

# Geometric Design and Outcome of Transposition Flaps for Scalp Reconstruction

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## Abstract:

### Background:

The scalp is a unique part of the human body and various etiological factors, such as tumor extirpation, avulsion, infection, burns, or trauma, can lead to scalp defects. Primary closure, skin grafting, local flaps, tissue expansion or free tissue transfer is modalities available for scalp reconstruction. Local flap coverage is best option for full thickness loss with exposed bone. Among various local flap transposition flap is reasonable and flexible option with good outcome for scalp reconstruction.

### Objective:

The purpose of this study was to evaluate the geometric design of transposition flap for scalp reconstruction concerning the dimension of the defect and outcome the surgery.

### Methods:

This was a prospective observational study, conducted in the Burn & Plastic Surgery department of Rangpur medical college hospital, Rangpur and different private hospitals of Rangpur city over a period of three years from June 2018 to July 2021 through purposive sampling. All aged patients having single full thickness scalp wound with loss of pericranium were included in this study. In all cases transposition flaps were used. All the flaps were elevated through sub galeal loose areolar plane. Flap donor site was covered with split thickness skin graft taken from thigh. Surgical technique, patient factors and outcome were evaluated.

### Results:

A total 50 patients were operated. The age range was 07-68 years, among them 36% patient were in the age range of 21 – 30 years. 80% patients in this series were male. In this series 64 % patients were construction and electric worker by profession. Electric burn was the main (64%) cause of soft tissue defect of scalp. The majority (46%) of the patients had a wound dimension of 51-70 cm<sup>2</sup>, smallest was (5x6) = 30cm<sup>2</sup> and largest was (9x15) = 135cm<sup>2</sup>, indicating that extent of soft tissue defects in this series is quite extensive. 12 (24%) patients had complication and all were due to infection, seven patients had infection in flap recipient site, 2 patients had infection in flap donor site and 3 patients developed infection in skin donor site. There was no flap loss in our study.

### Conclusion:

Sound knowledge of flap geometry and clear evaluation of the defect is mandatory for successful reconstruction of scalp defect. A local transposition flap with donor site skin grafting is reliable option for reconstruction of full thickness scalp defect in most instances.

**Keywords:** Scalp defect, Transposition flap, Skin graft.

## Introduction:

There are multiple flap options to cover a single defect like local flaps, distant flaps and free flaps.<sup>1</sup> Scalp defects may be caused by various etiological factors such as tumor extirpation, avulsion, infection, burns, trauma, or congenital lesions leading to significant surgical and aesthetic concern.<sup>2</sup> Due to the inelastic galea, the paucity of the adjacent

tissue, its limited expandability, and the convexity of its shape, reconstruction of scalp defects is often challenging.<sup>3</sup> Small defects (less than 3cm<sup>2</sup>) can be closed primarily. Skin grafting is an appropriate option in cases when the pericranium is intact. However, in cases of large scalp defects with denuded calvarium, neither primary closure nor skin grafting is applicable. Although micro vascu-

lar tissue transfer has recently been reported for extensively large scalp defects, local flaps should be considered as the first line of treatment cases for small to medium-size defects. Local flaps from the adjacent regions provide the best method for functional and aesthetic reconstruction as they provide the best color and tissue quality match, and permit not only the restoration of continuous hair covering but also effective protection for the skull and its contents.<sup>4</sup> The transposition flap is classically designed as a parallelogram of tissue that is rotated about a pivot point into an immediately adjacent defect.<sup>5</sup> The flap donor site is covered by skin grafting, For scalp defects 5-9cm wide, local transposition flap can provide healthy, durable hair bearing skin and may aid in healing in patients with compromised wound (e.g. Previous surgery, radiation therapy, low grade infection, CSF leaks etc.). The shortening of surgical time compared with other technique, the simplicity of surgical procedure, minimum morbidity in the skin graft donor area and satisfactory aesthetic outcome make this a reasonable option for repairing defects of this kind.<sup>6</sup> The use of these flaps generally leaves 'dog ear' at the end of surgery. They tend to disappear over time. If aesthetic deformity persists it can be corrected by means of a small operation under local anesthesia. Later on, we can use tissue expander in this wound for replacing non hairy area by hair bearing tissue. So, for moderate sized scalp defect (5-9cm wide) transposition flap with donor site skin graft may be a good option.

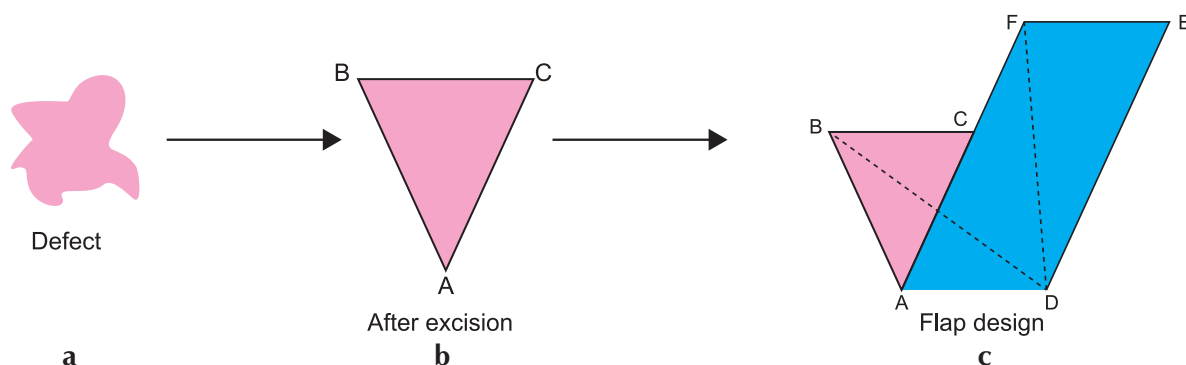
**Methods:**

This was a prospective observational study, conducted in the Burn & Plastic Surgery department of Rangpur medical college hospital, Rangpur and different private hospitals of Rangpur city over a period of three years from June 2018 to July

2021 through purposive sampling. All aged patients having single full thickness scalp wound with loss of pericranium were included in this study. Here 50 patients with soft tissue defect of variable sizes over scalp underwent coverage with transposition flap. All the flaps were elevated through sub galeal loose areolar plane. Flap donor site was covered with split thickness skin graft taken from thigh. We reviewed the prospectively collected data of the patients who underwent reconstruction of soft tissue defects of scalp with transposition flaps between June 2018 and July 2021. By analyzing the clinical scenarios, flap dimension, the location of flap inset and associated complications, we put forward few significant findings from our experience.

**Surgical Technique:**

**Design and Marking:** Each and every patient was carefully assessed by through history taking, local examination and relevant investigations to assess the pathology and fitness for surgery. After giving general anesthesia all patients were placed in the supine position with slight head up. Simultaneously thigh was prepped and draped for harvesting skin graft. After wound or oncological excision the defect was measured. All wound were made in an isosceles triangular shape (fig-1b). According to the size of the defect a transposition flap was designed adjacent to the defect (fig-3a). Most of the time flap was axial pattern but it was random pattern also. Base of the flap (AD) was remained adjacent to the apex of the wound. It was equal and parallel to the base of the triangular defect (AD=BC). The line AC was increased up to F so that BD = DF. Then another line was drawn parallel to AC, so that DE = AF. Connect the point E & F. ADEF was the designed flap that transposed to the defect ABC. D was the pivot point.



**Figure-1: Schematic Representation of flap Geometry**

**Dissection:**

Flap was raised below the galea preserving the pericranium in the donor defect. Attention was paid to hemostasis during flap elevation. When incising hair bearing scalp an attempt was made to bevel the cut parallel hair shaft direction to avoid follicular damage and incisional alopecia. Flap was rotated about a pivot point immediately adjacent to the defect. A dog ear was produced during inseting the flap. It was not corrected immediately which may cause injury to vascular pedicle of the flap. A drain was placed beneath the flap. A partial thickness graft was used to cover the donor area.

**Postoperative care:**

All patients were given standard post operative

care. Flaps were monitored on day five for presence of infection, marginal necrosis, and flap loss. On the same day flap donor side was inspected for presence of infection and graft loss. At the same time dressing of skin donor side was monitored for soaking or bad odor. For any sign of infection, wound swab for c/s was taken. If uneventful, pin was removed from skin graft area at seventh postoperative day. On 14th post operative day, stitches were removed from flap in setting area. On the same day skin donor site was inspected for complete healing. After 6 weeks all operative area were observed for assessment of outcome of the procedure.

**Case series**



a. defect with exposed bone

b. after excision

c. after flap coverage



d. on 5th POD, donor site



e. On 5th POD flap

**Figure-2 (a-e): Transposition flap**

**Results:**

In the study, the age range was 07-68 years. Majority (36%) of the patients belonged to the age group 21-30 years and the mean age was 25.3 years. This reflect that soft tissue defect of scalp were much more prevalent in young & active. Male (80%) were more commonly predisposed to soft tissue defect of scalp, probably due to their outside work. A majority 32(64 %) of the patients were construction & electric worker, probably due to lack of personal protective equipment during work or unsafe working environment. (Table-I)

**Table-I: Socio-demographic characteristics of the patients (n=50)**

Socio-demographic characteristics	Frequency	Percentage (%)
<b>Age group (Years)</b>		
<10	03	06
11-20	10	20
21-30	18	36
31-40	09	18
41-50	06	12
>50	04	08
<b>Sex</b>		
Male	40	80
Female	10	20
<b>Occupation</b>		
Construction worker	18	36
Electric worker	14	28
House wife	08	16
Farmer	03	06
Student	05	10
Others	02	04

Table-II showed, majority of the cases (64 %) cause was electric burn, followed by road traffic accident (22 %). This reflects that high voltage electric burn usually cause full thickness scalp defect.

**Table-II: Etiology of soft tissue defect of scalp (n=50)**

Cause	Frequency	Percentage (%)
Electric burn	32	64
Road traffic accident	11	22
Neoplasm	07	14
Total	50	100

Wounds were categorized into five groups based on dimension. Most of them were 51-70 cm2 (46%). The smallest size of the wound was (5x6) cm<sup>2</sup> and largest one was (9 x 15) cm<sup>2</sup> indicating that extent of soft tissue defects in this series is quite extensive. Size of the wound was measured per operatively after wound excision.(Table-III)

**Table-III: Wound dimension (Length X Width) cm<sup>2</sup> (after excision) (n=50)**

Dimension of the defects (Width X Length) cm <sup>2</sup>	Frequency	Percentage (%)
35 – 50	10	20
51 – 70	23	46
71 – 90	08	16
91 - 111	05	10
112 - 142	04	08
Total	50	100

Table-IV showed, out of 50 patients post operative complications observed in 12(24%) patients, among them 07(14%) had wound infection, 02(04%) patients had flap donor site infection and 03(06%) had skin donor site infection. There was no flap loss and no re-graft was required.

**Table-IV: Post operative complications of study patients (n=50)**

Post operative complications	Frequency	Percentage (%)
Infection	07	14
Flap donor site Infection	02	04
Skin donor site infection	03	06
Flap loss	00	00
Re-graft required	00	00

Correction of standing cutaneous deformity (Dog ear) done under local anesthesia on last follow up day as day case. (Table-V)

**Table-V: Dog ear management**

Name of procedure	Frequency	Percentage (%)
Correction under local anesthesia	07	14
Spontaneous regression	43	86

**Discussion:**

Reconstruction of the scalp following tumor extirpation, deep burns, traumatic injuries or postoperative complications can be quite challenging. Coverage of soft tissues wounds of the scalp is the task of the plastic surgeons.<sup>7</sup> The simplest possible method of reconstruction should be considered in all patients while using tissues with the same thickness and hair growth, which allows for adequate coverage, mobility, and stability.<sup>8</sup> For defects that are less than 5cm<sup>2</sup> in diameter, primary closure is usually achieved with undermining of the remaining scalp with scoring of galea where necessary.<sup>9</sup> Age incidence in this study patients ranged from 7 to 68 years with a mean age 25.13 year. Among them maximum patients 18(36%) were between 21-30 years. 62% patients were below 30 years and rests of the patients (38%) were above 30 years. This picture is similar to the study of Memon et al.<sup>10</sup> This is not surprising as people in this age bracket are quite active and mobile, predisposing them to various type of accidents; road traffic, industrial and/or domestic. Male are more vulnerable than female, as in our country they work outside and travel frequently where as females are mostly remain in home and involved in household work. In this study, male and female ratio was 4:1. Most of the patients were male which is also found by Memon et al<sup>10</sup> in their study. No age or sex is immune to this ever challenging reconstructive surgical problem. By occupation electric technicians and construction worker was the greatest proportion (64%) of the study. This is near similar to the study done by Dalay et al.<sup>11</sup> they found 73.3% of electric technicians and construction worker. Major cause was electric burn (64%) among the study patients, followed by road traffic accident (22%) and neoplasm (14%). Legbo JN et al<sup>12</sup> study states, road traffic accidents (RTAs) was the commonest cause of scalp defect as seen in 81.4% patients in their study, followed by burns and tumor ablation in 7.4% patients each and scalp infection (necrotizing fasciitis) in 3.7% patient. Memon et al<sup>10</sup>

showed, when burn and electric injury is consider as trauma then it account for more than 60% of all cases of scalp defects. In this study 5-9cm wide wound was closed with transposition flap. Most of the wound dimension was 51-70 cm<sup>2</sup> (46%). The smallest size of the wound was (5 x 6) cm<sup>2</sup> and largest one was (9 x 15) cm<sup>2</sup>. Size of the wound was measured peroperatively after wound excision. Newman et al<sup>9</sup> series showed average size defects (52 ±37) cm<sup>2</sup> covered by local flaps was most reliable. Cornelia Mueller et al<sup>13</sup> study dealt with a big range, mean defect size was 59.7 cm<sup>2</sup> ranging from 44 to 337 cm<sup>2</sup>. In this study, reconstruction of all patients of scalp defects with exposed bone width ranging from 5cm to 9cm, done by one surgical method, local transposition scalp flap. Most of the other related study; they used different methods for reconstruction on different dimension of wound. Newman et al<sup>9</sup> in their study, performed primary closure 4.1%, skin graft in 17.8%, local flaps in 39.7% and free flap in 38.4% cases. Cornelia Mueller et al<sup>13</sup> performed local flaps in 20 patients, skin Grafts in 29 patients, free Flaps in 17 patients. The study of Jose Antonio et al<sup>14</sup> described a simple procedure for repairing a large scalp defect by means of a local transposition flap with donor site skin graft which is the same of this study. First post operative follow up of this study was given on 5th day. Wound infection was found in 24% case. 14% case had infection in flap recipient site, 6% patients had infection in skin donor site and 4% patients had flap donor site infection. There was no flap related complication. Infections were treated with regular dressing and specific antibiotic which was chosen from post operative culture and sensitivity report. Eventually all the patients had a safe outcome with no infection and no bone exposure. In a study of Newman et al<sup>9</sup>, out of 29 different type of local flaps 24.1% were complicated, out of them there was marginal necrosis and dehiscence in 6.89% and wound infection in 17.24% patients. In the study of Gonzalez et al<sup>15</sup> there was 15% complication rate, majority was wound infection which was managed conservatively. Legbo et al<sup>12</sup> observed in their series, post operative morbidity was minimal: three patients had partial skin graft loss (from infection and graft shift) but did well on regular dressing and required no further grafting, while another patient had persistent discharging sinus that resolved after curettage. Post operative complications are almost same with this study. Dog ear was



produced in every case of the study which was regressed spontaneously in time in 86% of patients, whereas 14% patients came to correct the standing cutaneous deformity (dog ear) which was done on last follow up under local anesthesia as a day case. Jose Antonio et al<sup>14</sup> operated dog ear after one and half month of operation.

### Conclusion:

Reconstruction of scalp defects with transposition flaps is a safe, relatively short and simple procedure unlikely to cause any major complications or demand special postoperative care. Even for a large and complex scalp defect, a transposition flap can be a reconstructive method of choice. Our results from the application of 50 transposition flaps indicate that complications were quite less and did not affect the survival of the flaps.

### Limitations of the study:

Comparison with different flaps would yield better understanding for the reconstruction of scalp defects. The sample size was small and done only in one centre that was not representing whole Bangladesh. Time elapsed between creation of wound and operation was not included in this study which can affect the outcome of the flap.

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