Original Research Article

Prospective study on outcome and advantage of primary skin grafting in cases of avulsion scalp injury following trauma

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ABSTRACT

Background: Traumatic avulsion injury poses severe risk as the overlying protective covering is lost and the raw tissue is exposed to the environment. Avulsion injuries involving the scalp are even more complicated to treat because of significant cosmetic concern involved. Aim of the study was to find a better solution than the existing method, we conducted a prospective study involving 13 patients with isolated traumatic scalp avulsion injury.

Methods: This prospective study was conducted in Motilal Nehru Medical College and associated Swaroop Rani Nehru Hospital, Prayagraj, after taking written and informed consents from the patients, between June 2017 and June 2019. These were divided into two groups (A and B) based on whether the underlying periosteum was intact or not.

Results: Patients with intact periosteum (Group A) underwent primary thin thickness skin grafting within a few hours of their admission while the other group (Group B) was treated with a traditional conservative approach. We compared the results of both the groups and found that Group A patients not only had satisfactory graft uptake (≥ 85 TBSA) but also had significant decreased risk of infection, lesser hospital stay, overall decreased healthcare cost, better cosmeses and early return to routine activity.

Conclusions: For the surgeon, this single step procedure is safe and technically easy. Thus this approach was found to be superior than the current traditional approach.

Keywords: Avulsion, Grafting, Scalp, Trauma

INTRODUCTION

Avulsion scalp injury involves a specific irreplaceable tissue loss, risk of serious complications and significant cosmetic issues in young women. This injury has serious consequences in terms of hospital stay, economic loss and importantly devastating disfigurement and psychological effects on the patients. Today the principal causes of avulsion injury are industrial machinery and road traffic accidents. Usually the treatment of such cases

is either local or distant flap. But this may not be possible due to other pre-existing conditions of the patient. Such cases a 2 stage procedure involving removal of outer table of skull and exposing the diploic spaces to allow better granulation.^{1,2}

Because of the advancement in the medical field no patient dies from scalp avulsion today. It is a prospective study on outcome and advantage of primary skin grafting in cases of avulsion scalp injury following trauma.

METHODS

This prospective study was conducted in Motilal Nehru Medical College and associated Swaroop Rani Nehru Hospital, Prayagraj, after taking written and informed consents from the patients, from June 2017 and June 2019. Those patients who were admitted in emergency department with isolated partial or complete scalp avulsion (without underlying brain injury), significant tissue loss and non replantable avulsed skin were included in this study and were initially resuscitated and then treated primarily by skin grafting. The skin graft was harvested from the thigh. They were followed up for a period of 6 months.

Inclusion criteria

All the patients presenting to the emergency department with isolated scalp injury between June 2017 and June 2019 with non replantable avulsed skin were included.

Exclusion criteria

Patient with associated visceral or bone injury, patient who did not give consent, patient who were lost in follow up were excluded.

General treatment

The blood loss was adequately replaced. Anti-tetanus serum or if the patient was previously immunized, tetanus toxoid was given. Broad-spectrum antibiotic therapy was instituted. If the avulsed scalp was brought to hospital, consideration was given if the avulsed skin was reimplantable. As soon as the patient was resuscitated, primary grafting was done maintaining complete haemostasis.

Local treatment

The scalp was shaved and the raw areas were cleaned. Haemorrhage was controlled by ligature or diathermy. The underlying raw areas were washed with saline adequately to get rid off of all the foreign material and all the devitalized tissue was debrided. All flaps that were still attached were sutured into correct anatomical position. Only if the periosteum was intact patient was categorised under Group A and thin split-thickness Thiersch grafts was applied to the defects. Otherwise, patient categorised under Group B and underwent secondary grafting after adequate granulation over defect

The grafts were fixed in position by suturing them to the edges of the defect and to each other. If a single graft could not cover the whole raw area, multiple grafts were used. The best possible piece of skin was used for the frontal region and preferably applied transversely in order to place the junctional scars in the line of the natural skin creases. First dressing was done after 5 - 7 days, excess graft was trimmed and sutures removed. Thereafter

dressing was done on alternate day if it was clean, otherwise daily wet dressings with saline was done. If there was loss of graft, then stored skin is applied. First the granulations must be clinically clean, then a sensitivity swab is taken for culture and an appropriate antibiotic applied for 3 days, then the stored skin is applied as a dressing. Subsequent treatment is as for a graft dressing.

RESULTS

This study involved 13 patients from the period of June 2017 to June 2019. Patients with intact periosteum were primarily treated with thin thickness split skin graft. Out of 13 patients 7 were included in Group A and the remaining 6 under Group B. Out of 13, 9 patients had satisfactory graft uptake ($\geq 85\%$ area), 4 from Group A and 5 from group B. 2 patients of Group A and 1 patient of Group B developed hypergranulation which was treated by excision of excess tissue followed by grafting.

Table 1: Observation of the study (n=13).

	No. of patient (%)
Gender	
Male	3 (23.07)
Female	10 (76.9)
Age (in years)	
20-30	2 (15.3)
30-40	6 (46.15)
40-50	4 (30.7)
50-60	1 (7.6)
Outcome	
Good primary uptake ($>85\%$ TBSA)	9 (69.23%) 4 - Group A; 5 Group B
Hypergranulation	3 (23.07%) 2 - Group A; 1 - Group B
Poor graft uptake	1 (7.69%) 1 - Group A

Figure 1: 45 year old female patient with isolated scalp avulsion injury.

Figure 2: Same 45 year old female after the graft dried completely.

One patient from Group A had poor primary graft uptake due to infection who was treated with antibiotics according to pus culture sensitivity and after the control of infection, re-grafting was done with successful result.

DISCUSSION

The scalp consists of 5 layers of skin, subcutaneous connective tissue, occipitofrontalis muscle and its aponeurosis, subaponeurotic layer and periosteum (pericranium). The superficial fascia in the scalp is a firm fibro-fatty layer adherent to the skin and to the underlying occipitofrontalis and its aponeurosis. The galea aponeurotica is a dense fibrous tendinous structure between the frontal and occipital muscles. The occipitofrontalis muscle is loosely attached to the periosteum by a subaponeurotic areolar tissue and a layer composed of a network of loose areolar tissue containing fat. This has commonly been referred to as the 'cotton-wool' layer, and in this plane the scalp can be undermined easily and extensively. It is also the plane in which avulsion or scalping injuries take place.

The first three layers are intimately united and, whether they are raised as a flap or torn off in an accident, they remain firmly attached to each other. The blood vessels and nerves run in the superficial fascial layer. This is the reason why large scalp flaps can be raised without interference with the blood supply. The skin at the scalp is thicker than elsewhere in the head and neck region, and it is even thicker in the occipital region. The tensile strength of the hair and its firm attachment result in rupture of the scalp from the cranium. Therefore, people with long hair are at a high risk of scalp avulsion injury as they get trapped in the machinery. The starting point of the avulsion usually begins in the frontal area, where the skin is thinner, and the prominent supraorbital edge acts as a knife edge and cuts through the skin of the upper lids where the scalp is torn. The plane of cleavage is through the loose areolar tissue, and the periosteum usually

remains intact, but may be avulsed. Rarely skull fracture may be present. Scalp avulsion is an injury that has far-reaching effects on the patient. It involves long-term hospitalization, significant haemorrhage, economic loss, and devastating disfigurement and psychological effects.

The pericranium and periosteum is a thin fibrous membrane containing blood vessels, and is loosely attached to the cortex of the outer table of the skull, except at the suture lines, to which it is firmly adhered. The blood supply of the scalp is profuse from the frontal, posterior auricular and occipital arteries and the superficial temporal, parietal, and temporal branches.

Scalp reconstruction following avulsion injury can be challenging for various reasons like contamination of the wound, excessive bleeding, denuded bone which lacks granulation tissue bed. Depending on the size and depth of the defect various reconstruction options includes primary skin grafting (STSG/FTSG), second intention healing, 10 closure, local flaps, tissue expansion with subsequent flap repair, free tissue transfer.

But these procedures require weeks or months of meticulous wound care. With intact pericranium, even smaller defects may also take significant time to heal.

This simple reconstruction option of primary grafting can be performed in one stage and in single setting and often provides acceptable aesthetic result with minimal healing time and where needed secondary reconstruction can be done at a later date. Because the time taken for granulation tissue to cover exposed bone in weeks is two times the width of the defect (in cms) and the time taken for complete re-epithelization is 3 times the width. This prolonged period increases the morbidity and duration of hospital stay of the patient. Basically skin grafts require an intact periosteum, fascia or soft tissue for predictable perfusion and uptake of graft.

Primary grafting

In cases where the pericranium or periosteum was intact, the defect of the scalp was covered with the thin split skin graft which was harvested from the anterior aspect of the thigh with the dermatome. Few fenestrations were made and graft was applied to the defect with margins secured with sutures. Since the bone was not denuded, healthy granulation tissue in the form of pericranium was present which was cleaned with saline irrigation and were treated with i.v antibiotics in the first instance. In our study most of the cases presented to our emergency department within 8 hours (range 2 hours - 14 hours) from the time of injury.

Primary grafting provides good cover over the abused part thereby preventing superficial infection of the local site and promote healing. It is a good intermediary procedure before reconstructive surgery as the healing is expedited.

In a study by James et al, 28% were applied on day 1 and 80% being applied by the 3rd day, where the timing of application was empirical, no particular time interval to wait for granulation tissue to form as a criteria for application of grafts.³ Foong et al applied split thickness skin graft at the base of the skull as a single stage procedure of 2 patients and had 100% graft uptake.⁴

In some cases where the denuded bone with absent periosteum a rotation flap of temporalis fascia was used as cover for periosteal defect and a thiersh graft places on the fascia. Also thin split thickness skin graft with few fenestrations was applied as a sheet which also prevented hematoma or seroma formation. Finally ensued there were no tight compressive or any shearing forces being applied while covering the grafting during the dressing.

In a case series study by Aldabagh et al, flap and graft reconstructive technique, one staged operation for medium to large scalp defect had good aesthetic outcomes in all 20 patients.⁵

In a study by Pitkanem et al, obtained coverage in a single operation by burring followed by immediate application of skin graft over the bleeding resulted in stable coverage with shortened hospital stay significantly. Also case report study by Araki et al, where there was successful replantation and grafting of an avulsed scalp without microvascular anastomosis.^{6,7}

The study by Molnar et al, where STSG was done immediately after removal of outer table resulted in 100% graft uptake without any complications. Also case report study by Jensen et al, repair of denuded cranial bone by bone burring and free skin grafting of 3 patients, utmost success was seen.⁸

CONCLUSION

In our study, most of the patients had good graft uptake and skin cover, with low complication rates and shortened hospital stay. The procedure had the advantage of being economical, safe and easy with satisfactory cosmeses. Secondary procedures were done according to the patient's demand. Since it was a one stage procedure done in a single setting no special care was required

except, close monitoring to avoid complications such as displacement or hematoma formation or infection. If the procedure turns out unsuccessful, alternative reconstructive methods are still available which can be planned and carried out to achieve desired results.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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