Original Article

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Local Transposition and Rotation Scalp Flap for Coverage of Scalp and Calvarial Defect : One Stage Solution

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Abstract

Background: Electric burn and machinery avulsion injury at scalp is very common in developing country like us. Early coverage by local flap may reduce extra cranial and also intracranial complication. To see long term functional and cosmetic outcome of local transposition/rotation scalpflap.

Materials and methods: It is a prospective observational study to find out long term effect of local transposition flap over scalp/Calvarial wound.18 patients of scalp wound were included in this study with 14 male and remaining 4 were female for last 3 years (July 2022 to June 2025). Average age limit 32 years (7 years to 59 years). Patient of scalp wound actually caused by high voltage electric burn, tumour excision, bullet injury, machinery avulsion injury and road traffic accident. Five patients need intensive care unit and neurosurgical treatment for head injury.

Results: All 18 patients under gone local transposition/ rotation flap for scalp wound. Only three of 18 flapshave marginal necrosis which gradually healed by dressing. Long term follows up shows complete functional and cosmetic recovery. Follow up X-ray skull shows good healing at bone and no evidence of osteomyelitis. All doner site of scalp flap covered with split thickness skin graft which remain hairless at long term follow up.

Conclusion: Local subgaleal transposition/rotation scalp flap is the good option for scalp defect for variety of wound. Early coverage can prevent life threatened complication like brain abscess, CSF leakage and osteomyelitis.

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Introduction

Defects involving the scalp, forehead, calvarium, skull base and maxilla are among the most challenging reconstructions. Electric burn at scalp and head region are very common in this country as high voltage lines are always swinging in open sky. Scalp injury also common for avulsion and tearing force with entrapment of long hair, related to rice splitting machine as well as propeller of engine boat. Scalp injury also common at bullet injury. Some wounds at scalp also create after cancer excision.

The blood supply of the forehead and scalp is robust and consists of the paired supraorbital, supratrochlear, superficial temporal, posterior auricular and occipital vessels. The sensory nerves are also paired and include the supraorbital, supratrochlear, zygomaticotemporal, auriculo-temporal, lesser occipital and greater occipital nerves.[1] Structurally, the calvarium is comprised of three layers: an outer table, a diploic space and an inner table. Layers of the scalp is named like S, skin, C, subcutaneous tissue, A, aponeurotic layer, L, loose areolar tissue and P, pericranium.[2] In fact, due to the broad collateralization of the scalp blood supply, it is possible to replant the whole scalp based on only one vessel.

Image 1 Road traffic accident at temporal region

Image 2 Avulsion injury at rice splitting machine

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The techniques employed to restore these anatomic regions are complex and troublesome. These reconstructions are challenging because of the potential for major, life-threatening complications that may occur should the reconstruction fail, such as brain exposure and neurologic injury, blindness, Cerebrospinal Fluid (CSF) leak, meningitis and osteomyelitis. To see long term functional and cosmetic outcome of local transposition scalp flap.

Materials and methods

It is a prospective observational study to find out long term effect of local transposition flap over scalp/Calvarial wound.Study done at Department of Burn and Plastic Surgery, Chittagong Medical College Hospital.

From July 2022 to June 2025. almost three years with long term follow up like maximum one year to at least six months.18 patients of scalp wound are included in this study with 14 are male and remaining 4 are female for last 3 years. Average age limit 32 years (7 years to 59 years).

Patient of scalp wound actually caused by high voltage electric burn, tumour excision, bullet injury, machinery avulsion injury and road traffic accident. Five patients need intensive care unit and neurosurgical treatment for head injury.

Functionally flap improves vascularity of expose bone that can prevent osteomyelitis. If osteomyelitis already developed it can reduce bacterial load by importing plenty of WBC and macrophage through increased vascularity at wound site.

Every flap taken onecm larger and one cm wider than wound size that nicely adapt with wound and maintain contour of head circumference which improve cosmetic appearance. Functionally flap is durable than skin graft. It can absorb weight and external force pressure, as well as create suitable taught surface for radiotherapy,if need.

Patients were informed about the study before enlisted and take informed consent about the operation and also take consent for post operative follow up to one year. Departmental permission taken for the study as well as for the operation. All the procedure done under direct supervision of senior anesthesia consultant. Every step carefully taken and supportive machinery provided to ensure highest safety of the patient during operation.

Results

A successful reconstruction should provide better patient morbidity, reasonable hospitalization time, acceptable cosmetic appearance, durability and preservation of normal body contour.[3] All 18 patients under gone local transposition and rotation flap for scalp wound. Only three of 18 flaps have marginal necrosis which gradually healed by dressing. One bullet injury patient lost part of parietal bone, titanium mesh is fixed by neurosurgeon.Plastic surgeons cover the wound along with metallic mesh by transposition flap. Another patient has osteomyelitis at parietal bone due to previous electric burn, which debride properly and reposition of previously done transposition flap.Whenthe flaps need a little bit more length, galeal scoring can be performed perpendicular to the desired tissue length gain for slightly improved reach. If Calvarial bone is exposed, a more complex reconstruction might be required. larger defect requires large advancement flaps that incorporate multiple vessels to supply the scalp. A middle size flap includes at least one major artery.[4]

Image 3 Titanium mesh at parietal bone one month after bullet injury

Image 4.Flap over metallic mesh

Long term follows up shows complete functional and cosmetic recovery. Follow up X-ray skull shows good healing at bone and no evidence of osteomyelitis. All doner site of scalp flap covered with split thickness skin graft which remain hairless at long term follow up.

Average recovery time from the injury or wound creation to complete back to work one month.

Middle and small size bone expose/prosthesis area can be covered by local transposition and rotation flap coverage after proper debridement and excision. It is a one stage operative solution for

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scalp wound created by different cause like electric burn, avulsion injury, bullet injury extra. Local flaps are pliable, look alike hair contain area, moderately expandable and having profuse and robust blood flow.

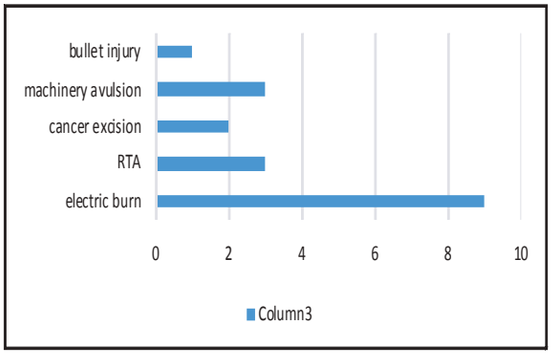

Figure 1 Cause of scalp wound in this study which shows maximum electric burn

Image 5 RTA wound with temporal bone

Image 6 CT Transposition flap with donor skin graft

Average wound dimension 9.2cm to 7.3 cm and also average flap dimension 10.2 cm to 8.3cm.with male female ratio 3.5:1. Average age of patient's 32 years. Mainly affected out door male workers.

Early flap coverage gives advantage of supply of profuse blood circulation over wound reduce microorganism load, improve vascularity of skull bone that actually reduce the possibility of osteomyelitis of the bone.

Different scalp flaps nourish and survive by specific blood vessels depend on which area of scalp need to be covered. Sometimes flap supplied by superficial temporal/posterior auricular, sometimes supratrochlear /supraorbital and lastly it may survive by occipital vessels.

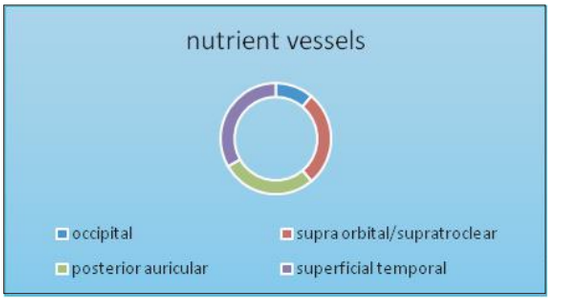

Figure 2 shows most of the flap survives on superficial temporal vessels

Every patient of electric burn and trauma with necrosis of pericranium and surface of outer cortex having proper debridement and excision of wound before flap coverage. We use a rotating olive head scraper machine, which is a perfect tool for this purpose.

Discussion

Early coverage is very essential to prevent life threatened complication though some patient come at hospital after few days later. Several flap options are available like transposition flap, rotation flap, micro vascular free flap etc. This study shows transposition/rotation flap cover all of the 18-patients scalp wound defect. Only very large area of expose bone may need free flap like Antero lateral thigh flap or Latissimus Dorsi free flap, which is very time-consumingand tissue not match with surrounding tissue. Local flap is actually great option for coverage due to excellent look alike hair containing structure, sensate, pliable and aesthetic match with surrounding tissue.

Donor site covered with thick split thickness skin graft, which does not have any hair growth. After long time, donor grafted skin contracted almost half of its original size. Surrounding long hair sometimeshide the defect. Sometimes we do multi stage flap coverage later on, after healing of study flap by using tissue expander to improve cosmetic outcome of skin grafted doner site. But it is unaffordable like tissue expander cost, multiple surgical and anesthetic interfere and lastly it is very risky to developed wound dehiscence and may cause extrusion of tissue expander, in case of comorbid patients.

Among 18 patients 4 are female and remaining 14 are male with wide range of age like 7 years to 59

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years. Defect size of scalp average 74 cm^2andthe average flap size 84 cm^2, which is little bit larger than wound size.

Alessandro Andreone and Maria Giaquinto-Cillers describe artificial dermis substitute like Integra and flowable wound matrix followed by skin micrograft over scalp injury.[5] We actually use autologous, durable, sensate and hair containing transposition/rotation flap for skull bone coverage. This fascio cutaneous composite tissue flap has robust blood supply with natural hairy look make our patient mostly with excellent and good satisfaction during follow up.

Tariqul Islam and his colleagues shows different scalp wound covered by skin graft, transposition flap, rotation flap as well as remove outer cortex followed by skin graft[6].Our study shows we did only transposition/rotation flap which is more durable, sensate and cosmetically lustrous and hair bearing.

Deepak Krishna et al describe different types of scalps wound etiology andthe most common etiology of the defect was trauma (16, 29.6%) and second one was electric burn (12, 22.2%).[7] Whilethis study shows most of scalp injuries are electric burn (9, 50%) and second one are trauma like RTA and machinery avulsion injury of scalp (6, 33.33%).

The primary goal of scalp reconstruction is to provide a viable and durable covering for the cranium. The secondary goal is to maintain the hairline and contour of scalp.[8]

Patient shows functional outcome contain durable flap with natural growth of healthy hair, can bear weight on flap if outer cortex is intact and lastly no discharging pus or serous fluid. It also includes digital X-ray of Skull postoperatively that shows good and healthy healing of bone cortex with no sign of osteomyelitis. Functional outcome scale remarks good and satisfactory according to above mention criteria. Rotation flap with no doner site skin grafting reveals as excellent type remarks.

Patient also shows aesthetic/cosmetic outcome like looks natural contour and head circumference and also show flap surface match with surrounding tissue. Rotation flap with no doner site skin grafting reveals as excellent type remarks.

Limitations

Sample size is small. So, it may not represent the whole population.

Conclusion

Local transposition/rotation scalp flap for scalp/Calvarial reconstruction is very effective after proper debridement and excision. This flap actually one stage complete solution that reduce different life-threatening complication like brain abscess, CSF leakage and osteomyelitis, gives the patients early recovery as well as back to work very soon. This local flap reduces the use of high tech, time consuming free micro vascular flap at scalp area. Frequent use of Less time-consuming local flaps may increasethe number of operations, reduce waitingtime and also sufferings of unfortunate burn victim and cancer related patients.

Recommendation

Multicenter large sample sized study to be recommended.

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Contribution of authors

MSK-Conception, design, data analysis, interpretation of data, critical revision & final approval.

FA-Acquisition of data, data analysis, drafting, critical revision & final approval.

LKP-Acquisition of data, drafting & final approval.

RF-Acquisition of data, drafting & final approval.

MSA-Conception, design, data analysis, interpretation of data, critical revision & final approval.

ND-Acquisition of data, drafting & final approval.

Disclosure

All the authors declared no conflict of interest.

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