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Reconstruction of Scalp Defects: An Algorithmic Approach

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Abstract:
Background:*Reconstruction of scalp defects is required for acute trauma, tumor excision, radiation necrosis, the repair of traumatic alopecia, post electrical burn defects and exposed cochlear implants.*
Methods: *The proper choice of a reconstructive technique is affected by several factors—the size and location of the defect, the presence or absence of periosteum, the quality of surrounding scalp tissue, the presence or absence of hair, location of the hairline and patient comorbidities. Successful reconstruction of these defects requires a detailed knowledge of scalp anatomy, hair physiology, skin biomechanics and the variety of possible local tissue rearrangements. For smaller defects local flaps are advised in near total defects, local tissues may be inadequate and tissue expansion or free tissue transfer may be the only alternatives.*
Results: *Plastic surgeons are now able to obtain coverage over the calvaria after the most devastating of defects. However, the challenge to the reconstructive surgeon today is to do so with excellent cosmetic results. Cosmetic scalp reconstruction requires restoration and preservation of normal hair patterns and hair lines.*
Conclusions:*Successful reconstruction of the scalp requires careful preoperativePlanning and precise intraoperative execution. Detailed knowledge of scalp anatomy, skin biomechanics, hair physiology and the variety of available local tissue rearrangements allows for excellent aesthetic reconstruction.*
Keywords: *calvarium, hair line,rotation flap, scalp defects, transposition flap.*

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I. Introduction

Scalp defects are caused by trauma, following tumor resection surgery, radiotherapy-induced necrosis, burns, infections (1-3)and exposed cochlear implants.The repair of such defects depends upon their location, size and depth (2). Unlike in other head and neck areas where local flaps are used to repair large defects, in the region of the scalp the repair of even small defects is complicated (1,3-5). Rotation and transposition scalp flaps are used for reconstructing these defects. The correct design of such flaps includes preservation of the original hairline, acceptable redirectioning of the hair follicles, the incorporation of large vascular pedicles and wound closure without excessive tension (3-6). These flaps in turn may require skin grafts to cover the donor site (1,4,6). Knowledge of scalp anatomy is essential for preparing these flaps (4). The skin layers of the scalp are easy to remember: SCALP (S: skin; C: subcutaneous tissue; A: aponeurotic layer; L: loose areolar tissue; P: pericranium) (6-8). The skin in this region is the thickest, resistant, inelastic, and is covered with hair (3,6,8). The subcutaneous tissue in turn contains the blood vessels, nerves and hair follicles (6,7). An exception to this anatomical distribution is the location of the superficial temporal artery in the temporoparietal region, which is located in the temporoparietal fascia (6,7,9). The main arteries supplying the scalp are the superficial temporal artery, with its frontal and parietal branches, the posterior auricular artery and the occipital artery ,all of which are branches of the external carotid artery and the supraorbital and trochlear arteries (branches of the internal carotid artery)(6,8). Local flaps must be based on one or two vascular pedicles of the scalp to afford a large rotation angle, thereby facilitating closure of the defect (1,6). The aponeurotic layer, also known as the epicranial aponeurosis, is the strongest layer of the scalp and is anteriorly contiguous to the frontal muscle, posteriorly to the occipital muscles and laterally to the temporoparietal fascia (6,8). As a result of its scant elasticity, the aponeurosis opposes desired flap advancement. This can be overcome by making incisions perpendicular to the direction of flap movement- Galeal Scoring (5,6,8). Correct closure with these flaps requires suturing the aponeurotic layer (6). Local scalp flaps are composed of skin, subcutaneous tissue and aponeurosis, intimately connected by fibrous trabeculae. The loose areolar tissue also known as the subaponeurotic fascia, fascia innominata and subaponeurotic plane allows mobility of the scalp (6,8). The parietal zone is the most mobile scalp region. The pericranium is intimately adhered to the skull. It must be left intact as far as possible, since free skin grafts can be applied to it . There are a number of local flap techniques: single or multiple, and with or without skin grafting to close the donor defects. Single flaps in turn comprise rotation, transposition flap, Bipedicle advancement flap,VY advancement and rhomboidal flaps, etc. (1,5,8,9).

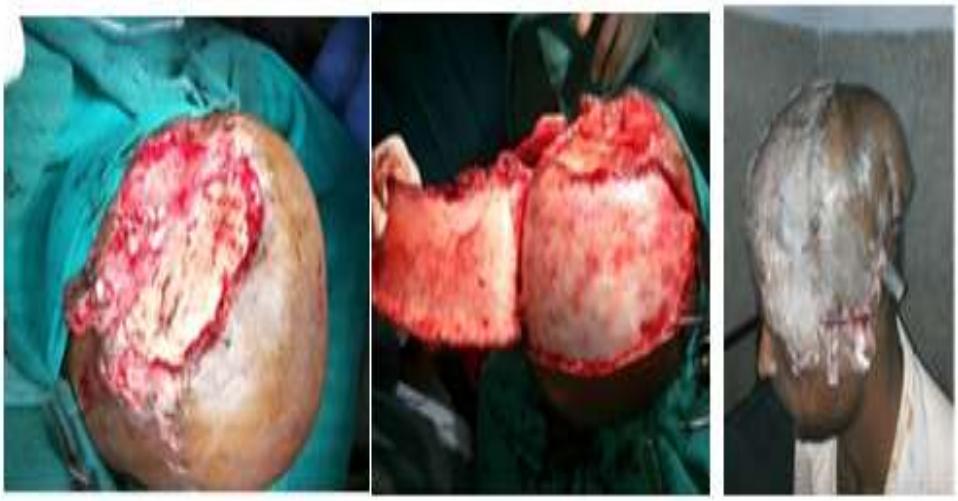
Multiple flaps include the triple-flap technique described by Orticochea, the triple rotation (pinwheel) flap, double rotation flap, triple rhomboid flap, and V-Y-S scalp plasty technique, etc. (1,2,5). The patients at greatest risk of complications after scalp reconstruction are those previously subjected to radiotherapy, patients receiving adjuvant or postoperative chemotherapy, those with cerebrospinal fluid fistulas, and patients with anteriorly located defects (4).

II. Materials And Methods

This paper analyses a number of 15patients. All 15 were males. Thirteen were adults and 2 were children. Age was between 5- 60 years. Ten patients were operated for posttraumatic defects. Two cases were operated for post electrical burn defects. Two defects were following neurosurgical procedure. In one patient there was exposed cochlear implant.All the procedures were done under GA. The defect sizes are ranging from 4-15 cm. All were exposing skull bones. Rotation flapwas done for 6 cases. Transposition flap was done for 7 cases. Two bipedicle flaps were done for exposed cochlear implant in the mastoid region and post electrical burn defect. For those two patients the necrosed flaps were debrided and local transposition flaps were done to cover the implant and the bone respectively. In one case rotation flap was combined with pericranial flap. Split thickness skin graft done for one patient after allowing the calvarium for granulation. In one patient there was scalp avulsion and the avulsed scalp was used as full thickness graft.

Our cases

Transposition flap



Rotation flap

Rotation with pericranial flap and SSG

SSG

FTG

III. Discussion

Scalp defects are classified into <3 cm , 3-6 cm, 6-9 cm and >9 cm. Best replacement of scalp is scalp itself. Primary closure is possible for the scalp defects upto 3 cm. Galeal scoring and undermining are aiding closure of the defect. Healing by secondary intention gives acceptable outcomes. Split thickness skin grafts can be used if the periosteum isintact. SSG can be used once there is acceptable granulation over the bone. Granulation over the bone can be achieved by allowing the bone to heal bysecondary intention and vacuum-assisted closure.But the aesthetic results are suboptimal due to alopecia and poor colour match.Scalp defects of 3-6 cm are closed by rotation advancement flap. Incorporation of one named vessel allows maximal excursion of flap. Length of the rotation flap should exceed five times the diameter of the defects. Incisional alopecia should be avoided by making the incision parallel to the hair shaft direction to avoid follicular damage. Placement of incision should not alter the hair line. Advantage of the rotation flap is donor site can be primarily closed. Local flaps and skin grafting may not be possible when prior radiotherapy was given. Disadvantage of this flap is extensive mobilization of scalp.Scalp defects of 6-9 cm are covered by local transposition flap based on a major pedicle and the donor site was covered with SSG. That is the disadvantage of transposition flap. This flap can be unilateral or bilateral. Bipedicle flap can be based on two major pedicles.The use of three or four flaps popularized by Orticochea can be done for the larger defects. Tissue expansion is an another choice.The choice for the Scalp defects more than 9 cm is free flap. Muscle flaps with nonmeshed SSG are used. The latissimus dorsi ,rectus abdominis and serratus anterior muscle flaps can be used. Anterolateral thigh flap is an alternate flap. Large omental flap can also be used. Superficial temporal artery is the commonly used recipient vessel.

IV. Conclusion

Successful reconstruction of the scalp requires careful preoperative planning and precise intraoperative

execution. Detailed knowledge of scalp anatomy, skin biomechanics, hair physiology and the variety of available local tissue rearrangements allow for excellent aesthetic reconstruction. We used rotation flaps for the defects measuring 3-6 cms and transposition flaps for the defects measuring 6-9 cms. We used bipedicle flap to cover the mastoid area.Cosmetic scalp reconstruction was possible due to restoration and preservation of normal hair patterns and hair lines.

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