นิพนธ์ต้นฉบับ

# Surgical Managements for Totally Avulsed Scalp : Experiences in Regional Hopsital

**Kriengsak Sirirak M.D.***

**Abstract**

**Introduction** : Totally avulsion of scalp is a serious injury that is often occurred while using induatrial and agricultural machines. It generally results from entanglement of long hair in rotary machines. The best management for the sake of functional and cosmetic purpose of this type of injury is replacing the avulsed scalp with its own tissues. However, if replantation is unavailable or impossible, scalp reconstruction must be done to minimize morbidity.

**Objectives** : surgical managements for the patient with totally avulsed scalp

**Study design** : Retrospective design

**Materials and methods** : From year 1995 to 2004, there were 5 cases that presented with totally avulsion scalp. Their ages varied from 22 to 63 years. All of them were women. They were caused by contact with agricultural machine.

**Results** : One case was died from multiple traumas. Four cases were survived; 2 cases for replantation (one case fail, one case succeeded), 1 case for omentum free flap, and 1 case for galeal flap plus skin graft. The succeed replantation has good hair growth and all other cases are baldness.

**Conclusion** : Totally avulsed scalp is associated with significant physical and psychological morbidity. Microsurgical replantation is the treatment of choice. Nevertheless, if replantation is unavailable, one stage reconstruction with well-vascularized tissue must be done. The use of surrounding galeal flap, free omentum transfer or free latissimus dorsi is also necessary. As totally avulsed is a serious injury, prevention is important.

* กลุ่มงานศัลยกรรม โรงพยาบาลพระปกเกล้า จังหวัดจันทบุรี

## Introduction

Totally avulsed scalp is an uncommon trauma resulting from sudden and severe tangential force on the scalp. A large shearing force applied to the scalp will avulse it at the loose areolar tissue layer between the galea and periosteum, the easily defined dissection plane in coronal flap. The exact specimen will vary, depending on specific direction and strength of the force applied. It generally results from entanglement of long hair in rotary machine, totally avulsed scalp is serious injury that is often incurred in industrial and agricultural machinery.[1,2,3,4] The totally avulsed scalp may have significant associated morbidities due to cranial exposure. Predictable sequelaes of such injury include vulnerability to minor traumatic accident, recurrent ulceration, dryness, progressive breakdown, baldness, and eyelid ectropion. Prior to advent of microvascular anastomosis, replacement of torn-off scalp results in failure in almost every instance[5]. Despite an occasional reported success of a thickness scalp replacement, Lu in 1969[6], a part the best treatment has been split thickness skin graft, either from a distant donor site or from the scalp[7,8,9,10]. When the periosteal cover has been lost, a popular treatment has been the perforation of the outer table of the skull to allow the diploic stimulation of a granulating bed that can then be split skin grafted over, which the method coverage can be achieved, and over grafting may be some help for durability. Full thickness coverage provide necessary protection, free tissue transfer such as omentum up on which they placed split thickness skin graft over[11,12], free latissimus dorsi flap[13]. As in all area of reconstructive surgery, the best tissue coverage is its original tissue if possible. Reattachment and microvascular anastomosis is possible in acute avulsed scalp and was first report by Miller et al in 1976[14] and many surgeons respectively.[15,16,17,18,19,20,21]

In this paper, I would like to report my experiences to date and to add some comment.

## Materials and methods

From 1995 to 2004, there were 5 cases admitted with totally avulsed scalp (Table 1). Their ages varied from 22 to 63 years. All were women who caused by contact with agricultural machine and denuded skull.

## Results

5 cases had totally avulsed scalp, women all with long hair, suffered from contact with agricultural machine in shrimp farm. All of them had denuded skull. One case died from multiple traumas; head injury, hemorrhagic shock, lung contusion with bilateral hemopneumothorax, and totally avulsed scalp. Two of them received replantation but the first case failed and needed decortications followed with skin graft, the second case was succeeded with good hair growth. In a case, free omentum flap was used to revascularize the large denuded skull followed with skin graft. The last one, galeal flap was used with skin graft over. All of them had good skull coverage, but they were baldness except the successful replanted case that had normal hair growth.

**Table 1** patient with avulsed scalp at Prapokkloa Hospital from 1995 to 2004.

| No. | Sex/Age (year) | Diagnosis | Cause | Defect | Management | Result | Denuded skull |
|---|---|---|---|---|---|---|---|
| 1.38-1 | F/35 | Totally avulsed scalp | Contact with agricultural machine |  | Replantation Decortication Skin graft | Fail Baldness | Present |
| 2.41-1 | F/41 | Totally avulsed scalp | Contact with agricultural machine |  | Free omentum flap plus skin graft | Good Baldness | Present |
| 3.43-1 | F/63 | Totally avulsed scalp, hemorrhagic shock, pneumothorax | Contact with agricultural machine |  | CPR, Bilateral ICD | Cardiac arrest, death | Present |
| 4.43-2 | F/45 | Totally avulsed scalp | Contact with agricultural machine |  | Replantation | Good hair growth | Present |
| 5.47-1 | F/22 | Totally avulsed scalp | Contact with agricultural machine |  | Galeal flap plus skin graft | Good baldness | Present |

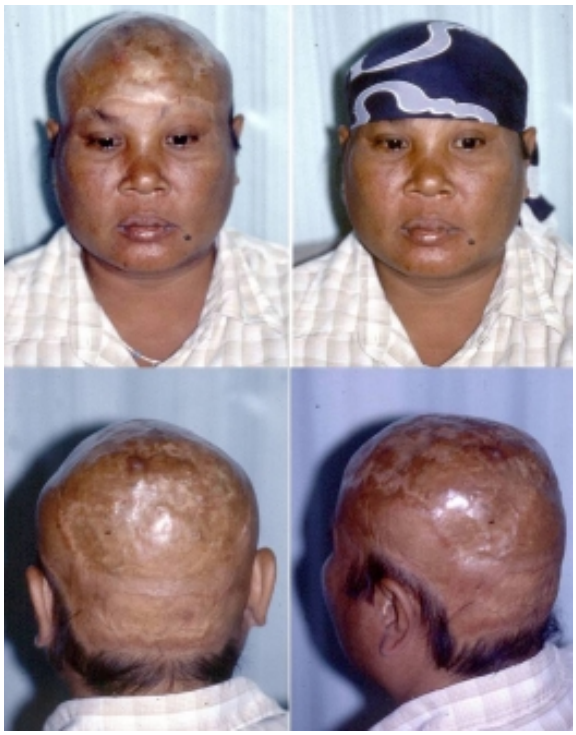
**No.** = number of case, **F** = female

**Case presentations**

**CASE 1** (25 Dec 1995, 38-1)

A 35-years married Thai female working in shrimp farm presented with total avulsed scalp included forehead skin and nose half and hour before admission. She was slightly pale but physically fit enough then she was sent to operating theater for replantation. The scalp replantation was done using both superficial temporal arteries and concomitant veins without graft. The replanted scalp became pink and it took 6 hours to complete the operation. Three units of pack red cell were given to the patient. Six hours after the operation, the scalp seemed to be congested and became purple in color. The replanted scalp was revised but failed. The replanted scalp was removed and the denuded skull was decorticated. The skull was left until

Preoperative presentation is missing



Preoperative presentation case 2

Postoperative presentation case 1

Postoperative presentation

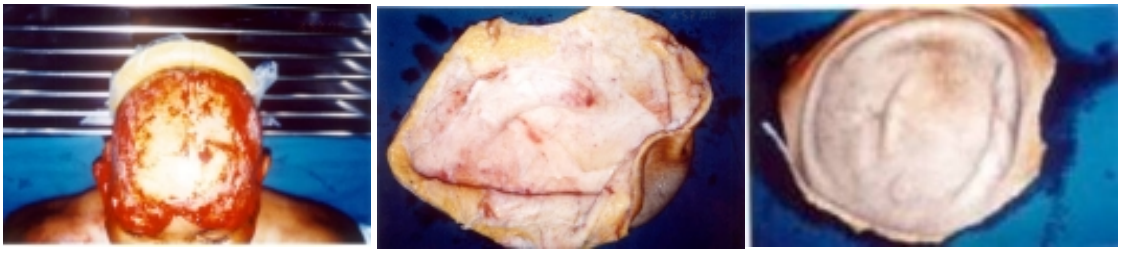
it had good granulation tissue and skin graft was done. She had baldness.

**CASE 2** (23 July, 1998,41-1)

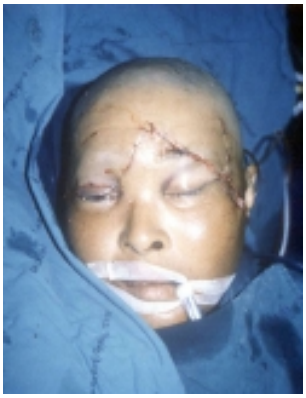
A 41- years married Thai female working in shrimp farm was transferred to Prapoklao Hospital two hours after injury. The avulsed scalp included of both sides of upper eyelid, both sides of temporoparietal scalp just above the ears and occipital scalp at nuchal line. It was so severe crushed and poor candidate for replantation. She was slightly pale but fit so reconstructive procedure free omentum flap was done. The omentum was attached to cover the skull using both superficial temporal arteries and both occipital veins and split skin graft was placed on it. It took for eight hours to complete the operation. She came home with baldness.

**CASE 3** (25 Apr 2000,43-3)

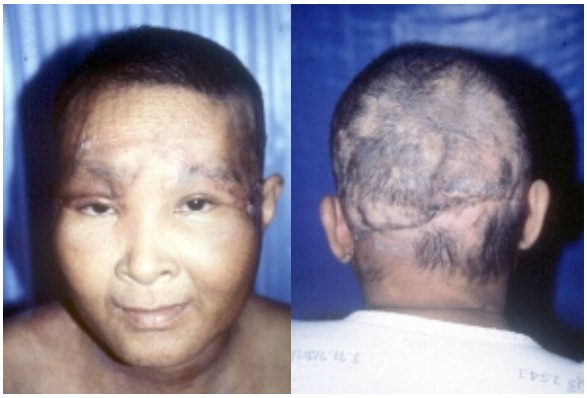
A 45-years married Thai female working in shrimp farm was approximately transferred to Prapokklao Hospital four hours after sustaining a totally avulsed scalp. Additive supraclavicular skin and left medial arm were torn off. She looked pale but physically fit, impending shock with good response to fluid and blood transfusion. Then she was sent to the operating room and the operation was carried out under general anesthesia in supine position. The scalp was cleaned and debrided, and the thrombosed superficial temporal vessels were cut. The avulsed scalp was partially reattached with staples and revascularized by anastomosing



Preoperative presentation case 3



Intraoperative presentation

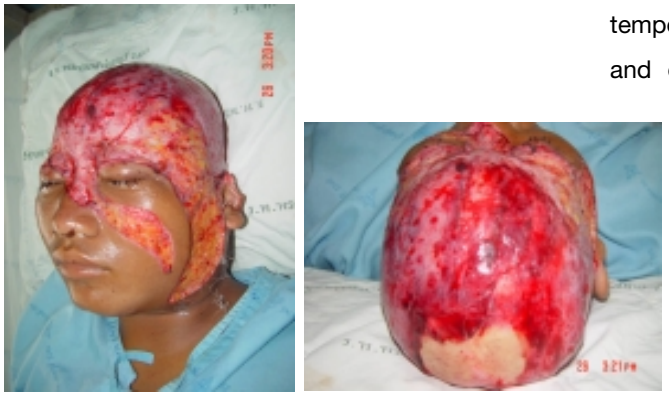


Postoperative presentation case 3

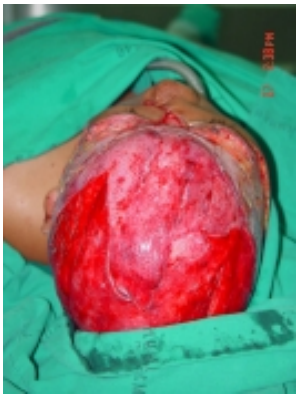
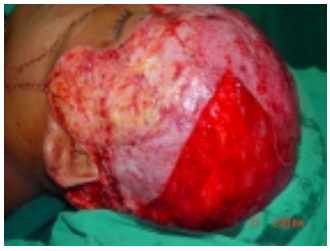
both superficial temporal arteries with interposition vein graft, and venous drainage by anastomosing both occipital veins. The operation was completed in five hours by a single team. She had no complication during the operation. On the fourteen$^{th}$ postoperative days she was sent to the operating room because of marginal necrosis of the scalp and large subgaleal hematoma on the left occipital region. Hematoma was removed and necrotic skin was debrided and it was graft later. She was discharged from hospital with normal hair growth

**CASE4** (25 Apr 2004, 47-1)

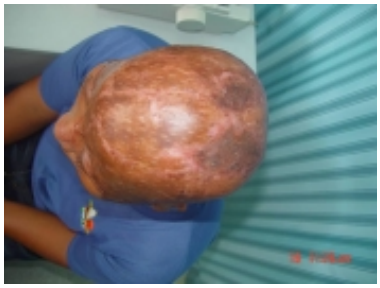
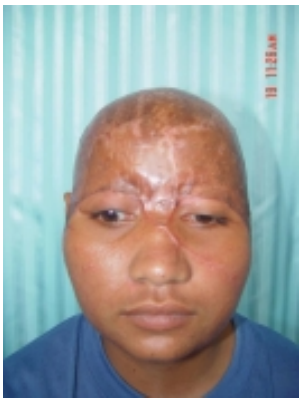
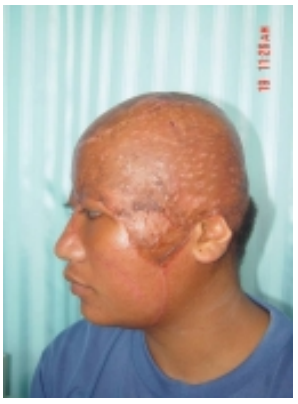
A 22-year married Thai female working in shrimp farm was referred from community hospital because of electrical shock with transient loss of consciousness and totally avulsed scalp 2 hours before admission. The avulsed scalp included forehead skin, eyebrows, root of nose, temporoparietal skin, left cheek, partial of left ear, and occipital scalp at nuchal line. The avulsed



Preoperative presentation case 4

Intraoperative presentation

Postoperative presentation case4

scalp was severe torn and left at the scene. She looked pale, mild confused, and impending shock with good response to fluid resuscitation and blood transfusion. She was sent to the operating room and the operation was carried out under general anesthesia in supine position. The defect was debrided and cleaned. At the top of her head, denuded skull was present. Thus surrounding galea was transposed as galeal flap to cover the denuded skull and the entire defect was covered with skin graft from her thigh. She was discharged with baldness.

## Discussion

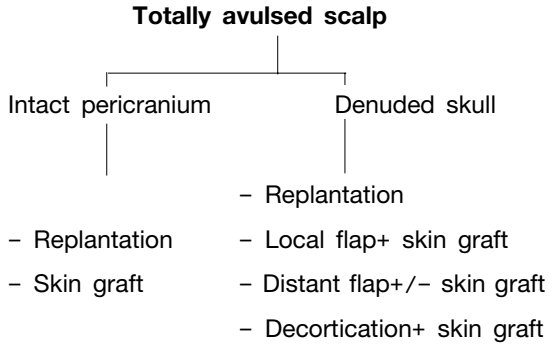
The totally avulsed scalp is uncommon injury with significant associated morbidities due to cranial exposure. Reconstruction of this condition is difficult and still remains a challenging problem for the reconstructive surgeon. As in all areas of reconstructive surgery, the best tissue coverage is the original tissue if possible. There is no question that an attempt to conduct microvascular replantation is the treatment of choice for totally avulsed scalp if there are no other injuries or circumstance such as poor general condition of the patient or severe crushed scalp that preclude replantation. The superiority of the replantation over the other method of the scalp reconstruction is demonstrated by luxuriant growth of hair, restoration of forehead skin and eyebrow included in avulsed segment of the scalp and return of scalp

sensibility.[12,13,14,15,16,17,18,19] The morbidity from removal of the outer table of the skull to provide a vascular bed for skin grafting when periosteum is missing is great. The scar is unsightly and the wound is often unstable even when the pericranium is intact skin grating of wound yields and adherent hairless skin that must be covered by a wig. Replantation of avulsed scalp as a composite graft had rarely been successful unless microvascular anastomosis was performed.[6, 9] Blood supply of the scalp come mainly from superficial temporal and occipital vessels, and the blood supply through one artery is adequate for survival of the whole scalp[21] and the superficial temporal artery has been the most successfully to the scalp replantation.[1, 2,19] Accompanying veins can usually provide venous drainage. Avulsed scalp usually damages the vessels within scalp; so proximal and distal vessels debridement and the placement of interposition vein grafts[20,21] to replace the damaged vessel region are often necessary (case3.43-3) in replantation. For avulsed scalp, vein is susceptible to damage more severe than artery. Thus, during the replantation there may not be enough veins found suitable for anastomosis under such condition. Anastomosis of one or two arteries within the scalp as venous substitute to vein in recipient head arterial to venous shunt so venous back flow can be established in the recipient scalp.[20] In the first case, knowledge about scalp replantation was so little, replantation of the avulsed scalp was done as microvascular replantation in digit as usual and it failed. This might result from severe crushed vessels, poor venous return, and vigorous hematoma, and excessive bleeding from anticoagulant or in adequate drainage. And the important thing of the succeeded case may result from using interposition vein grafts.

In situation that scalp replantation is unavailable or impossible, scalp reconstruction must be done to minimize morbidity (case 2.41-1 and case 4.43-2). Well revascularized procedure; galeal flap, free omentum transfer, latissimus dorsi myocutaneous flap or free parascapular flap[23] may be a choice to make a good soft tissue coverage of denuded skull. Free omentum transfer, the necessity of laparotomy, is the obvious disadvantage, and previous abdominal surgery may preclude use of omentum. Free tissue transfer such as latissimus dorsi myocutaneous flap may be another choice to make good tissue coverage of denuded skull because muscle itself is large enough to cover entire scalp. If there is no denuded skull, skin graft can be used. As mention previously, this condition is rare, it is hard to say which technique is the best. Conditions of patient, surgical skill, and team may affect the choice of treatment. The simple way, local flap may be firstly chosen and then distant tissue is necessary.

All injuries occurred in women with long hair working with rotating machine. Prevention, of course, is the best management of this trauma, any men or women with long hair, who work with rotating machine are in great hazard. To deal with this problem, one who work in such condition must wear short hair or hairnet if has long hair. Modification of existing equipment, overhead rotating shaft is well covered in proper

guard, so that clothing and hair cannot drag onto the machine. And the most important thing is turning off a machine before fixing it.




Local flap:Galeal flap, pericranium flap

Distant flap : Omentum flap, latissimus dorsi flap, parascapular flap, groin flap etc.

**Suggested surgical management for totally avulsed scalp**

**Summary**

Totally avulsed scalp is associated with significant physical and psychological morbidity. Microsurgical replantation is the treatment of choice. However, if replantation is unavailable, one stage reconstruction with well–vascularized tissue must be done. The use of surrounding galeal flap, free omentum transfer or free latissimus dorsi flap is necessary as well. Prevention of totally avulsed scalp can be made by teaching workers to use machine carefully, such as turning off a machine before repairing or cleaning, and wearing short hair.

**Acknowledgement**

I am grateful to associate professor Apirak Chuangsuvanich, Division of plastic surgery, and Department of surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, for his advice.

## REFERENCES

1. Stock BE, Wolfensberger CH, et al. Successful replantation of a totally avulsed scalp. Br J of Plast Surg 1979;2:6,19–21.
2. Tantri DP, Cervino A L, Tabbal N. Replantation of the totally avulsed scalp. Trauma 1980;20:350–2.
3. Handerson H P, Matti B, Liang AG, et al. Avulsion of the scalp treated by microvascular repair : the use of leeches for post–operative decongestion. Br J of Plast Surg 1983;36: 2,235–9.
4. Feierbend TC, Bindra RN. Injuries causing major loss of scalp. Plast Reconstr Surg 1985; 76:189–94.
5. Koss N, Robson ME, and Krizek TJ. Scalping injuries Plast Reconstr Surg 1975;55:439.
6. Lu M. The successful replacement of avulsed scalp. Plast Reconstr Surg 1969; 43:231–4.
7. Robinson, F. Complete avulsion of scalp. British J Plast Surg 1952;5:37.
8. Wynn S, et al. Free pattern skin grafting in total scalp avulsion. Plast Reconstr Surg 1951;7:225.
9. Araki K, Hatano T, Toki M, Ogino A. et al. Replantation of a totally avulsed scalp without microvascular anastomosis. Acta Neurochirugica 1999;141:1353–54.
10. Dingmann RO, Argenta LC. The surgical repair of traumatic defect of the scalp. Plast Reconstr Surg 1982;69:786.

11. McLean DH, and Buncke HJ, Jr. Auto transplantation of omentum to a large scalp defect with microsurgical revascularization. Plast Reconstr Surg 1972;49:268.
12. Ikutaya Y. Auto transplantation of omentum to cover large denudation of scalp. Plast Reconstr Surg. 1975;55:490.
13. Maxwell GP, Stuber K Hoopes JE. Free latissimus dorsi myocutanous flap. Plast Reconstr Surg.1978;62:468.
14. Miller GD, Anstee EJ, and Snell JA. Successful replantation of an avulsed scalp by microvascular anastomosis. Plast Reconstr Surg 1976;58:133-6.
15. Bunke HJ, Rose EH, Browstein MJ, et al. Successful replantation of two avulsed scalp by microvascular anastomosis Plast Reconstr Surg 1978;61:666-72.
16. Nahai F, Huteau J, and Vasconez LO. Replantation of and entire scalp and ear by microvascular anastomosis of only one artery and one vein. Br J Plast Surg 1978; 31:339-42.
17. Zhou S, Chang TS, Guan WX, et al. Microsurgical replantation of the avulsed scalp : report of six cases. J Reconstr Microsurgery 1993;9:2, 121-5, discussion 125-9.
18. Srimuninnimit V, Visuthikosol V, Vivatan-sithipong M, et al : Replantation of the scalp : a case report. J Med Assoc Thai 1996; 79:9,608-12.
19. Spira M, Daniel RK, and Agris J. Successful replantation of totally avulsed scalp, with profuse regrowth of hair. Plast Reconstr Surg 1978; 62:447-51.
20. Kaixiang C, Su Z, Kecheng J, et.al. Microsurgical replantation of avulsed scalp : report of 20 cases. Plast Reconstr Surg 1996;97:1099-106.
21. Evan S, Hess J, and Larkin GC : Total scalp replantation based on one artery and one vein. Microsurgery 1993;14:4,266-71.
22. Apert BS, Bucke H, Jr. and Brownstein M. Replantation of damaged arteries and veins with interposition vein graft when replanting crushed amputated fingers. Plast Reconstr Surg 1978;61:17.
23. Chiu DTW, Sherman JE and Edgerton BW. Coverage of the calvarium with free parascapular flap. Annual of Plastic Surg 1984;12:1,60-66.