

Original Article

AN ANALYSIS OF DIFFERENT RECONSTRUCTION MODALITIES UTILIZED FOR FULL THICKNESS DEFECTS OF SCALP

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Objective: To highlight the use of various reconstruction modalities and to stress the importance of timely and proper coverage of these defects as otherwise the chances of Marjolin ulcers increase with the passage of time.

Material & Methods: A total of 35 cases included 20 males and 15 females. All the cases which presented with full thickness soft tissue defects of scalp or where the defect was the result of excision of some growth were included in the study. Long standing wounds were biopsied to rule out any chances of malignancy before reconstruction of the defect.

Results: In 11 cases defect was result of burn injury, in nine cases etiology was road traffic accident, while another group of eight patients had these defects as a result of ablation surgery. One defect resulted from excision of the arteriovenous malformation and in other flaps necrosed after a craniotomy. All the treated cases did well. There was partial flap necrosis in one case caused by excessive tension on the flap. Surgery was deferred in three of the cases as they were in advanced stage of malignant degeneration in the post burn scar.

Conclusion: Series witnessed a spectrum of options for coverage of soft tissue defects. Every case needs to be dealt on individual basis for selection of the option. Post burn wounds if not provided with a proper soft tissue cover may lead to malignant transformation.

Keywords: Scalp Injuries, Reconstruction and Flaps.

Introduction

Scalp skin is the thickest in body. Firm, fibrous septae running through the subcutaneous tissue attach this skin to underlying galea and make this subcutaneous layer inelastic. As a result, direct primary closure of the soft tissue defects may be difficult as compared to defects of the same dimensions elsewhere in the body.

Loose areolar plane beneath galea is thin and dissection in this plane is quite easy. It is for the same reason that it is most often involved in the avulsion injuries of scalp.^{1,2}

Extensive defects of scalp are not uncommon and same is true for the full thickness defects. Different options are utilized to cover these defects. Along with other options, immediate or delayed skin grafting after removal of outer table is not uncommon.³

However, skin grafting of these areas may not be the treatment of choice as grafts may not be stable. Malignant degeneration of long standing burn scars and unstable grafts is also not uncommon. A soft, pliable cover which has good padding effect similar to the normal scalp is ideal requirement for these defects.⁴ A variety of procedures are used to provide the soft tissue cover for these defects.

This paper reviews the etiologies of various soft tissue defects of scalp presenting at an institute along with different options utilized depending upon the circumstances and their outcome.

Material & Methods

This study was carried out at the department of Plastic Surgery, Services Hospital, Lahore. Patients of all ages and both sex presenting with partial or full thickness soft tissue defects of scalp were dealt in the study. However, simple cuts and lacerations of scalp were not included. Bio-data of all the patients presenting with different injuries was recorded on a proforma. This included age and sex of the patient, etiology of the injury, extent of the wound, option utilized to cover the soft tissue defect and outcome of the procedure. All the cases admitted were treated to get healthy wound. In cases with exposed necrotic bone, outer table was removed to get healthy granulation tissue before any reconstructive procedure. Choice of the operative procedure depended upon the location and extent of the wound and utilization of best among the available options. Whereas skin grafted areas were given a good compression dressing to ensure immobility of the skin graft, dressings for flaps were kept loose so that they did not compress the flap. Suction drains were

used for various flaps which were removed on 2nd or 3rd post operative day. Scalp wounds were closed in single layer with skin stapler. Stitches were removed on 8th to 10th postoperative day. Patients were followed up postoperatively to see the late results of the reconstruction.

Results

Starting from January 2004 to June 2008, this series registered a total of 35 cases with various soft tissue defects of scalp. This included 20 males and 15 females. Age of the patients ranged from 11 to 57 years.

Table-1: Etiologies.

S. No	Etiology	No. of Patients
1	Burns	11
2	Roadside accidents	10
3	Growth	08
4	Trauma	03
5	Post surgery defects	03

Table-2: Soft tissue defect sites.

S. No	Area Involved	No. of Cases
1	Frontal Region	11
2	Temporal Region	09
3	Occipital Region	08
4	Calvarium	08

Table-3: Different modalities utilized.

S. No.	Treatment Modality	No. of Patients
1	Split thickness skin graft	03
2	Rotation flap	07
3	Occipital artery flap	07
4	Orticochea technique	04
5	Superficial temporal artery flap	03
6	Trapezius myocutaneous flap	01
7	Others	02
8	Not operated	08

Majority of the patients were in the third decade of life. Burn injury was the most common cause of soft tissue defect in scalp region. Out of 11 cases of burn

injury, nine had electrical burn injury, one acid burn injury and one case had soft tissue defect due to flame burn.

Road traffic accidents and growths in the scalp region were the second common cause of these defects with nine patients in each group. Three cases had soft tissue defect resulting from trauma, two as a result of earth quake injury and one due to mechanical trauma caused by use of agricultural machinery. One patient had defect after excision of huge vascular malformation while in last case the rotation flaps raised for craniotomy necrosed giving rise to a soft tissue defect. **(Table 1)**

Most of the patients i.e., eleven cases, had defects in frontal region. Calvarium, temporal and occipital regions had 8 patients in each sub group. **(Table 2)**

Flaps based on occipital artery were utilized in seven cases. Random pattern rotation flaps were used in other seven cases. Four of the cases were dealt with Orticochea technique and three had soft tissue cover based on superficial temporal artery. Split thickness skin grafts were used in two cases while one case was allowed to heal secondarily **(Table 3)**.

Discussion

Head occupies the most prominent position in body which makes it vulnerable as well. Moreover, it is not covered by any protective clothing used on other parts of body which makes it exposed to the injurious effects of the environment. Long scalp hair may get entangled in the machinery and induce particular type of degloving scalp injury which is very common in agricultural areas.⁵

Present study however witnessed a number of other etiologies causing extensive soft tissue defects of the area. Burns, and especially electric burns, were the most common single cause in this series. Electric burns are known for causing deep and extensive burns due to their unique mechanism of burn injury. As bone is the main organ causing resistance to the flow of current, it suffers the main blow of the injury which later leads to loss of the bone thus compounding the problem. Still another important element is the path of the current flow through the body which leads to entry and exit wounds. As a result, patients with electric burn wounds on scalp present with simultaneous burn wounds on other parts of the body as well.

Road traffic accidents remain among the major causes of soft tissue defects. This study also witnessed the second big subgroup resulting from road traffic accidents.

Extensive full-thickness defects of the region are

prone to necrosis and sequestration of dried exposed calvarium. These wounds must be dealt with an aggressive approach. While wound is being taken care of, debridement is being carried out and healthy granulation tissue awaited, every care is taken to save the pericranium to avoid the necrosis and sequestration of the underlying bone. One important step observed during this series was to provide wet environment to the wound as it enhances the speed of granulation and helps to prevent bone necrosis.

Due to its unique anatomy, scalp skin has minimum yield and cannot be stretched. As a result, even small soft tissue defects are difficult to be closed primarily and different flaps are utilized for this purpose. This requires a good knowledge of the scalp anatomy. The word scalp itself speaks of the layers it is made of, i.e., skin, subcutaneous connective tissue, aponeurotic layer, loose areolar tissue and pericranium.² The skin in this area is thickest, resistant, almost inelastic and covered with hair.^{5,6} The subcutaneous tissue in turn contains the blood vessels, nerves and hair follicles.^{7,8} It is the loose areolar tissue plane which gets involved in the degloving injuries and it is the plane utilized while raising different flaps.



Fig-1: Full thickness soft tissue defect at frontal region. It was operated twice with 'rotation flap' but wound got reopened.

Rotation flaps with long arc of rotation and careful scoring of the galea may provide solution for smaller soft tissue defects. The scoring of the galea has to be perpendicular to the line of tension and any possible injury to the blood vessels is to be avoided. Although galeal relaxation incisions can be used, they risk the blood supply of the flap.⁹ However, it be may be pointed out that if arc of rotation is not long enough, tension on the advancing edge may result in failure of the flap. Figs 1-3 show a defect which was

covered with rotation flap twice but as it did not adhere to the basic principles of planning and rotation, it ended in failures and when same defect was covered with the rotation flap from same area, but with proper planning, it successfully covered the area. These flaps may be unilateral or bilateral depending on the site and size of the defect. Bilateral flaps help in spreading the tension over the wider surface area. However, they may denervate the adjacent skin as well. Similarly, care is needed not to damage the hair follicles while raising these flaps or it will result in hair loss in that area.¹⁰



Fig-2: Planning of the rotation flap for coverage of the defect at frontal region



Fig-3: Post operative results of the same defect seen in fig 1, 2.

Scalp also has rich supply of paired axial vessels which can nourish the flaps crossing the midline. Designed carefully, these flaps may provide coverage to 50% of the scalp area.⁹ Soft tissue defects of the frontal, temporal, or occipital areas may be effectively covered with single flaps based on superficial temporal artery or occipital artery. Defects occupying the central area or at the confluence of these areas may be covered with multiple flaps incorporating various axial

vessels.^{11,12} Large soft tissue defects of the posterior scalp may be covered with vertical trapezius flap.¹³ At times, combinations of flaps are tried to provide the soft tissue coverage. Orticochea has utilized multiple flaps to cover the soft tissue defects of scalp without leaving any donor site defect.^{12,14} This series witnessed four cases dealt by the technique with excellent results (Figs 4-7).



Fig-4: Post burn full thickness defect at temporal region.



Fig-5: Preoperative marking for covering the defect with orticochea three flap technique.

It was also observed that although skin grafted areas for post burn wounds do not behave well and often result in unstable wound, the grafted donor sites of the scalp healed good and managed well to the daily wear and tear. However, it may take longer for these areas to show any changes and it may be too early to comment about the grafted areas.

Series also included one case with both soft tissue and bone defect after surgery in the mastoid region. The dura was exposed and patient needed a good cover. Pedicled trapezius flap was utilized. The most distal part of flap was used as filler while rest of the flap provided cover for the area.¹¹



Fig-6. Closure of the defect after three flaps have been raised and mobilized to cover the defect.



Fig-7: Post operative results of the same patient in fig 4 showing healing of the site and preservation of the anterior hair line.

Another important observation was malignant transformation in the preexisting post burn scars in half of the total malignancies encountered in this series. Most of these patients had history of more than seven years of scars or unstable grafted areas. It is for the same reason that skin grafting is not the treatment of choice for most of the soft tissue defects of the scalp. Grafted skin needs good subcutaneous padding to be stable and supple. However, this effect is not present at the scalp and as a result it is more prone to the wear and tear which leads to unstable grafted area, frequent injuries, cracks and ulcers leading to malignant transformation in due course of time.

Provision of soft tissue coverage for post-ablative

defects is a challenging job. Whereas armamentarium for soft tissue coverage is quite extensive and a variety of options are utilized, some of the studies advocate healing by secondary intention of the exposed calvarial bone in patients with aggressive or recurrent tumors. In a study, Snow et al reported a secondary intention wound healing rate of 95% without any case having osteomyelitis.¹⁵ However, this study witnessed only one case being skin grafted and rest of the cases were given full thickness cover with local flaps.

Although free tissue transfer has become the treatment of choice for extensive soft tissue defects,^{7,16} the inherent disadvantages of the free transfer like prolonged surgical procedure, specialized skills and equipment may restrict its usage and same was the case in this study where we did not witness this

option being utilized.

Study witnessed a number of options being utilized for reconstruction of soft tissue defects of scalp but every option must be further explored in detail regarding its utilization for particular defects.

Conclusion

Series witnessed a spectrum of options for coverage of soft tissue defects. Every case needs to be dealt on individual basis for selection of the option. Post burn wounds if not provided with a proper soft tissue cover may lead to malignant transformation.

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