

## ASSESSMENT OF OUTCOMES OF RECONSTRUCTION FOR MAJOR SCALP DEFECTS USING LOCAL FLAPS OF VASCULAR PEDICLE

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### ABSTRACT

**Objectives:** Assess treatment outcomes of major scalp defects using local flaps of vascular pedicle. **Materials and methods:** Cross-sectional descriptive study on 16 patients with major scalp defects who received surgery at Center of Craniofacial and Plastic Surgery, Military Central Hospital 108 from September 2016 to April 2021. Participants were received reconstruction surgery to cover their defects using local flaps of vascular pedicle. **Results:** 15/16 participants were reconstructed using temporal fasciocutaneous flap based on superficial temporal artery pedicle, 1/16 participant was used skin flap based on occipital artery pedicle. Short-term results showed that 14/16 reconstruction flaps had good vitality and covered 100% of the defects. For each participant, the average surgery duration lasted 140 minutes, and the average post-operative hospitalization duration was 12 days. Long-term results showed that 16/16 flaps had good vitality and 100% coverage. **Conclusions:** reconstruction of major scalp defects using local flaps of vascular pedicle brought good coverage, high vitality, and was safe for patients, especially the elderly with many underlying diseases.

### I. INTRODUCTION

Major scalp defect is a lesion that requires a reconstruction solution to cover the skull. It can occur in many diseases (burns, infections, after tumor removal and so on).

For the elderly with many underlying diseases has major scalp defect, we need to choose a effective and safe reconstruction method with short surgery duration.

We almost can't use reconstruction methods such as thick skin grafting or splitting in half because of loss of periosteum. Skin expansion has many advantages but requires many surgeries and is expensive. Free skin flap with microsurgical technique is a very effective method with a large volume of material. However, it requires modern equipment as well as microsurgical surgeons, takes long time, so patient's physical condition needs to be good enough. In addition, this method carries high risk of embolism for patients who are elderly or have underlying diseases such as diabetes, hypertension, atherosclerosis, etc, [1], [2].

Local scalp flap with outstanding advantages in skin quality, simple technique, safety, ease of implementation, short surgery and recovery durations is the most suitable solution for patients with major scalp defects who are not candidates for skin expansion or microsurgical flaps. Our study aims to assess treatment outcomes of major scalp defects using local flaps of vascular pedicle

### II. MATERIALS AND METHODS

**Materials:** 16 patients with major scalp defects who received surgery at Center of Craniofacial and Plastic Surgery, Military Central Hospital 108 from September 2016 to April 2021.

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**Methods:** cross-sectional clinical descriptive study without control group

**Steps:**

*Retrospective group:* data and research variables were collected based on medical records

*Prospective group:* patients were examined, diagnosed, classified, assessed lesions, chosen treatment plan and recorded their images before, during and after surgery.

Patients were examined to assess the locations and sizes of the lesions, done basic tests, and received head CT scans to assess the level of invasion to skull and meninges before surgery. They also biopsied for histopathology to orientate properties of the lesion to plan surgery and flap design. Locations of superficial temporal or occipital artery were determined by clinical examination and Doppler ultrasound. Resection margin was determined and reconstruction flap was designed.

**Surgery:** for lesions that are scalp cancer which had not invaded the skull, we performed surgery to remove all the periosteum layer. For cancer that invaded the skull, surgery combined with neurosurgery was performed. Cancerous lesions were removed by conventional or immediate biopsy was used to ensure that resection margin had no malignant cells. Artificial materials may be used to reconstruct the skull.

Rotating and shifting flaps with vascular pedicle axis located in the middle of them were designed. The distance from the furthest point of the flap to its supplying root was greater than the distance from the supplying root to the furthest point of the defect. The scalp flap was dissected from the periphery towards the supplying root.

Dissection was done into the loose space between Galea's fascia and the periosteum.

The flap was rotated or shifted to location of the defect, at the place where the skin graft flap was split in half, the graft skin was taken using a Humpy knife from the thigh region or right at the adjacent scalp area that was not compressed. The graft skin region was sutured using gauze pillows that would be removed after 7 days.

**Research variables and assessment standards**

**Percentage of reconstruction flaps:** superficial temporal and occipital artery pedicle flaps, lesion and reconstruction flap sizes.

**Treatment duration:** surgery duration: from the time of skin incision to the end of the surgery, general treatment duration was taken from the day of admission to the day of discharge.

**Assessment of short-term outcomes:** was performed from after surgery until the day of discharge.

**- Vitality of the flap**

+ Good: the flap had pink color, non-inflammatory borders, no discharge, and no signs of infection.

+ Moderate: the flap had small burns or necrosis, inflammatory borders, and partial incision rupture.

+ Poor: the flap had a high risk of necrosis, yellow fluid discharge, wound infection.

**- Coverage area:** (due to necrosis or poor supply of the flap)

+ Good: From 70% to 100% of the defect.

+ Moderate: From 50% to 70% of the defect.

+ Poor: less than 50% of the defect.

**- Status of grafted skin at the flap-donor site**

+ Good: grafted skin completely covered the donor site.

+ Moderate: grafted skin was partially necrotic, which received care by changing bandages and did not require surgery again.

+ Poor: the grafted skin was completely necrotic and required surgery again.

**Assessment of long-term outcomes:** was performed after the patients were discharged at least 3 months. They answered questions according to the available form or received clinical examination.

**- Status of the scalp in the defect region:**

+ Good: Elasticity and skin color similar to the surrounding scalp, small scars which did not protrude and did not create boundaries with adjacent regions.

+ Moderate: Elasticity and skin color different from the surrounding scalp, scars which caused slight deformation in the adjacent regions.

+ Poor: Elasticity and skin color different from the surrounding scalp, increased pain, scars which caused contraction and deformation of tissues.

**- Hair growth status of the hair-bearing scalp region**

+ Good: similar to surrounding scalp.

+ Moderate: thinner hair growth than the surrounding scalp.

+ Poor: no hair growth.

**- Status of the flap donor site:** assess status of the grafted skin.

+ Good: the grafted skin survived well and covered 100% of the donor site.

+ Moderate: the grafted skin survived but there were some regions that need additional skin grafting (< 10% of the area of the donor site).

+ Poor: additional skin grafting was more than 10%.

III. RESULTS

3.1 Results of reconstruction methods.

**Table 1: Percentage of local flaps of vascular pedicle (n=16)**

Flap type	n	%	Area of the defect (cm <sup>2</sup> )		Flap area (cm <sup>2</sup> )
Flap based on superficial temporal artery pedicle	15	93.75	Largest	270	300
Flap based on occipital artery pedicle	1	6.25	Smallest	30	42
Total	16	100	Average	84.4	90

In our study, 15/16 patients were reconstructed scalp defects using fasciocutaneous flap based on superficial temporal artery pedicle. 1/16 patient was used skin flap based on occipital artery pedicle. This patient received surgery for the second time due to recurrent occipital squamous carcinoma invading the skull, requiring surgery to remove bone and

meninges, and reconstruct meninges using femoral fascia and skull plate using titanium mesh.

**3.2 Treatment duration.**

- Average surgery duration for 1 patient: 140 minutes, the shortest was 70 minutes, the longest was 310 minutes. Patients with scalp cancer that invaded the skull and part of the dura mater had prolonged surgery duration

because they need to be removed skull, sutured the dura mater, and reconstructed using titanium mesh.

- Average treatment duration: The average duration of hospitalization from the day of

surgery to day of discharge was 12 days, of which the shortest hospitalization duration was 9 days and the longest was 18 days.

**3.3. Assessment of short-term outcomes.**

**3.3.1 Flap vitality.**

**Table 2: Vitality of flaps based on superficial temporal and occipital arteries (n=16)**

Flap type	Flap vitality			Total
	Good	Moderate	Poor	
Flap based on superficial temporal artery pedicle	13	2		15
Flap based on occipital artery pedicle	1			1
n	14	2		16
%	87.5	12.5		100

**3.3.2 Coverage outcomes**

**Table 3: Coverage outcomes of reconstruction flap (N=16)**

Reconstruction methods	Coverage area			Grafted skin at flap-donor site			Total
	Good	Moderate	Poor	Good	Moderate	Poor	
Flap based on superficial temporal artery pedicle	13	2		9	6		15
Flap based on occipital artery pedicle	1			1			1
n	14	2		16			16
%	87.5	12.5		100			100

**3.4 Assessment of long-term outcomes.**

**Table 4: Properties of the scalp on the lesion (N=16)**

Reconstruction methods	Properties of the scalp			Total
	Good	Moderate	Poor	
Flap based on superficial temporal artery pedicle	15			15
Flap based on occipital artery pedicle	1			1
n	16			16
%	100			100

**Table 5: Properties of hair growth on the lesion (N=16)**

Reconstruction methods	Properties of hair growth			Grafted skin at flap-donor site			Total
	Good	Moderate	Poor	Good	Moderate	Poor	
Flap based on superficial temporal artery pedicle	15			15			15
Flap based on occipital artery pedicle	1			1			1
n	16			16			16
%	100			100			100

## IV. DISCUSSION

**4.1 Reconstruction methods**

15/16 flaps used are based on superficial temporal artery pedicle, accounting for 93.75%, 1/16 flap used is based on occipital artery pedicle, accounting for 6.25%. Lesavoy's study on covering the scalp using local axial scalp flap shows percentage of using fasciocutaneous flap based on superficial temporal artery up to 70%, with only 1 patient using fasciocutaneous flap based on occipital artery [3]. The fasciocutaneous flaps based on superficial

temporal artery has much broader indications than those based on occipital artery pedicle.

For fasciocutaneous flaps based on superficial temporal artery, the pedicle is easily mobile, the flap's rotation range is wide and can almost reach all scalp defects, the temporal region has less strict requirements for covering the flap-donor region. Because of these advantages, we prioritize to use the superficial temporal artery fascia skin flap as the first method to cover scalp defects.



**Figure 1.** *Flap based on superficial temporal artery pedicle and skin graft to the flap-donor region*

For defects in the occipital region, we can use flaps based on occipital artery pedicle on the opposite side to cover them. However, this is compression region of the scalp, so taking the occipital flap without covering flap-donor region suitably will affect patient's quality of life during long-term follow-up. Although this pedicle is stable, the mobile segment of the pedicle emerging from behind the mastoid process is short and the scalp is too poor elastic to be pushed much, so we can't use this flap to cover the wide defects in the parietal and forehead regions. For these reasons, we usually don't

use flaps based on occipital artery pedicle as the first method to cover scalp defects. In fact, the only patient whom we use this flap has a recurrent scalp tumor who had used fasciocutaneous flaps based on superficial temporal artery in the previous surgery and could no longer use this flap. Because of their disadvantages, fasciocutaneous flaps based on occipital artery pedicle should only be used when:

- They can adequately cover the flap-donor region
- Fasciocutaneous flaps based on superficial temporal artery cannot be used.



**Figure 2.** *Flap based on occipital artery pedicle and skin graft to the flap-donor region*

#### **4.2 Treatment duration**

The shortest surgery duration is 70 minutes, and the longest is 310 minutes, and the average is 140 minutes. The average surgery duration is long because among our 16 patients, there are 2 cases with scalp cancer lesions that invades the skull and dura mater. In these cases, we operate in conjunction with neurosurgery with indications to remove the invaded skull bones and dura mater, and use titanium mesh to reconstruct the skull defect, then use a pedicled scalp flap to close the defect. In 1 patient, we use a pedicled scalp flap to close the defect after removal of brain tumor, during the same surgery.

The average postoperative hospitalization duration in our study is 12 days, the shortest is 9 days and the longest is 18 days. CK Muller's 2012 study on 29 patients with damage to fasciocutaneous layer and to the periosteum finds that hospitalization duration has difference between reconstruction methods. Specifically, local flap method has average hospitalization duration as 14 days, while the skin grafting method as 30 days and free flap with microsurgical anastomosis as 32 days in which patients need to be monitored in the intensive care unit in the first 24 hours. CK Muller suggests local reconstruction flap as the first choice,

because it gives better aesthetics and has shorter hospitalization duration compared to skin grafting and free flap with microsurgical anastomosis – should only be performed on patients in good physical condition with no underlying diseases. [4]

#### **4.3 Short-term outcomes:**

In our study, 14/16 patients receive flaps which cover the entire defect and have good vitality, pink color, non-inflammatory borders, no discharge and no signs of infection. After surgery, local region progresses well. There is no flap with poor vitality or necrosis requiring surgery again. For cases requiring skull reconstruction using titanium mesh, there is no phenomenon of splint fistula inflammation. There are 2 reconstruction flaps with average vitality that have poor supply of its distal part. Patients who receive these flaps require resection and a second surgery. They are patients after brain tumor removal and skull defect reconstruction using titanium mesh. After surgery, local region progresses well. There is no flap with poor vitality or necrosis requiring surgery again.

Our result is consistent with J.O.Guerrissi's study (1998) on 21 patients after removal of scalp tumor with soft tissue lesions or skull invasion. Of these, 18/21 patients only use superficial temporal artery

pedicle flap, 3/21 patients use flaps supplied by temporal, occipital and posterior auricular arteries. All cases have good postoperative results and there is no case of partial or complete necrosis of the reconstruction flap recorded [5]. Yolanda's study (2013) on 13 patients with scalp defects reconstructed with local axis flaps shows that all defects are completely covered, the reconstruction flaps have good vitality, and the recovery is fast without complications such as hematoma, seroma or infection [6]. O.Egemen (2012) uses local flaps with vascular pedicles to reconstruct major scalp defects for 22 patients and 90.9% of which has comorbid diseases such as hypertension and coagulation disorders and so on. His result shows that all flaps survives completely, with only one case of necrosis recorded at a distal

margin. In the study, the author also says that the cases belong to the older age group and the majority of them have poor health status due to comorbid diseases, and are not suitable candidates for complex and prolonged surgeries. Most of them have high-risks when undergoing general anesthesia. [7]

At flap-donor site, we must perform a skin graft. During the flap removal, we must make sure not to damage the periosteum because this supplies to grafted skin. In our study, 10/16 patients have good skin graft status which has pink color and cover the entire flap-donor site. There are 6/16 patients with partial necrosis at the border of the skin graft, however, they only need local care and bandage changing, but no surgery again.



A. Right temporal tumor



B. Temporal defect and fasciocutaneous flap based on superficial temporal artery



C. 7 days after surgery



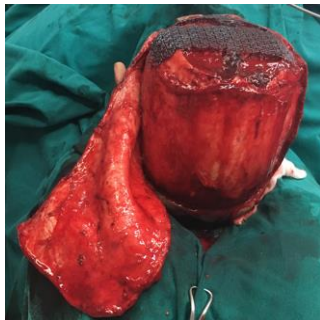
D. 14 days after surgery

**Figure 3. Scalp defect reconstruction using fasciocutaneous flap based on superficial temporal artery**

**4.4 Long-term outcomes**

We follow up all 16 patients for their outcomes for at least 3 months and even for several years in some cases. All of them have well-healed reconstruction flaps, small scars that do not retract and hair that grows similar to the surrounding healthy skin. There is no cases without hair growth. The grafted skin region has the same color as the surrounding skin. In our study, 14/16 patients have lesions in occipital or combined parieto-occipital region, which bears compression and pressure for the head, but there is no case of progressive ulceration and

inflammation. This result is also similar to that of Guerrissi’s 1998 study which shows that 21 patients have good function recovery and aesthetic outcomes and no complications. All of them are satisfied with the scar shape and properties of hair growth at the flap graft site [5]. O.Egemen (2012) monitors outcomes of 22 patients from 2 to 36 months and records 3 cases of tumor recurrence due to the malignant properties of the original lesion, the remaining cases are not recorded any complications, and they are satisfied with aesthetic outcomes. [7]



A. Occipital defect, the tumor invades skull



B. Flap-donor region that is grafted skin after 7 days



C. Reconstruction flap 7 days after surgery



D. 5 years after surgery

**Figure 4. Scalp defect reconstruction using fasciocutaneous flap based on superficial temporal artery**

**V. CONCLUSION**

Reconstructing and covering major scalp defects using local skin flap with vascular pedicle brings good coverage results, high

flap vitality, and safety for patients, especially elderly patients with many underlying diseases.



## REFERENCES

1. **Nguyen Bac Hung (2006)**, Bài giảng phẫu thuật tạo hình, Hanoi Medical Edition.
2. **Tran Thiet Son**, Phương pháp giãn da trong phẫu thuật tạo hình, Hanoi Medical Edition
3. **Lesavoy, M. A., Dubrow, T. J., Schwartz, R. J., Wackym, P. A., Eisenhauer, D. M., & McGuire, M. (1993)**. Management of large scalp defects with local pedicle flaps. *Plastic and reconstructive surgery*, 91(5), 783-790
4. **Mueller, C. K., Bader, R. D., Ewald, C., Kalf, R., & Schultze-Mosgau, S. (2012)**. Scalp defect repair: a comparative analysis of different surgical techniques. *Annals of plastic surgery*, 68(6), 594-598
5. **Guerrissi, J. O. (1999)**. Reconstruction of large defects in the scalp with fasciocutaneous flaps. *Scandinavian journal of plastic and reconstructive surgery and hand surgery*, 33(2), 217-224
6. **Zayakova Y., Stanev A., Mihailov H., et al (2013)**. Application of local axial flaps to scalp reconstruction. *Arch Plast Surg*, 40 (5),564
7. **O. Egemen, D. Bingol, O. Ozkaya, T. Aksan, S.Erol, M. Akan** “ Use of Scalp flaps as a Salvage Precedure in reconstruction of the large defects of head and neck region” *Turkish Neurosurgery* 2012, 712-717