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Original Research Article

Study of Different Modalities of Scalp Defect Reconstructions & Devising a Treatment Protocol in a Tertiary Care Center in Eastern Part of India

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Abstract

Background: Various modalities for managing scalp defects have previously been described in the literature. Aims & Objective: This study estimates and describes the various causes of scalp injury and suitable method for closure of scalp defects in eastern part of India and to devise a treatment protocol for the management of scalp defects resulting from different conditions.

Methods: A prospective study of patients who sustained trauma, electrical burns, marjolin's ulcer of the scalp & bear mauling to the head from September 2018 to November 2020 was carried out in department of plastic & reconstructive surgery, SCB medical college & hospital, Odisha, India. Etiology, Size of scalp defect, age, sex and modalities of reconstruction were analysed.

Results: Thirty-four patients were enrolled in this study. Twenty-seven electric burn injuries accounted for most of the scalp injuries. The scalp defects in 28 patients were covered using local scalp flap rest with free flap, regional flap or skin graft. X ray skull and NCCT brain were used to assess the underlying calvarium.

Conclusions: Majority of the soft tissue defects of the scalp resulting from trauma, high-voltage electrical burns, resection of marjolins ulcer & bear mauling can be managed with local scalp flaps alone. In cases of larger defects, free flaps can be used. Other methods of coverage include SSG and tissue expansion using expanders. In cases of progressive diseases like electric burns delayed reconstruction is better. Secondary procedures for cosmetic reconstruction and alopecia management are required later.

Keywords: Bear-mauling, Electrical burns, Marjolins ulcer, Transposition flaps, Scalp defect

Background

Scalp extends anteriorly from the supraorbital ridge and posteriorly until the superior nuchal line of occiput [1]. Scalp defects result from trauma, burns, oncologic resections, infections & congenital abnormalities. Reconstruction is determined by the size and depth of defect & is accomplished by various challenges in managing the scalp defects with regard to need for split-thickness skin graft or flap, choice of flap, role of debridement of bone, timing of management, and reconstructive method to be adopted [2]. Exposure of the calvarium necessitates the requirement of a vascularized flap. With proper management, various complications and cosmetic disfigurement can be prevented.

Aims & Objective

This study estimates and describes the various causes of scalp injury and suitable method for closure of scalp defects in eastern part of India and to devise a treatment protocol for the management of scalp defects resulting from different conditions.

Materials and methods

This was a prospective study done for a period of two years from September 2018 to November 2020 at department of plasticand reconstructive surgery, SCB medical college & hospital, Odisha. A total of 34 patients with scalp defects were studiedafter taking proper informed consent from them. Thorough clinical examination and mental status assessment, routine blood and appropriate radiological (X ray Skull, NCCT brain) investigations were done.

Inclusion criteria

1. Patients of all age groups admitted for scalp defects with either isolated scalp injury

2. Scalp injury associated with polytrauma.

Exclusion criteria

1. Patients with scalp injuries with underlying head injury evident on CT scan.

2. Patients with age < 10 years.

Collected data were tabulated in an excel sheet and analysed using IBM SPSS Modeler 18.1 (201, 7 Armonk, NY: IBM Corp) for descriptive and inferential statistics.

Results

Out of the 253 patients who presented with burns, 51(20.15 %) had sustained electrical injury, out of which 14 patients sustained electrical burns to the scalp. Twenty-seven male patients & seven females belongingto the age group between 11 and 60 years were enrolled in the study. Out of 34 patients (15 cases of electric burns, 10 cases of trauma, 3 cases of marjolin's ulcer, 3 cases of bear mauling, 1 post cranioplasty exposure, 1 case of Ventriculo-Peritonea l(VP) Shunt exposure& 1 case of spindle cell tumor), 3 patients presented late (3 months after injury) with osteomyelitic bony changes which were confirmed by imaging and they underwent excision of the osteomyelitic bone segment which resulted in full-thickness defect of the skull. (Table-1) The scalp defects ranged from 10 to 136 cm^2 with an average of 55.8 cm^2. All patients underwent CT scan at the time of admission to rule out head injury & were assessed for scalp injury after stabilisation. The necrotic scalp and underlying bone were debrided in 8 (three trauma & five electrical burns) patients resulting in lossof full thickness defect of the scalp. The remaining 26 patients had sustained injury extending to involve only the outer cortex. After debridement of the outer cortex, there was healthy intact inner table, thus maintaining continuity of the skull.

Out of 34 patients 10 patients there was involvement of front parietooccipital region. There were 32 flaps successfully used to cover various soft tissue defects of the scalp. Out of which, 28 were local scalp flaps, one pedicle trapezius flap (Fig- 1) one free latissimus dorsi (LD) muscle flap (Fig-2), gracilis flap & one was ALT flap. Among the 28 local scalp flaps, 23 patients underwent transposition flaps (Fig-3) & five had rotation flaps. (Table-2) The largest defect covered

with local scalp flap was 96 cm^2, ALT flap covered a maximum size of 122 cm^2, and free LD muscle flap was used to cover a defect of 106 cm^2. Two patients underwent resuturing for flap dehiscence. Total surface area involved during electrical burns ranges from 12 to 36 % (average of 18.15 %).

Associated injuries included defect over the upper limb & lower limb in 7 patients & were treated with different local flapcovers. One trauma patient had loss of left auricle. In addition to this, one more patient had sustained injury to the genital region and subsequently underwent partial penile amputation.

Minor complications like partial skin graft loss over the harvested flap site were notedin two patients, managed with regrafting All the patients were followed up for aperiod of 3-6 months. While on follow-up, one patient who underwent trapezius pedicled flap developed cataract after 3 months of injury. Two trauma patients had mild head injury treated conservatively involving the neurosurgery and neurology team. Out of the three bear mauling cases, two had concomitant facial injury which was repaired with primary suturing.

One patient had frontoparietal spindle cell tumor which was excised followed by skin graft. Patient later came for treatment of alopecia which was managed with tissue expansion. (Fig-4)

Table 1: Causes of scalp defects

Sl no	Cause	No	%
1	Electric burn	15	44.12
2	Trauma	10	29.41
3	Tumor	4(3+1)	11.76
4	Bear mauling	3	8.82
5	VP shunt exposure	1	2.94
6	Post cranioplasty exposed calvaria	1	2.94
	Total	34	100

Table 2: Various reconstructive procedures

Sl no	Type of recostructive procedures	No	%
1	TRANSPOSITION	23	67.65
2	ROTATION	5	14.71
3	LIMBERG	1	2.94
4	TRAPEZIUS	1	2.94
5	LD free flap	1	2.94
6	ALT free flap	1	2.94
7	SSG	1	2.94
8	Tissue expansion	1	2.94
	Total	34	100

Figure 1(a): Electric burn scalp defect

Figure 1(b): Trapezius flap

Figure 2(a): Bear mauling scalp defect

Figure 2(b): Latissimus dorsi flap

Figure 3(a): Electric burn scalp defect

Figure 3(b): Transposition flap

Figure 4(a): Post excision alopecia with tissue expanders

Figure 4(b): Rotation & advancement flap top view

Figure 4(c): Lateral view

Figure 5(a): Traumatic avulsion ofscalp

Figure 5 (b): Split thickness graft

Discussion

Scalp defect reconstruction depends on location, size & depth of the defect,viability of surrounding tissue, presence ofchronic or active infection & general health of the patient [3]. While planning local flaps, hair growth patterns, hairline and brow position & facial symmetry should be given the utmost importance [4].

The initial management revolves around stabilization of the patient with basic life support in cases of immediate presentation. A head-to-toe examination is imperial to exclude head injuries, abdominal trauma, long bone fractures and other associated injuries. Then the focus is shifted toward the scalp wound(s) and a thorough examination is performed. Electrical burns cause greater damage to deeper tissues and often classified as 3rd or 4th degree burns, even-though the total body surface area

involved is less. Complete shaving of the scalp should be done to assess the extent of injuries so that no injury is hidden by the scalp hair. The injured site often takes a few days to week for complete demarcation, thus routine examination and serial debridement are required before deciding upon the exactsize of the scalp defect so as to decide on the management accordingly [5].

Netolitzky, in 1871, used skin grafting of the calvaria after the presence of granulation tissue. The success of skin grafting on intact periosteum before the presence of granulation tissue was demonstrated by Robinson in 1908. Thereafter multiple authors shortly demonstrated successful reconstruction with local flaps [6]. Four-flap techniquefor large scalp defects was published by Orticochea in 1967 and was revised to the use of three flaps in 1971. Radovan popularized tissue expansion in 1976. In 1984, Manders *et al*. reported reconstruction of nearly half the scalp with hair-bearing tissue using tissue expansion. Advances in microsurgery have also played a significant role in scalp reconstruction. Miller *et al*. in 1976 successfully replanted a totally avulsed scalp with return of normal hair growthand frontalis function [7].

Knowledge of scalp anatomy, underlying structures, type of injury is very important before planning any reconstructive procedure. Various methods used for reconstruction are primary closure, debridement and skin grafting, local flaps, regional flaps like trapezius, free flaps. Local flaps like rotation flap, transposition flaps and pin wheel flaps are helpful in bridging the defects caused by high voltage electrical burns, which cause more damage at a depth than superficial. Dowbak and Demir demonstrated the use of V-Y-S plasty flap for closure of scalp defects [8,9]. Transposition flaps were simpler, less time consuming, and minimal donor site morbidity, but disadvantage was that the donor area had to be covered with split-thickness skin graft which may later require secondary cosmetic reconstruction [10]. In this study, the largest defect covered with local flap was the size of 70 cm^2. Pedicle flaps like trapezius flap can be used for occipital defects where galea aponeurotica is continuous with the back muscles. But pedicle flaps have a limited role in covering scalp owing to their restricted arc of rotation.

Free flaps are used in cases of very large defects, not amenable to coverage by local or pedicle flaps. Most of the free flaps are harvested from the trunk as the damage caused by the current to this region is less owing to its high volume in contrast to the extremities, where the current conduction is high due to lesser tissue volumes.

LD flap from the trunk region is one such example and the thoracodorsal vessels are anastomosed with the facial artery and external jugular vein with or without vein graft which are away from the site of injury. Other than that ALT and Gracilis free flaps are preferred. Superficial temporal and facial arteries are preferred donor arteries while superficial temporal vein, external jugular veins are preferred veins for anastomosis. Wait *et al* have alsodescribed the use of radial forearm, medial arm, anterolateral thigh, scapular flaps, omental flaps and free jejunum flaps [11].

Early coverage is crucial to prevent osteomyelitis of bone [12]. But in case of electrical burn progressive necrosis occurs which requires multiple debridement to get healthy margin. So, in electrical burns delayed covering of defect is preferred [13]. Debridement should be done with loupe magnification and continued till bleeding occurs from the margins.

Sometimes whole scalp was lost, and no covering was possible. In such cases multiple drill holes were done to induce granulation tissue which was later covered with split thickness skin grafting. (Fig-5)

Management of skull injuries makes use of the Clinical examination, X ray skull, NCCT brain with bone window & biopsy

(for marjolins ulcer) give information about the salvageability of the bone in majority of the cases. Viability of bone can be detected by CECT scan, SPECT (Single Photon Emission CT) and Tc99 scan.

All patients with complete loss of calvaria were managed with titanium mess cover followed by flap cover to protect the brain from trauma.

- Necessary skull bone imaging is imperative before intervention to prevent graft loss and postoperative complications.
- The most common etiological factor for scalp injury was electrical burns with avulsion injury of the scalp being the 2nd most common cause in our series.
- Due to progressive skin necrosis delayed reconstruction is preferred in cases of electrical burn while in other cases of scalp defects early reconstruction is preferred.
- Local transposition flaps can manage most of the scalp defects (small to medium defects) but in larger defects, free flaps should be considered.
- Secondary procedures are required for better cosmetic outcomes.
- Additional permission was obtained for the use of their images

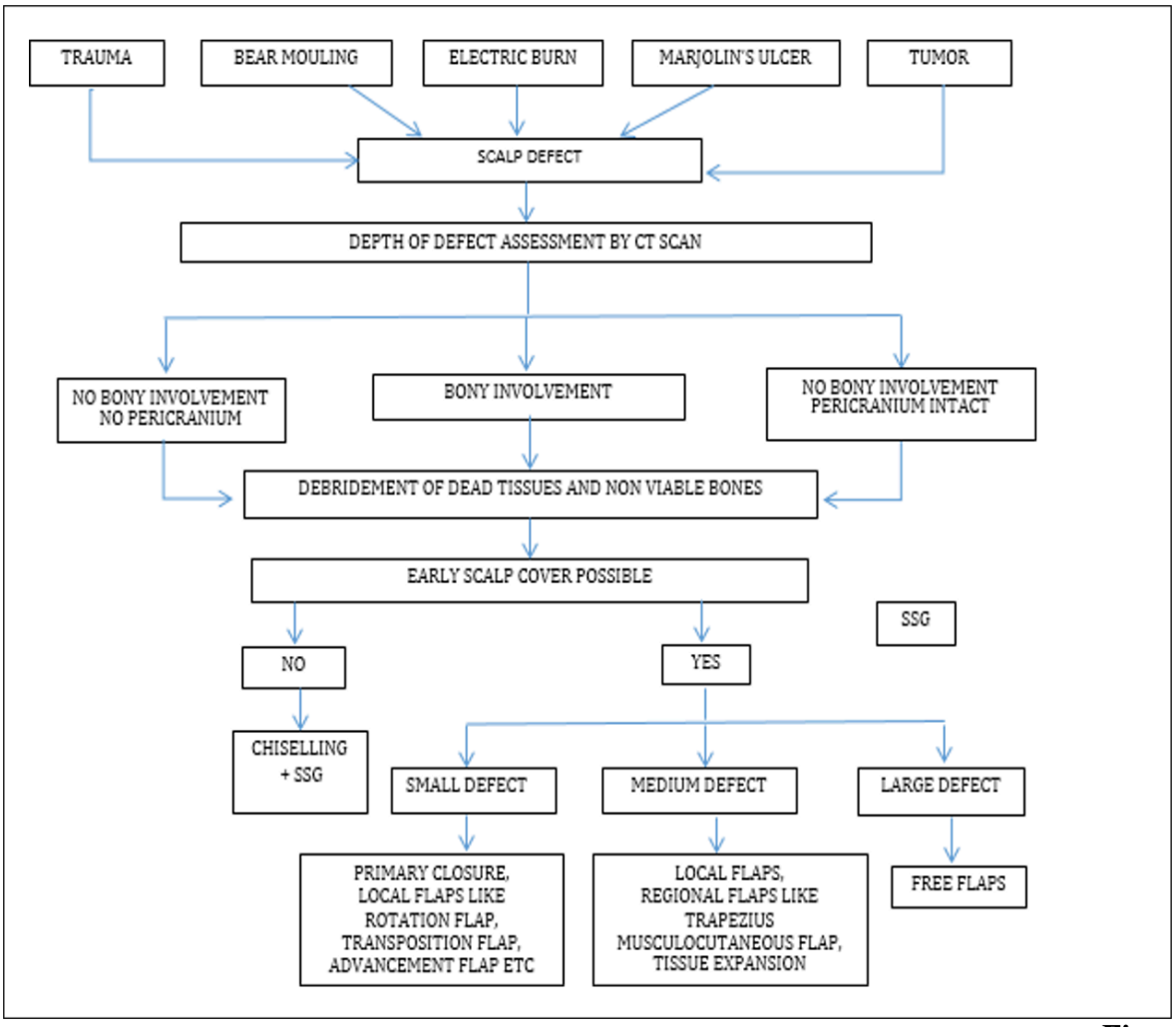

Figure 6: Patient consent: Patients provided writtenconsent prior their inclusion in the study.

Disclosure

This material has never been published and is not currently under evaluation in any other peer reviewed publication.

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