

Surgical Managements for Traumatic Avulsed Scalp: 10-year Experiences in 14 Cases at Prapokkloa Regional Hospital

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Abstracts : Traumatic avulsed scalp is an uncommon and serious injury. 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.

Objectives : Alternative surgical managements for avulsed scalp.

Study design : Retrospective design.

Materials & methods : From 1995 to 2004, there were 14 cases admitted with traumatic avulsed scalp, 7 men and 7 women. Among these patients nine of them had partial loss of their scalp, while five cases had totally lost theirs.

Results : Among these 14 patients, 5 cases were classified as women with totally avulsed scalps, caused by contact with agricultural machines. One case died from multiple traumas. Four cases survived; 2 cases for replantation (one case succeeded and one case failed), 1 case for an omentum free flap, and 1 case for a galeal flap plus skin graft. The successful replantation has good hair growth, and all others are baldness. 9 cases, partially avulsed scalp, were 7 men, and 2 women. 6-scalp flap had good result with normal hair growth. 1-scalp flap with skin graft and 2-skin graft had baldness.

Conclusion : Microsurgical replantation is the treatment of choice for avulsed scalp. However, if replantation is unavailable, one stage reconstruction with well-vascularized tissue must be done. As avulsed scalp is a serious injury, prevention is very important.

Key words : avulsed scalp and surgical management

เรื่องย่อ : การรักษาผู้ป่วยหนังศีรษะหลุด : ประสบการณ์การรักษาผู้ป่วย 14 รายในโรงพยาบาลพระปกเกล้า จังหวัดจันทบุรี

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ภาวะหนังศีรษะหลุดเป็นอาการบาดเจ็บที่พบได้ไม่บ่อย แต่รุนแรง เกิดจากการหมุนกระชากหนังศีรษะอาจเพียงบางส่วนหรือหลุดไปทั้งหมด การรักษาที่ดีที่สุดคือการนำหนังศีรษะที่หลุดไปกลับมาต่อเข้ากับที่เดิม

วัตถุประสงค์ : ศึกษาทางเลือกในการรักษาผู้ป่วยบาดเจ็บหนังศีรษะหลุดโดยการผ่าตัด

รูปแบบการวิจัย : การศึกษาวิเคราะห์แบบย้อนหลัง

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วัตถุประสงค์และวิธีการ : รวบรวมข้อมูลผู้ป่วยอุบัติเหตุที่มีภาวะหนังศีรษะหลุดระหว่างปี พ.ศ. 2538 ถึง พ.ศ. 2547 ทั้งหมด 14 ราย ผู้ชาย 7 ราย ผู้หญิง 7 ราย หนังศีรษะหลุดบางส่วน 9 ราย หนังศีรษะหลุดหมดทั้งศีรษะ 5 ราย

ผลการรักษา : จำนวนผู้ป่วยที่มีปัญหาหนังศีรษะหลุดหมดทั้งศีรษะ 5 ราย ทุกคนเป็นผู้หญิง ว่างมยาว เสียชีวิต 1 ราย เนื่องจากที่มีอาการบาดเจ็บรุนแรงหลายระบบ มีชีวิตรอด 4 ราย ทำการรักษา Replantation 2 ราย (ประสบความสำเร็จ 1 ราย ไม่ประสบความสำเร็จ 1 ราย) free omentum flap 1 ราย และ galeal flap + skin graft 1 ราย ประสบผลสำเร็จในการสร้างสิ่งคลุมศีรษะทุกราย รายที่ประสบผลสำเร็จในการทำ replantation มีผมงอกตามปกติ ใน 9 รายที่มีหนังศีรษะหลุดบางส่วนมีผู้ชาย 7 ราย และ ผู้หญิง 2 ราย ทำการรักษาโดยการทำให้ scalp flap 6 ราย มีผมงอกเป็นปกติ ทำ skin graft 2 ราย และ scalp flap + skin graft 1 ราย รวม 3 รายที่มีศีรษะล้าน

สรุป : การแก้ปัญหาหนังศีรษะหลุดทั้งศีรษะที่ดีที่สุดคือการผ่าตัดทางจุลศัลยกรรมต่อหนังศีรษะอันเดิมกลับเข้าไปใหม่ แต่ถ้าไม่สามารถทำได้หรือสถานะการณ์ไม่อำนวย การสร้างสิ่งปกคลุมทดแทนทันทีในขั้นตอนเดียวเป็นสิ่งที่ต้องกระทำ และการป้องกันอุบัติเหตุที่ทำให้เกิดภาวะหนังศีรษะหลุดเป็นสิ่งที่ดีที่สุด

INTRODUCTION

Avulsed scalp is an uncommon trauma resulting from a sudden and severe tangential force on the scalp. The exact specimens will vary, depending on the specific direction and strength of the force applied. It generally results from entanglement of long hair in rotary machines. A totally avulsed scalp is a serious injury that is often incurred in industrial and agricultural machinery.¹⁻⁴ The totally avulsed scalp may have significant associated morbidities due to cranial exposure. Predictable sequelae of such an injury include vulnerability to minor traumatic accident, recurrent ulceration, dryness, progressive breakdown, baldness, and eyelid ectropion. Prior to the advent of microvascular anastomosis, replacement of torn-off scalp resulted in failure in almost every instance.⁵ Despite an occasional reported success of a thick scalp replacement, Lu in 1969⁶, the best treatment in the past has been split thickness skin graft, either from a distant donor site or from the scalp.⁷⁻¹⁰ Reattachment and microvascular anastomosis are possible in an acute avulsed scalp and was first report by Miller et al in 1976¹¹ and many other surgeons.¹²⁻¹⁸ If replantation is unavailable, several solutions can be considered as full thickness coverage to provide necessary protection. The surgical solutions include skin graft, scalp flap¹⁹⁻²², perforation of calvarium and moist dressing for subsequent skin graft, pericranium flap with skin graft²³, free tissue transfer such as omentum with skin

graft^{24,25}, latissimus dorsi²⁶, parascapular flap²⁷ or groin flap.^{28,29}


MATERIALS AND METHODS

From 1995 to 2004, there were 14 cases admitted with avulsed scalp; 5-totally avulsed scalps and 9-partially avulsed scalps (Table 1). The ages of these patients varied from 16 days to 63 years; they were 7 men and 7 women. Seven were injured because of an agricultural machine. Five cases were injured by traffic accidents; 3 cases from motorcycle and 2 cases from car accidents. One was bitten by a dog bite and another was injured from a birth trauma. Eleven cases had denuded skulls while 3 cases did not. Surgical procedures were done, including scalp flap in 6 cases, replantation in 2 cases, skin graft in 2 cases, scalp flap with skin graft in 1 case, decortications follow by skin graft in 1 case, free omentum with skin graft in 1 case, and galeal flap with skin graft in 1 case.

RESULTS

Of the 14 cases, 5 had totally avulsed scalps. These five cases were women with long hair, who were injured while using a machine on a shrimp farm. All of them had denuded skulls. One case died from multiple traumas: head injury, hemorrhagic shock, lung contusion with bilateral hemopneumothorax

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

No.	Sex/Age (year)	Diagnosis	Cause	Defect	Management	Result	Denuded skull
1.38-1	M/27	Avulsed scalp	Car accident		Scalp flap	Good hair growth	Present
2.38-2	F/35	Totally avulsed scalp	Contact with agricultural machine		Replantation Decortication Skin graft	Fail Baldness	Present
3.41-1	F/41	Totally avulsed scalp	Contact with agricultural machine		Free omentum flap plus skin graft	Good Baldness	Present
4.43-1	M/21	Avulsed scalp	Motorcycle accident		Scalp flap	Good hair growth	Present
5.43-2	F/63	Totally avulsed scalp, hemorrhagic shock, pneumothorax	Contact with agricultural machine		CPR, Bilateral ICD	Cardiac arrest, death	Present
6.43-3	F/45	Totally avulsed scalp	Contact with agricultural machine		Replantation	Good hair growth	Present
7.44-1	M/19	Avulsed scalp	Motorcycle accident		Scalp flap	Good hair growth	Present
8.45-1	F /24	Near totally avulsed scalp (70%)	Contact with agricultural machine		Skin graft	Good baldness	None
9.45-2	F/27	Near totally avulsed scalp (70%)	Contact with agricultural machine		Scalp flap plus skin graft	Good baldness	Present
10.45-3	M/4	Avulsed scalp	Dog bite		Scalp flap	Good hair growth	Present
11.45-4	M/27	Avulsed scalp	Car accident		Scalp flap	Good hair growth	Present
12.45-5	M/4	Avulsed scalp	Motorcycle accident		Scalp flap	Good hair growth	Present
13.46-1	M/16d	Avulsed scalp, cephalhematoma	Birth trauma		Skin graft	Good baldness	
14.47-1	F/22	Totally avulsed scalp	Contact with agricultural machine		Galeal flap plus skin graft	Good baldness	Present

and a totally avulsed scalp. Two of them received replantation but the first case (2.38-2) failed and needed decortications followed by skin graft. The other case (6.43-3) was successful with good hair growth. In one case (3.41-1), the large denuded skull was revascularized with a free omentum flap followed by skin graft. A galeal flap with skin graft was used on the last one (14.47-1). All of them had good skull coverage but they were bald except for the case (6.43-3, successful replantation) who had normal hair growth. Nine of them had partially avulsed scalps, surgical managements including 6-scalp flaps (case 1.38-1, case 4.43-1, case 7.44-1, case 10.45-3, case 11.45-4, case 12.45-5), 2-skin grafts (8.45-1, 13.46-1), and 1-scalp flap with graft (9.45-2). These were good results with normal hair growth in the scalp flaps (6 cases); the other three had baldness.

Case 1

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

Case 2

A 45-year married Thai female working on a shrimp farm was transferred to Prapokkloa Hospital approximately four hours after sustaining a totally avulsed scalp. Additive supraclavicular skin and the left medial arm were torn off. She looked pale but physically fit. Although she was in impending shock, she responded well to fluid and blood transfusions. Then she was sent to the operating room; the operation was carried out under general anesthesia in a 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 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 fourteenth postoperative days she was sent to the operating room because of a marginal necrosis of the scalp and large subgaleal hematoma on the left occipital region. The hematoma was removed and necrotic skin was debrided and was grafted later. She was discharged from the hospital with normal hair growth.

Case 3

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



Preoperative presentation case1

Postoperative presentation case1

Figure 1. Demonstration of case3.41-1 using free omentum flap, good coverage and baldness.



Preoperative presentation case2



Intraoperative presentation



Postoperative presentation case2

Figure 2. Demonstration of case 6.43-3, successful replantation having a good result with normal hair growth.



Preoperative presentation case3



Intraoperative presentation



Postoperative presentation case3

Figure 3. Demonstration case 14.47-1, using galeal flap with skin graft for good coverage but with baldness.

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

DISCUSSION

The totally avulsed scalp is an uncommon injury with significant associated morbidities due to cranial exposure. Reconstructing 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 at microvascular replantation is the treatment of choice¹¹⁻¹⁸ for totally avulsed scalp if there are no other injuries or circumstance such as the poor general condition of the patient or a severe crushed scalp that preclude this. The superiority of the replantation over the other methods of scalp reconstruction is demonstrated by luxuriant growth of hair, restoration of forehead skin and eyebrow included in the avulsed segment of the scalp and the return of scalp sensibility. Replantation of the avulsed scalp, as a composite graft, has rarely been successful unless microvascular anastomosis was performed^{6,9}. Blood supply to the scalp comes mainly from superficial temporal and occipital vessels, and the blood supply through one artery is adequate for the survival of the whole scalp¹⁸; the superficial temporal artery has been the most successful in scalp replantation.^{1,2,16} Accompanying veins can usually provide venous drainage. In avulsed scalp usually damages the vessels within the scalp so proximal and distal vessel debridement and the placement of interposition vein graft^{17,31,32} to replace the damaged vessel region are often necessary (case 2, 6.43-3) in replantation. For the avulsed scalp, the vein is susceptible to more severe damage than the artery. Thus, during the replantation there may not be

enough veins found suitable for anastomosis under such conditions. Anastomosis of one or two arteries within the scalp as venous substitute for the vein in the recipient's had arterial to venous shunt so venous back flow can be established in the recipient's scalp¹⁷. In the first case, knowledge about scalp replantation was so little, replantation of the avulsed scalp was done as a microvascular replantation in digits and it failed. This might result from severely crushed vessels, poor venous return, vigorous hematoma, and excessive bleeding from anticoagulant or inadequate drainage. Long periods of ischemic do not appear to threaten graft viability³¹. The important part of this success may result from using interposition vein grafts and generous debridement of damaged vessels.

In a situation where scalp replantation is unavailable or impossible, scalp reconstruction must be done to minimize morbidity. Well-revascularized procedures such as local tissues (galeal flap, pericranium flap), distant tissues (free omentum transfer, latissimus dorsi myocutaneous flap, free parascapular flap, groin flap and etc.) may be choices to make good soft tissue coverage of a denuded skull. Local tissue is chosen first and then the distant tissue. The free omentum transfer, the necessity of laparotomy, is an 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 a denuded skull because the muscle itself is large enough to cover the entire scalp. If there is no denuded skull, the best solution is a skin graft¹⁰.

Partial avulsed scalps are rare because of strong galea resistance to traction³³. In a small to medium size defect, 70% or more of the scalp remains with normal vascularity; a multitude of scalp flaps¹⁹⁻²² are available for good coverage with normal hair growth (Figure 4). The possible use of tissue expander, in some cases, must be conservative if the pericranium is intact. In a larger defect, (Figure 5) solutions like the procedures to deal with a totally avulsed scalp may be necessary.

As mentioned previously, totally avulsed scalp occurred in women with long hair, working on farms with rotating machine. Prevention, of course, is the best management of all traumas. Therefore, any men or women with long hair who work rotating ma-

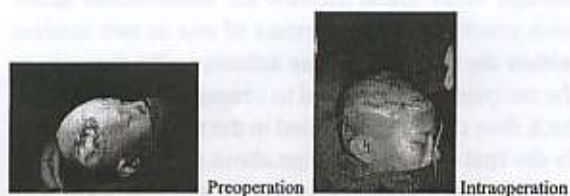


Figure 4. Demonstration using scalp flap for small defect coverage



Figure 5. Large scalp defect with intact pericranium; skin graft was placed with good coverage (case 13.46-1)

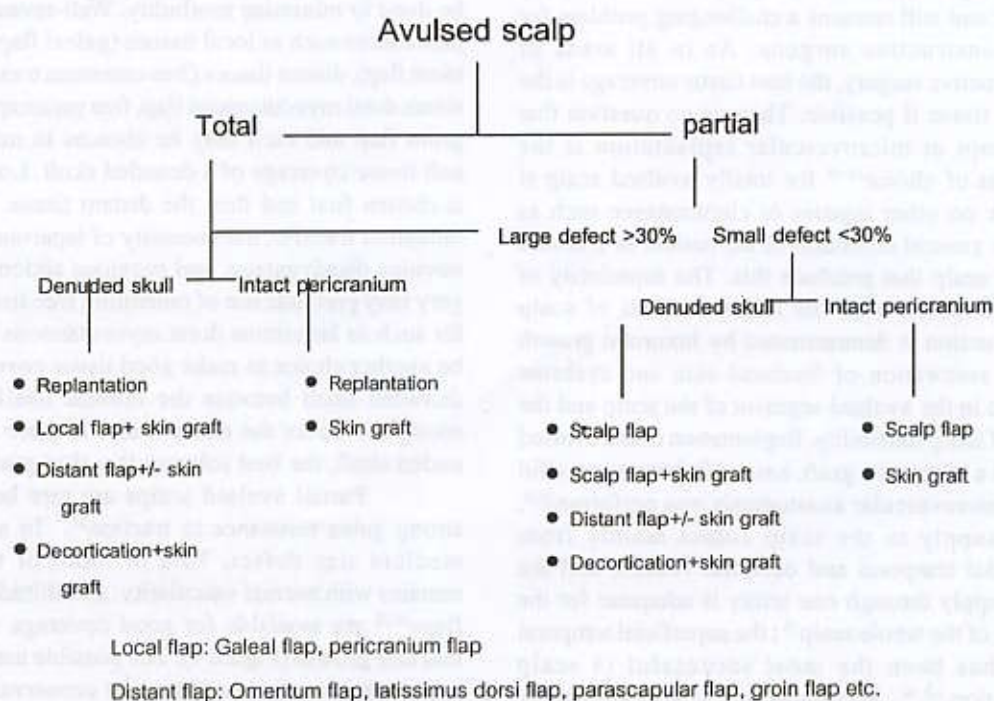


Figure 6. Suggested surgical management for avulsed scalp.

chines are in a great danger. To deal with this problem, one who works in such conditions must have short hair or wear hairnets at all times. Another strategy to prevent this severe injury is the modification of existing equipment so that the overhead rotating shaft is well covered. It properly guards users; clothing and hair cannot become entangled. In addition, the most important thing is to turn off a machine before fixing it.

SUMMARY

Total avulsion of the 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. If the pericranium is intact, skin graft is the

treatment of choice. If the skull is denuded, the use of surrounding tissues (galeal flap, scalp flap, pericranium flap) and then distant tissues (free omentum transfer, free latissimus dorsi and etc.) are necessary as well.

Prevention of a totally avulsed scalp can be made by teaching workers to use machines carefully, such as turning off a machine before repairing or cleaning it, and having short hair. Minor traumatic avulsed scalps, especially from traffic accidents can be prevented by safety belts or helmets.

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