free flaps of temporoparietal fascia. *Plast Reconstr Surg.* 1983;72:141–152.
16. Park C, Mun HY. Use of an expanded temporoparietal fascial flap technique for total auricular reconstruction. *Plast Reconstr Surg.* 2006;118:374–382.
17. Sivayoham E, Woolford TJ. Current opinion on auricular reconstruction. *Curr Opin Otolaryngol Head Neck Surg.* 2012;20:287–290. doi: 10.1097/MOO.0b013e328355b1d9.
18. Park C, Yoo YS, Hong ST. An update on auricular reconstruction: three major auricular malformations of microtia, prominent ear and cryptotia. *Curr Opin Otolaryngol Head Neck Surg.* 2010;18:544–549. doi: 10.1097/MOO.0b013e32833fecb9.
19. Gault D. Post traumatic ear reconstruction. *J Plast Reconstr Aesthet Surg.* 2008;61:S5–S12.
20. Chana JS, Grobbelaar AO, Gault DT. Tissue expansion as an adjunct to reconstruction of congenital and acquired auricular deformities. *Br J Plast Surg.* 1997;50:456–462.
21. Sasaki GH. Tissue expansion in reconstruction of acquired auricular defects. *Clin Plast Surg.* 1990;17:327–338.
22. Lanvers T, Van de Hulst RRWJ. Microvascular ear reconstruction using a free radial forearm flap after dog bite. *J Plast Reconstr Aesthet Surg J Plast Reconstr Aesthet Surg.* 2009;62:535–538.
23. Xiaobo Y, Haiyue J, Hongxing Z, et al. Post-traumatic ear reconstruction using postauricular fascial flap combined with expanded skin flap. *J Plast Reconstr Aesthet Surg.* 2011;64:1145–1151.