Original research article

A clinical study of various methods of reconstruction of scalp defects and its outcomes

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Abstract

Introduction: The scalp, as the body's superior boundary, is often subjected to environmental insults. Since the scalp is seldom covered by clothing, it is more vulnerable to burns and other wounds that can result in extensive disfigurement and scarring. The scale, depth, and position of scalp defects all influence decision-making in their repair. The existence of the defect is another important factor in determining management. **Aim :** To study the various scalp defects in terms of their clinical presentation, Management and their outcome and reconstruction of scalp defects with local flap and split thickness skin grafts. **Materials and methods:** This prospective interventional research was performed in the Department of Plastic and Reconstructive Surgery over the course of 18 months,. Patients with 0-70 years of age with electrical burns, trauma , benign tumors and congenital abnormality associated with loss of scalp tissue.**Results:** In this sample, 12 (60%) patients had a defect size varying from 9 to 100 cm^2, 02 (10%) patients had a defect size of less than 9 cm^2, and 6 (30%) patients had a defect size of more than 100 cm^2. In our sample, the majority of patients presented within 24 hours, 15% presented within one week, and 15% presented after three months. Transposition flap with ssg was performed in the maximum number of patients (50%) in ten patients, rotation flap in three (15%), ssg in five (25%) patients, and primary closure in three (15%) patients. **Conclusion:** Good knowledge of the anatomy, the individual patient, and the resurfacing choices that are available is the beginning, but the surgeon's success needs creativity to add all these elements together to give a satisfactory result for the patient.

Keywords: Scalp Defects**,** spit skin grafting, Transposition flap.

Introduction

The scalp being the superior border of the body, is many a times exposed to insults from the environment. As the scalp usually lacks clothing coverage, it is more commonly susceptible to burns and other trauma that cause extensive disfigurement and scarring. It is also the site for a variety of benign and malignant neoplasms, due to prolonged sun exposure. The factors influencing decision making in the repair of scalp defects are their size, depth and location.Another vital factor in deciding the management is the nature of the defect. In case of a tumour excision the bone may be removed sometimes requiring a complex reconstructive technique. The type of flap needed to cover the defect is also influenced by the integrity of the surrounding scalp tissue[2].Advancement, transposition and rotation flaps are the work horse flaps for reconstructing these defects. The design of these flaps should consider the preservation of the hairline, aesthetic re-directioning of the hair follicles, the inclusion of major vascular pedicles, and tensionless wound closure[1-3]. Primary closure is the best option for small defects less than 3 cm in diameter but the location of the defect has to be taken into consideration.

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Closure of defects using split-thickness skin grafts is quick and effective. Skin grafting is technically easy and donor site morbidity is minimal. Unilateral and bilateral rotation flaps are very useful for covering defects in the hair-bearing scalp. Bilateral flaps decrease the wound tension by distributing it over a wider area than single flaps. Forehead defects can also be reconstructed 3 using rotation flaps producing an aesthetic appearance but can desensitise the adjacent skin. Transposition flaps are used in the reconstruction of temporal or glabellar defects. Small defects may be covered with a single transposition flap and the donor defect can be closed primarily. This is not possible in case of large defects for which larger flaps are designed. Either a bilobed transposition flap or multiple rhomboid flaps may be designed in these situations[4,5].Multiple flaps have been shown to distribute the tension over the wound. But, multiple rhomboid flaps produce a complicated scar that is difficult to hide along the relaxed skin tension lines. The disadvantages of free flaps are that they are time consuming, cause significant donor site morbidity, and are expensive for the patient. Therefore, free flaps are indicated only when other simpler reconstructive techniques such as skin grafts, local scalp flaps, or healing by secondary intention cannot be done. The reconstruction of scalp defects can be successful if the decision making is based on a good knowledge of anatomy, a meticulous evaluation of the defect, and consideration of the relevant patient factors and the knowledge of the varied reconstructive

methods available. Preoperative planning is important. The planning must be tailored to the individual defect as no single method is available for covering scalp defect. A successful reconstruction must result in less morbidity, decreased hospitalization time, good aesthetic appearance, preserving the hairline without violating the body contour[6].

Materials and Methods

This Prospective interventional study is conducted in the department of plastic surgery, Osmania General Hospital. This study is conducted over a period of 18 months from 2019– 2020 and includes 20 patients who present with scalp defects.

Inclusion Criteria: Patients between 0-70 years of age cases of Electrical burns, trauma, benign tumors and congenital abnormality associated with loss of scalp tissue.

Exclusion Criteria: Scalp defects in patients due to malignancy

The ethical clearance was given by the Institutional Ethics committee, Osmania medical college. Informed and written consent was obtained from all patients prior to the study.

Patients admitted with electric burns were initially resuscitated from burn shock and after the patients general condition is stabilized, patients were taken up for fasciotomy for relieving compartment syndrome and Amputations with gangrene of upper and lower limbs if required. Once the patient is hemodynamically stable and fit for surgery patient were taken up for debridement and when the defect is healthy, wound was covered with flap cover. Patients admitted with scalp defects following trauma were thoroughly evaluated by respective departments for long bone fractures in orthopaedics and head injury in department of neurosurgery. Once the patient is found fit for surgery patient was taken up for wound debridement followed by primary flap cover. Based on the scalp defect various methods were used to reconstruct the defect like primary closure, skin grafting and local flaps. Patients were followed up at weekly interval for one month followed by once a month for 6 months. Detailed analysis of these cases with scalp defects was be done in terms of age, sex, etiology, time of presentation, site, size, side of the defect, associated injuries, procedures done, timing of surgery, complications and duration of the hospital stay

Reconstructive options for scalp

Multiple options are available for the reconstruction of scalp defects. Each method has its own role in the reconstructive ladder with its own advantages and disadvantages. The best method of reconstruction for a particular scalp defect can be an impossible choice for some other defect. Therefore many factors have to be taken into account before deciding the method of reconstruction for a defect. Stable coverage of the defect and good contour are the main goals in scalp defect reconstruction.

Closure by secondary intention

Small defects may be allowed to heal by secondary intention. In the scalp, this will result in a non-hair-bearing scar. In the forehead, it is preferred to allow residual defects that cannot be closed primarily (e.g., after use of a paramedian forehead flap transfer for nasal reconstruction) to heal by secondary intention. There is consensus that the resulting scar is superior to that that would be obtained by the use of skin grafting. If this method of reconstruction is adopted, daily dressing changes with moist dressing is indicated until the wound heals.

Results

This study includes 20 patients who presented with scalp defects admitted to Department of Plastic & Reconstructive surgery, Osmania General Hospital, Hyderabad. In our study 7(35%) patients were in age group of 31-40 years,6 (30%) patients in age group of 21-30 years, 3(15%) patients in 41-50 yrs, 2(10%) in age group of 51-60 yrs, and 1(5%) patient in each 0-10 and 11-20 years of age group.

Table 1: Showing age range of the patients

Age	Total Number of Patients	Percentage
0-10	**1**	5%
11-20	**1**	5%
21-30	6	30%
31-40	**7**	35%
41-50	**3**	15%
51-60	**2**	10%
Gender		
Male	**14**	70%
Female	**6**	30%
Site		
Right	**12**	60%
Left	**06**	30%
Bilateral	**02**	10%

In this study 14(70%) patients were male comprising 70 % cases and 6 patients were female comprising of 30 % of cases. In our study Right side was involved in12(60%) of patients, left in06(30%) and bilateral in 02 (10%) cases.

Table 2: Showing aetiology of scalp defect

Aetiology	Number of patients	Percentage
Trauma	10	50%
Post burn	07	35%
Post infection	02	10%
Post excision	01	05%

Most common cause of scalp defects in this study was post traumatic in 10 (50%) patients, second most common was burns i.e. in 07(35%) patients, 2(10%) cases were post infectious and 1(05%) was post excision of a cystic lesion.

Table 3: Showing site of the defect

Site	Number of patients	Percentage
Temporofrontal	03	15%
Parietal	03	15%
Temporal	08	40%
Temporoparietal	02	10%
Frontal	02	10%
Occipital	02	10%

In our study temporal region was most commonly involved with 08(40%) patients, parietal in 03(15%), temporoparietal in 02(10%) temporofrontal in 3(15%) frontal in 2 (10%)and occipital in 2(10%) cases.

Table 4: Size and presentation of the defect

Size	Number of patients	Percentage
< 9 cm^2	02	10%
9-100 cm^2	12	60%
> 100 cm^2	06	30%
Time of presentation		
0 - 24hr	14	70%
24hr – 1week	03	15%
1week – 3month	00	00%
3month – 1year	03	15%

In this study12 (60 %) patients had a defect size ranging from 9 to 100 cm^2, 02 (10%) had less than 9 cm^2 and 6 (30%) patients had more than 100 cm^2 of size.

Most of patients in our study presented within 24 hours, 03(15 %) presented within 1 week and 03(15%) presented after 3 months.

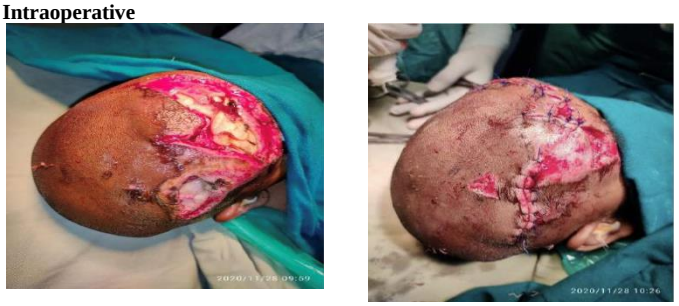
Table 5: Operative Procedures

Operative Procedure	Number of patients	Percentage
Transposition flap + spit skin grafting	10	50%
Rotation flap	03	15%
Spit skin grafting	05	25%
Primary closure	02	10%

Transposition flap with ssg was done in maximum number of patients that is in 10 patients 50(%), rotation flap in 3(15%), ssg in 5 (25%) and primary closure in 3(15%) patients.

Pre Operative

Intraoperative

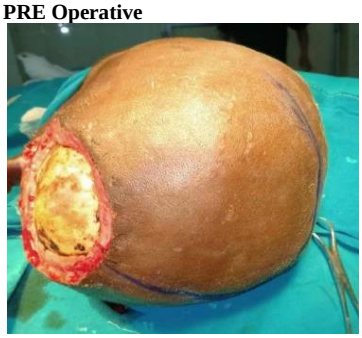
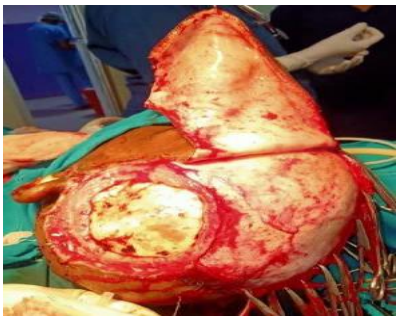


Post Operative

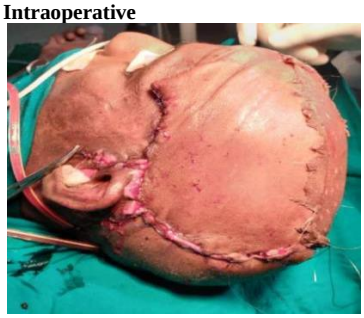
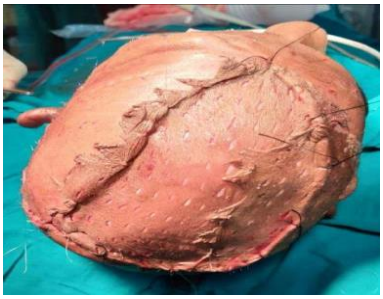
Fig 1: Cases in study

Case-1: 4 year old boy who presented with two post traumatic defects one at frontal region and one at the right temporal region which was of size 2x1.5 cm primary closure was done for temporal defect ,frontal defect was also closed primarily and remaining raw area was skin grafted.

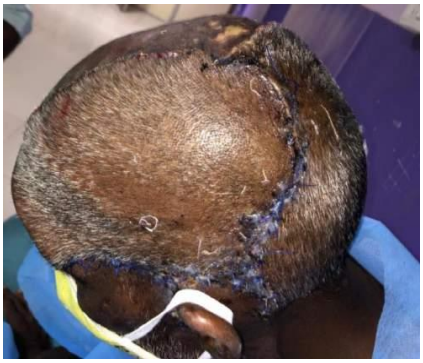
PRE Operative

Intraoperative

Postoperative

Case 2:37 year old male patient presented with post traumatic left temporal defect for which transposition flap and SSG was done.

Discussion

There are many considerations when formulating a treatment plan for a given patient with a scalp defect. Patient expectations and comorbid conditions need to be taken into account. Far and away the best tissue for replacement of lost scalp is adjacent scalp tissue. 48 Particular attention needs to be paid to the present hair distribution and its anticipated future. Our study includes 20 patients who were admitted in Osmania general hospital during 2019 to 2020, patients of different age groups were included in our study ranging from 0 to 60 years we had maximum patients in 31yrs to 40 yrs of age group. Mean age of patients was 33.15 yrs. Pankaj Bodra et al[7] in their study of 16 patients got maximum patients in age group ranging from 21 to 40 years with scalp defects.

In a study by Saxena S et al[8] out of 44 cases of scalp defects, 34.09% of the subjects belonged to age group of 11 -20 years which was the largest group. Second largest group belongs to age group 31 – 40 years which includes 18.18% cases of total 44 cases. No patients were more than 60 years of age. In present study only 15.9% patients were under 10 years of age. In study by Mario, Igor Luigi et al[9] the age of the patients ranged from 1day to 84 yrs, with mean age of 68 years.In another study by Antostane, Yolanda Hristo et al 10 the age of the patients ranged from 11 to 86 years, with mean age of 61.7 years. In a Study by Cameliatamas et al[11] age range of patients was from 37 to 85 years, with mean age of 59 years. MT Islam et al[12]conducted a study in the Department of Burn and Plastic Surgery, Khulna Medical College Hospital from July 2011 to June

2015. Scalp reconstruction was performed on 16 patients who sustained scalp loss from RTA, surgery for cancer, burn injuries and machinery injury. Most of the patients age ranged from 31-40 years in their study. In our study 70% cases were male and 30% cases were females which showed a male to female ratio was 2.33:1. This is similar to PankajBodra et al 7 who studied of 16 patients Among 16 patients, 12 were males and 4 were females. MT Islam et al [12] also found scalp defects to be more common in males in his 13 study on "Outcome of scalp reconstruction in a teaching hospital". In a study by Saxena S [8] Among 44 patients 35 were male and 9 were female with male to female ratio of 3.88. In study by Cameliatamas Lucian, Dana et al [11] ratio of male to female was 3.66. Yin, Jir -Wen, et al [13] in his study conducted from 1992 to 2003 found 50% of cases to be male. Mario Cherubino, Dominic Taibi et al[9] in their study Out of 78 patients with scalp defects. 58(74%) patients were men and 20(26%) were women,ratio of male to female was 2.9. Jordan P. Sand; Jason A. Diaz et al [14] found 69% male and 31% females in the study on "Outcome of scalp reconstruction in a teaching hospital Abdul Razak, Mahesh kumar et al [15] study on scalp defects also showed male preponderance of 73% male patients out of 38 patients. In B.S Lutz [16] study on reconstruction of scalp defects in 29 patients there were 19 (65.5%) males and 10 (34.4%) females. Feierbend, Bindra[17] study also showed male predominance with 63% males and 37% females.

Common etiology in our study was trauma including 50 % of total patients of RTA and second most common condition was post electric burn scalp defect including 35% , mostly related to occupation like electricians ,farmers and construction workers. J N Legboet al 18 in his two year prospective study to determine the common aetiological factors of scalp defects, and outcome of management found that Road Traffic Accidents (RTAs) was the commonest cause of scalp defects in 22(81.5%) cases included in the study. In B.S Lutz 16 study, scalp defects resulted from accidents in 13(45%)patients, electric burns 4(14%) patients, tumor excision in 8(23%)cases, chronic osteomyelitis in1(5%) case and osteoradionecrosis. Pankajbodra et al 7 in their study found that The causes of scalp defect were electric burn and malignancy 4 cases (25%) each, road traffic accident and arteriovenous malformation 3 cases (18.75%) each and thermal burns 2 cases (12.50%). In Abdul Razak et al [15] study trauma was the common cause 15 (39%) cases, followed by electric injury in 8(21%) cases, benign & malignant lesions 8(21%) cases, thermal burns 4(11%) cases. In our study temporal region was most commonly affected involving 08 (40%) patients, parietal in 03(15%), temporoparietal in 02(10%) temporo frontal in 3 (15%) frontal in 2 (10%) and occipital in 2 (10%)cases. J N Legbo [18] in his study found that the temporal region was the commonest site of defect as this was seen in 21(77.8%) patients. This was followed by the parietal region in 16(59.3%), the frontal region in nine (33.3%) and the post- auricular region in two (7.4%) patients. Saurabh s et al [8] in his study found Left Temporoparietal region was most common site of scalp defect in 31.8% of the cases. Tenna, stefania et al [19] in their study of 30 patients found defects in the anterior scalp subunits (temporal = 14; parietal = 12; forehead = 4). Study conducted by Jordan P S and , Jason A. Diaz et al [14]found most common location being the scalp vertex. In our study 12 (60 %) patients had a defect size ranging from 9 to 100 cm^2,02 (10%) had less than 9 cm^2 and 6 (30%) patients had more than 100 cm^2 of size. Average size of the defect in our study was 64.2 cm^2 In a study by SaxenaS et al[8]the mean size of the defects in its longest dimensions was about 4.5 cm.

In our study we had 1 patient who presented with total avulsion of scalp, for which SSG was done as the pericranium was intact. SSG was done in one post infectious case of post auricular region after excision of the infected post auricular area. In 3 cases SSG was done following debridement of scalp who presented with burns case involving scalp. Transposition flap and SSG was performed in maximum number of patients. Rotation flap was done in 03 (15%) patients. 2 patients (10%) were presented with defect size less than 3 cm^2 which were closed primarily after thorough wash and debridement. The earliest flap cover which was given was within 24 hours to the patients who presented with trauma without any associated injury. In Norma et al study the earliest flap cover was given after 22 days following electric burns. Feierabend [17] in his study did chiselling of the outer cortex and covering with split skin grafting in 46 cases was done . Follow up showed unstability of the skin graft and also the danger of malignant transformation. Bhattacharya et al. 20 in his study concludes that split thickness grafting remains the treatment of choice. In the presence of bare bone, local flap is preferred. If not the outer cortex is chiselled out or multiple drilling is done through it to accelerate the formation of granulation tissue. Subsequently, this is covered with split thickness skin graft. Hossain MZ et al 21 in their study of 30 patients, 28 patients had injuries to other sites of the body. The Single rotation flap was the most common procedure performed (26.67%).while Bipedicle flap was the 2nd commonest procedure performed in this series of patients. In Abdul razak et al. 15 study done in 2010, local flap cover was given in 42% cases, outer table drilling and skin grafting was done in 31% cases. Skin grafting was done in 24% cases, primary closure was done in 17% cases and tissue expansion was done in 1 case.

In MT Islam, SN Abdullah et al [12] study the transposition flap was the most common procedure performed (37.5%), while rotation flaps (31.25%) was the 2nd commonest procedure performed in this series of patients. In Dary J. Costa, Scott Walenet al study a total of 22 patients with large scalp soft tissue defects underwent scalp rotation flap reconstruction. In Legbo 18 study, 59% had local flap cover while the remaining 41% had split thickness skin grafting. In a study by Mueller CK and et al 22 a five year, 65 cases with scalp defects were studied. Local flaps were more effective than skin grafts ($p=0.038$) and Microvascular free flaps ($p=0.037$) in case of skin galea and periosteal defects. In Cherubino et al. 9 study, local flap cover was done in 37.5% cases, skin grafts in 35% cases, dermal regeneration plate in 20% cases primary closure in 17.5% cases and free flaps in 2 cases. In a study on Management of large scalp defects with local pedicle flaps by Manikumaribaswa24 also, local flap cover is the choice of reconstruction for scalp defects. Saurabhsaxena8 in his study used transposition flap along with split thickness grafting as the most commonly used procedure. In a study by Lutz 16 free flaps were done in all 30 cases. The hospital stay in our study was 43.85 days for burns patients, and 9.84 days in rest of the patients , longest stay was of 93 days in a electric burns patient shortest stay was of 5 days in a patient for which SSG was done. In a study by Denewer a et al [25] the mean hospital stay was 3.67 days (ranging from 3 to 4 days) in patients of skin grafts; 5.86 days (ranging from 5 to 7 days) in patients of local flaps; 7.96 days (ranging from 6 to 11 days) in patients of pedicled flaps; and 11.4 days (ranging from 9 to 14 days) in patients of free flaps. In Legbo study 18 the hospital stay duration ranged from 15 days to seven weeks with a mean of 3.5 weeks

Associated injuries were found in 4 patients in our study. One patient with electric burns had associated temporal bone fracture and right upper limb gangrene for which he underwent right above elbow amputation, also this patient was managed by neurosurgery team for temporal bone fracture. One patient of trauma had right sided clavicular fracture which was managed by our ortho team. Two patients of trauma had associated right parasymphysis fracture of mandible for which Archbar + ORIF + IMF was done. Complications in our study included distal flap necrosis in two patients which was debrided and was sutured back with some advancement, one patient with electric burns presented with osteomyelitis of right temporal bone which was removed ,this patient was managed by saline dressings as some granulation tissue was present at the wound bed and when the wound bed was healthy it was covered with local advancement flap and skin grafting. No cases had flap failure in our study.This is consistent with that of Norkus study in which only one

case had partial loss of the flap after local flap cover following electric burns. All our patients were followed up for 6 months we noticed no other comorbidities other than alopecia at grafted site. One patient had prominent dog ear at 2 months of follow up this patient did not come for follow up after that[20-25]

Conclusion

Scalp defects are more common in the middle age group of 31 to 40 years according to our study. Scalp defects are common in males as compared to females in our study. Most common cause is trauma to scalp followed by burns in this study. ➢Most common side involved is left side and temporal region is the most commonly affected site. As the elastic property of the scalp tissue is limited, primary closure of scalp wounds should be done only for defects measuring less than 3 cm. Transposition flap and ssg was the commonly performed operative procedure in our study. Earliest flap cover was given within 24 hours of admission after debridement in patients without any associated injuries and without any co morbid conditions. Proper debridement and early flap cover reduces the hospital stay. Complications like flap tip necrosis was observed in two cases which was managed with debridement and flap adjustment with little advancement. Patients only had alopecia and dog ears which were well settled in the follow up period. A good design for a local scalp flap should include major vascular pedicles. The flaps should be broad based and wound closure should be tension free. The perfect reconstruction for any defect never exists; therefore, the reconstruction for every defect must be tailored to each case to perfection. A good knowledge of the anatomy, the individual patient, and the resurfacing choices that are available is the beginning, but the surgeon's success needs creativity to add all these elements together to give a satisfactory result for the patient.

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