SCIENCEHOOD

Case Report Neurology and Neurological Research

Eric S. Nussbaum *

High Flow Arteriovenous Fistula of the Scalp Complicating a Hair Transplant Procedure

Josef T. Nussbaum [1], James K. Goddard [1], Eric S. Nussbaum [1*].

[1] National Brain Aneurysm & Tumor Center, Twin Cities, MN, USA.

***Corresponding Author: Eric S. Nussbaum,** National Brain Aneurysm & Tumor Center, Twin Cities, MN, USA.

Citation: Josef T. Nussbaum, James K. Goddard, Eric S. Nussbaum (2025), High Flow Arteriovenous Fistula of the Scalp Complicating a Hair Transplant Procedure; J. Neurology and Neurological Research, 2(3): DOI: SH-NNR-CR-008.

Case Report

Volume 02; Issue 03

Received Date: April 12, 2025

Accepted Date: April 26, 2025

Published Date: May 05, 2025

DOI: SH-NNR-CR-008

ABSTRACT

Background
An arteriovenous (AV) fistula of the scalp is a rare lesion that can result from scalp trauma resulting in injury to the underlying vasculature. We present the case of a young man who developed a clinically significant high-flow scalp AV fistula several months following a hair transplant procedure.

Description of Case
A 40-year-old man presented with an enlarging pulsatile mass in the mid frontal region roughly 3 months following hair transplantation. Diagnostic angiography revealed a high flow AV fistula connecting the superficial temporal artery and vein. To avoid the cosmetic concerns associated with the deposition of embolic material into the fistula, microsurgical disconnection of the fistula was performed. The patient made an excellent recovery.

Conclusion
Hair transplantation is a common and safe procedure. The delayed development of an enlarging subcutaneous mass should raise suspicion for a possible AV fistula to allow for proper and timely management of this entity. Early recognition and treatment of this complication may improve the ultimate cosmetic result in the setting of hair transplantation.

KEYWORDS:

artery, arteriovenous fistula, hair transplant

INTRODUCTION

Traumatic arteriovenous (AV) fistulae of the scalp are rare lesions that most commonly result from the development of an abnormal connection between the superficial temporal artery and vein. (1-11) Any injury to the scalp can theoretically result in the development of an AV fistula if the underlying vessels are injured. We describe the very rare development of a high flow scalp AV fistula complicating hair transplantation. The management of the lesion including cosmetic considerations is discussed.

CASE DESCRIPTION

A 40-year-old man underwent a hair transplantation procedure without immediate complication. Over the ensuing months, he developed an enlarging pulsatile mass associated with obvious dilatation of the superficial temporal artery and vein. The cosmetic concerns related to the dilated vasculature prompted the patient to seek medical attention. A diagnostic angiogram was performed revealing an obvious, high-flow scalp AV fistula with dramatic dilatation of the superficial temporal artery branches and draining vein. (Figure 1) Treatment options were discussed including conservative management, microsurgery, and endovascular therapy. It was felt that endovascular therapy would yield a subcutaneous mass of either metal coils or embolic glue material with concern for cosmetic deformity; therefore, microsurgical treatment was chosen.

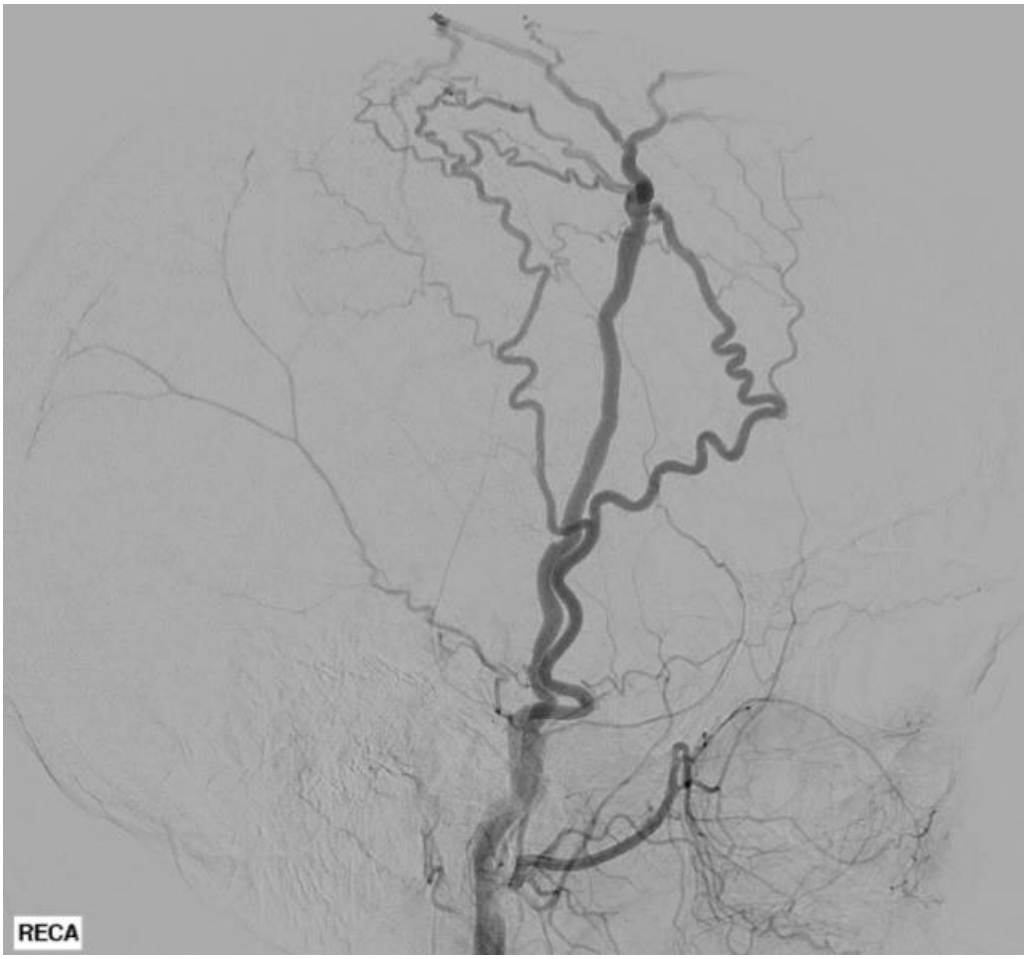
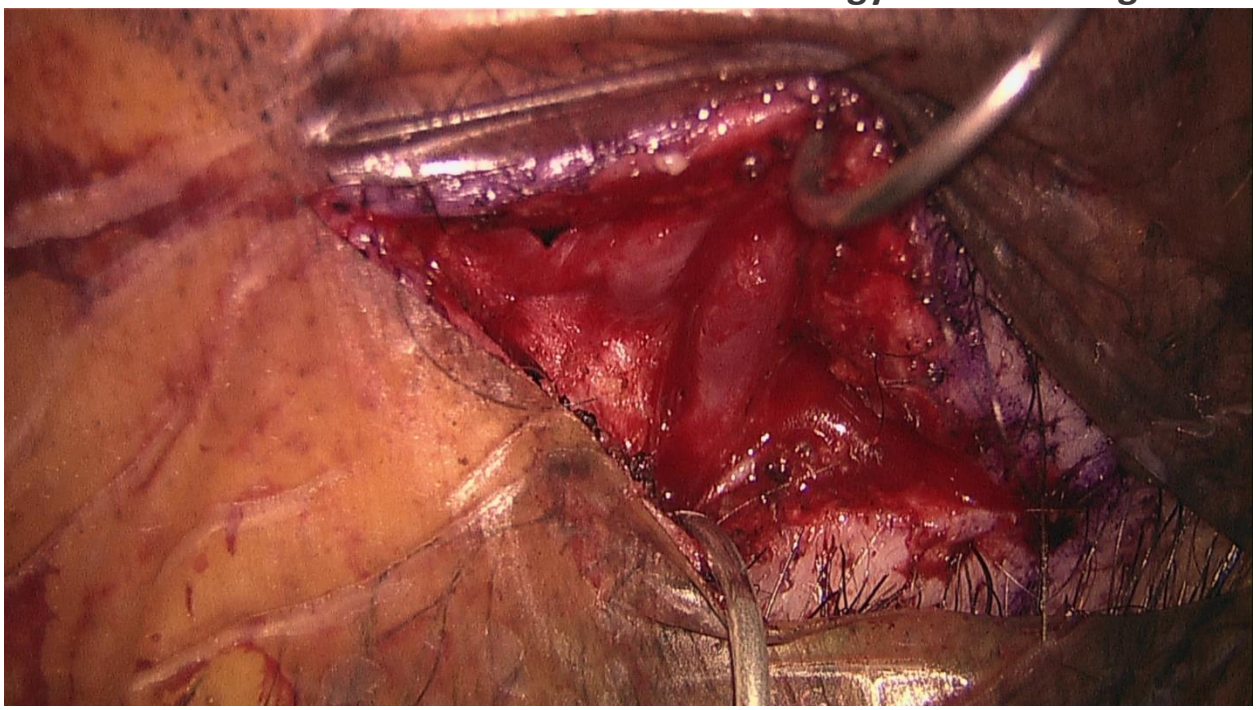
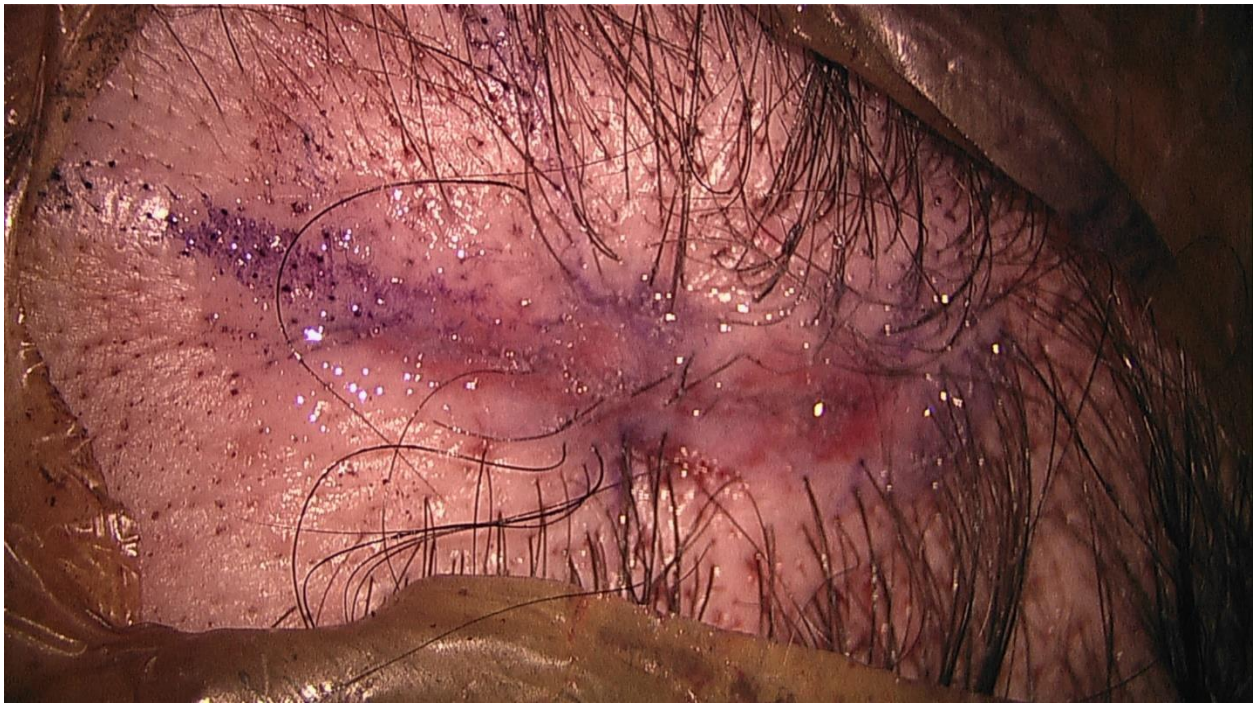


Figure 1. Diagnostic angiographic image of the external carotid artery demonstrates a high-flow AV fistula connecting the superficial temporal artery and vein.

The patient underwent uneventful surgical exploration of his AV fistula under general anesthesia. No hair was shaved. An intraoperative arteriogram was performed at the beginning of the procedure prior to incision to localize the exact site of the fistula. External carotid angiography with real-time fluoroscopic imaging allowed for the placement of a small clamp directly over the fistula. This allowed us to make a small, 2 cm incision directly over the fistulous connection. The connection was interrupted using bipolar electrocautery under microscope magnification. (Figure 2A) A second intraoperative angiogram confirmed complete obliteration of the fistula. A careful subcuticular skin closure was performed to optimize the cosmetic result.



(A)



(B).

Figure 2. Intraoperative photomicrographic images reveal the dilated artery and vein exposed through a small incision guided by angiographic localization of the fistula (A) and the incision immediately following meticulous subcutaneous skin closure (B).

DISCUSSION

Traumatic AV fistula of the scalp is a rare entity. [1-8] Although such AV fistulae can develop following blunt trauma, penetrating injury resulting in an abnormal connection between the superficial temporal artery and vein is the most common underlying cause. [9-11] In theory, any injury that disrupts the scalp vasculature can result in delayed development of an enlarging AV fistula. Although surgical repair has represented the traditional means of treatment for scalp AV fistulae, endovascular options have been used increasingly to manage this condition. [12-15] Nevertheless, concerns regarding cosmetic deformity associated with the permanent deposition of metal coils or glue material may limit endovascular options in some cases.

AV fistula of the scalp has been previously named cirsoid aneurysm, racemose aneurysm, plexiform angioma, pulsating anigoma, aneurysmal varix, arteriovenous aneurysm, and arteriovenous malformation [2,4-8]. Confusion regarding nomenclature has likely contributed to uncertainty regarding management of this entity. Although most AV fistulae of the scalp present as an enlarging pulsatile mass, these lesions can occasionally bleed. [2-4] They have also been associated with cerebral steal phenomenon and epilepsy when the fistula includes an intracranial component. [16-17]

Cases of scalp AV fistulae of iatrogenic origin have been described previously. [18-22] Although hair transplantation is an extremely common and safe procedure, complications including delayed AV fistula of the scalp have been described. [23-31] Most cases present in delayed fashion as the fistula enlarges with recruitment of collateral blood supply. In our case, the growing and easily visible AV fistula itself resulted in cosmetic concerns. In addition, emerging evidence suggests that vascular integrity and adequate scalp perfusion play critical roles not only in the early survival of transplanted hair follicles but also in their long-term viability. Impaired blood supply to the local tissue due to a “steal phenomenon” from the high flow fistula could theoretically impair the success of the hair transplant. This may pose further risk to a favorable cosmetic outcome.

Transplanted follicles rely on passive diffusion in the immediate postoperative period and therefore remain particularly vulnerable for an extended time. [32] As a result, studies have demonstrated that the local vascular environment can directly impact long-term graft density and survival. [32] Furthermore, the variability in baseline scalp oxygenation and vascular reserve among individuals may render certain regions especially susceptible to the effects of arteriovenous shunting [33]. Given this, even a mild diversion of blood flow could compromise graft revascularization and contribute to further follicular loss as the delayed effects of an expanding fistula become more prominent. These findings suggest that the presence of an AV fistula could adversely impact both immediate and sustained transplant success.

The development of a pulsatile mass following any type of trauma should prompt evaluation for an underlying AV fistula. Following hair transplantation, routine follow-up should include evaluation for this entity. Although these lesions can be treated endovascularly, the resulting metal coils or cast of embolic material can leave a prominent area underlying the thin scalp tissue potentially resulting in a cosmetic deformity. As a result, microsurgical disconnection of the fistula or trapping and removal of the aberrant AV connection may be reasonable options for treatment in these cases. Microsurgery was chosen in our case for this reason.

The use of intraoperative angiography to localize the fistula allows for a very small scalp incision. Intraoperative angiography was repeated after disconnection of the fistula to confirm adequate treatment of the lesion prior to closure. Shaving is not necessary to protect the transplanted hair, and a careful cosmetic subcuticular skin closure optimizes the cosmetic result.

CONCLUSION

We describe a rare case of scalp AV fistula developing in delayed fashion following hair transplantation. The enlarging, pulsatile mass appeared to be associated with dilatation of the superficial temporal artery and vein, and was managed with direct interruption of the fistula. Early treatment of a developing fistula should minimize cosmetic considerations and also potential surgical complications. The use of angiographic localization to allow for a very small incision and careful cosmetic closure are highlighted.

DISCLOSURES

The authors report no conflicts of interest. IRB approval was obtained for this study.

REFERENCES

1. Zheng F, Augustus Pitts H, Goldbrunner R, Krischek B: Traumatic arteriovenous fistula of the scalp in the left temporoparietal region with intra- and extracranial blood supply. Case Rep Vasc Med. 8671472, 2016. doi: 10.1155/2016/8671472. Epub 2016 Jan 18. PMID: 26885435; PMCID: PMC4739455.

2. Badejo L, Rockwood P: Traumatic arteriovenous fistula of the scalp: case report. *Journal of Neurosurgery.* 1987;**66**(5):773–774.

3. Li F, Zhu S, Liu Y, et al: Traumatic arteriovenous fistula of the superficial temporal artery. *Journal of Clinical Neuroscience.* 2007;**14**(6):595–600.

4. Gurkanlar D, Gonul M, Solmaz I, Gonul E: Cirsoid aneurysms of the scalp. *Neurosurgical Review.* 2006;**29**(3):208–212.

5. Kuroki K, Taguchi H, Sumida M, Eguchi K, Saitoh Y: A case of hemorrhagic non traumatic arteriovenous fistula of the scalp. *No Shinkei Geka.* 1999;**27**(9):851–853.

6. Matsushige T, Kiya K, Satoh H, Mizoue T, Kagawa K, Araki H: Arteriovenous malformation of the scalp: case report and review of the literature. *Surgical Neurology.* 2004;**62**(3):253–259.

7. Hasturk A, Erten F, Ayata T: Giant non-traumatic arteriovenous malformation of the scalp. *Asian Journal of Neurosurgery.* 2012;**7**(1):39–41.

8. Luessenhop AJ: Cirsoid aneurysms of the scalp. *Journal of Neurosurgery.* **75:167, 1991**

9. Ki HJ, Lee HK, Hur JW, Lee JW: Post-Traumatic Arteriovenous Fistula of the Scalp. J Korean Neurosurg Soc. 2015 Sep;58(3):298-300. Epub 2015 Sep 30. PMID: 26539278; PMCID: PMC4630366.

10. Fisher-Jeffes ND, Domingo Z, Madden M, de Villiers JC: Arteriovenous malformations of the scalp. Neurosurgery36:656–660, 1995.

11. Sofela A, Osunronbi T, Hettige S: Scalp cirsoid aneurysms: Case illustration and systematic review of literature. Neurosurgery 86:E98-107, 2020,

12. Muthukumar N, Rajagopal V, Manoharan AV, Durairaj N: Surgical management of cirsoid aneurysms. Acta Neurochir (Wien) 2002;144:349–356.

13. Dabus G, Pizzolato R, Lin E, Kreusch A, Linfante I: Endovascular treatment for traumatic scalp arteriovenous fistulas: results with Onyx embolization. *Journal of NeuroInterventional Surgery.* 2014;**6**(5):405–408.

14. Komiyama M, Nishikawa M, Kitano S, et al: Non-traumatic arteriovenous fistulas of the scalp treated by a combination of embolization and surgical removal. *Neurologia Medico-Chirurgica.* 1996;**36**(3):162–165. doi: 10.2176/nmc.36.162.

15. Gupta AK, Purkayastha S, Bodhey NK, et al: Endovascular treatment of scalp cirsoid aneurysms. *Neurology India.* 2008;**56**(2):167–172.

16. Mohanty S, Rao CJ: A large cirsoid aneurysm of the scalp associated with epilepsy. *Journal of Neurology, Neurosurgery and Psychiatry.* 1976;**39**(9):835–836.

17. Kelly K, Trites JRB, Taylor SM, Bullock M, Hart RD: Arteriovenous malformation of the scalp with cerebral steal. *Head and Neck.* 2009;**31**(11):1520–1523.

18. Miekisiak G, Mis M, Sandler A, Druszcz A: Iatrogenic arteriovenous fistula of the superficial temporal artery. Oral and Maxillofacial Surgery 12:219-221, 2008

19. Sakai K, Kitagawa T, Nakano Y, Saito T, Suzuki T, Kondo H, et al: Surgical resection of scalp arteriovenous fistulas after neurosurgical operation: A case report. Interdisciplinary Neurosurgery27:101409, 2022

20. Morioka T, Nishio S, Hikita T: Traumatic arteriovenous fistulae of the scalp at the area of previous craniotomy. *Surgical Neurology.* 1988;**30**(5):406–407.

21. Martin-Granizo R, Caniego JL, de Pedro M, Domínguez L: Arteriovenous fistula after temporomandibular joint arthroscopy successfully treated with embolization. *International Journal of Oral & Maxillofacial Surgery.* 2004;**33**(3):301–303.

22. Nouri S, Babaei M, Aalinezhad M, Otroshi B: AVF of superficial temporal vessels after thread brow lift, report of a case. Radiology Case Reports 18:2864-2868, 2023

23. Molinaro S, Terrana A, Vizzari, FA, *et al:* Endovascular Treatment of Scalp AVF Following Hair Transplantation: Case Report. *SN Compr. Clin. Med.* **4**, 245, 2022.

24. Liounakos JI, Urakov T, Snelling B, Peterson EC: Scalp arteriovenous fistula following hair transplantation: a case report and review of the literature. Clin Med Rev Case Rep 5:200, 2018.

25. Dogan S, Cinar C, Demirpolat G, Memis A: Endovascular treatment of AVF after hair transplantation. Cardiovasc Intervent Radiol. 31(Suppl 2):S128–30, 2008.

26. Garg AK, Garg S: Complications of Hair Transplant Procedures-Causes and Management. Indian J Plast Surg 31;54(4):477-482, 2021. PMID: 34984088; PMCID: PMC8719980.

27. Kerure AS, Patwardhan N: Complications in Hair Transplantation. J Cutan Aesthet Surg 11(4):182-189, 2018. doi: 10.4103/JCAS.JCAS_125_18. PMID: 30886471; PMCID: PMC6371733.

28. Alfaro AJQ, Ortíz AFH, Mejia JA, Ortegon JDC, Gutierrez LC, Tovar CAD, Zarate M, Gil-Quiñones SR, Montañez MYB, Beaujon LF, Daza OMD: Traumatic scalp arteriovenous fistula post capillary implantation successfully treated using PHIL embolic agent. Surg Neurol Int 13;14:12, 2023. doi: 10.25259/SNI_1002_2022. PMID: 36751445; PMCID: PMC9899462.

29. Bernstein J, Podnos S, Leavitt M: Arteriovenous fistula following hair transplantation. *Dermatol Surg.* 2011;37:873–5.

30. Perez-Meza D, Niedbalski R: Complications in hair restoration surgery. *Oral Maxillofac Surg Clin North Am.* 2009;21:119–48. vii.

31. Williams LR, Robinson JK, Yao JST: Hair Transplantation Producing Arteriovenous Fistulization. Annals of Vascular Surgery 1:241-243, 1986.

32. Jimenez F, Alam M: Donor and recipient influence in long-term survival of follicular unit grafts: A 4-year retrospective study. J Cutan Aesthet Surg. 2021;14(1):12–17. PMCID: PMC8061642.

33. Parsley WM, Perez-Meza D: Review of factors a ecting the growth and survival of follicular grafts. J Cutan Aesthet Surg. 2010;3(2):69–75. doi:10.4103/0974 2077.69017. PMCID: PMC2956960

SCIENCEHOOD

Neurology and Neurological Research