Case Report

Scalp defect associated with extensive fibrosis of artificial dura requiring modified closure

Janhavi Sirsat[1], Muath Al-Chalabi[2], Ahmad Sukari Halim[3], Abdul Rahman Izaini Ghani[4]

ABSTRACT

Background

A variety of methods are available for scalp defect closure and necessitate extensive planning. Superficial temporal artery (STA) based local flaps are widely used in the field of scalp and face reconstruction because of their flexibility and rich vascularity. Rotation and transposition techniques are commonly used in the area, however at times result in excessive tension. V-Y advancement allows tension-free closure with reduced post-operative complications.

Case presentation

A case of scalp defect post multiple craniectomies for a traumatic head injury complicated with subgaleal collection and poor wound healing in a 29-year-old male, is reported. Due to the nature of defect, with underlying fibrosis and previous artificial duraplasty, along with location in the frontotemporal region, a local STA based flap closed in a rotation, transposition and unilateral V-Y advancement pattern was used.

Conclusion

The challenges encountered in wound closure of complicated post-traumatic and multiple craniectomy cases can be overcome with a modified combined approach which achieves optimal wound closure.

Keywords

scalp, surgical flap, wound closure techniques, temporal artery

INTRODUCTION

Scalp reconstruction poses a significant challenge due to the atypical characteristics of the skin and subcutaneous layer in the area, along with consideration of anatomical and aesthetic aspects. The defects can be secondary to trauma, excision of tumors or burn injuries[1].

A variety of techniques can be used to reconstruct the scalp. These include healing by secondary intention, primary closure, skin grafts, local flaps, and free tissue transfer. Predominantly for large defects, local rotational, transposition or bilateral advancement flaps have been preferred[2].

The temporoparietal fascia (TPF) consists of the superficial temporal artery (STA) with its extensive branches which supply a wide area of the scalp[2]. The STA is of substantial importance due to its use as a vascular pedicle for cutaneous and fascial flaps in the field of facial and scalp reconstruction[1, 3]. With rich vascularity and wide pedicle rotation arc in addition to a steady anatomical course, use of these flaps for closure of scalp defects has proven to have good outcomes with complete restitution of scalp contour[1]. In addition, the flap offers healthy, hair-bearing skin for patients with complex injuries; either from trauma or prior surgeries, infections, radiotherapy, and cerebrospinal fluid leaks[3]. This case report presents the use of STA based flap;

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involving a combination of rotation, transposition, and V-Y advancement to cover a scalp defect after multiple craniectomies for a complicated traumatic head injury in a young male patient. We highlight the role of a multiple technique approach for closing challenging scalp defects.

Case presentation

A 29-year-old male of average built sustained an alleged motor vehicle accident 15 years ago. He sustained a head injury resulting in a left temporoparietal subgaleal hematoma. Neurological exam was within normal limits. Upon further workup, CT brain showed a left temporoparietal skull fracture with an underlying left temporoparietal extradural hemorrhage, with a mass effect and midline shift. A diagnosis of moderate traumatic head injury with intracranial hemorrhage was made. The patient, under the care of the neurosurgical team, underwent an emergency left temporoparietal craniotomy and evacuation of the extradural clot. Post-operatively, his condition was complicated by persistent subgaleal collection, poor wound healing with infection and dehiscence, necessitating further surgical intervention.

Over the course of two months after the initial operation, he underwent multiple procedures including a re-craniotomy with evacuation of clot, wound debridement, bone removal and dural repair with insertion of an artificial dura and release of contracture with excision of scarring tissue.

A persistently high white blood cell count ranging from 60-80,000 cmm and full blood picture suggestive of myeloproliferative disease; along with a complicated post-operative course, further workup confirmed a diagnosis of Chronic Myelogenous Leukemia in chronic phase. The patient was unaware of his condition prior to admission, as he was asymptomatic and had never sought medical attention. He was then started on oral chemotherapy (Imatinib mesylate), which after a course of two years, showed optimum response to treatment with normal blood counts and no detectable disease clinically. The patient then underwent an acrylic cranioplasty, with no complications over the following years.

He presented again twelve years later with headache, nausea, vomiting and dizziness. Neurological examination and lab investigations were within normal limits and blood cultures showed no growth. CT

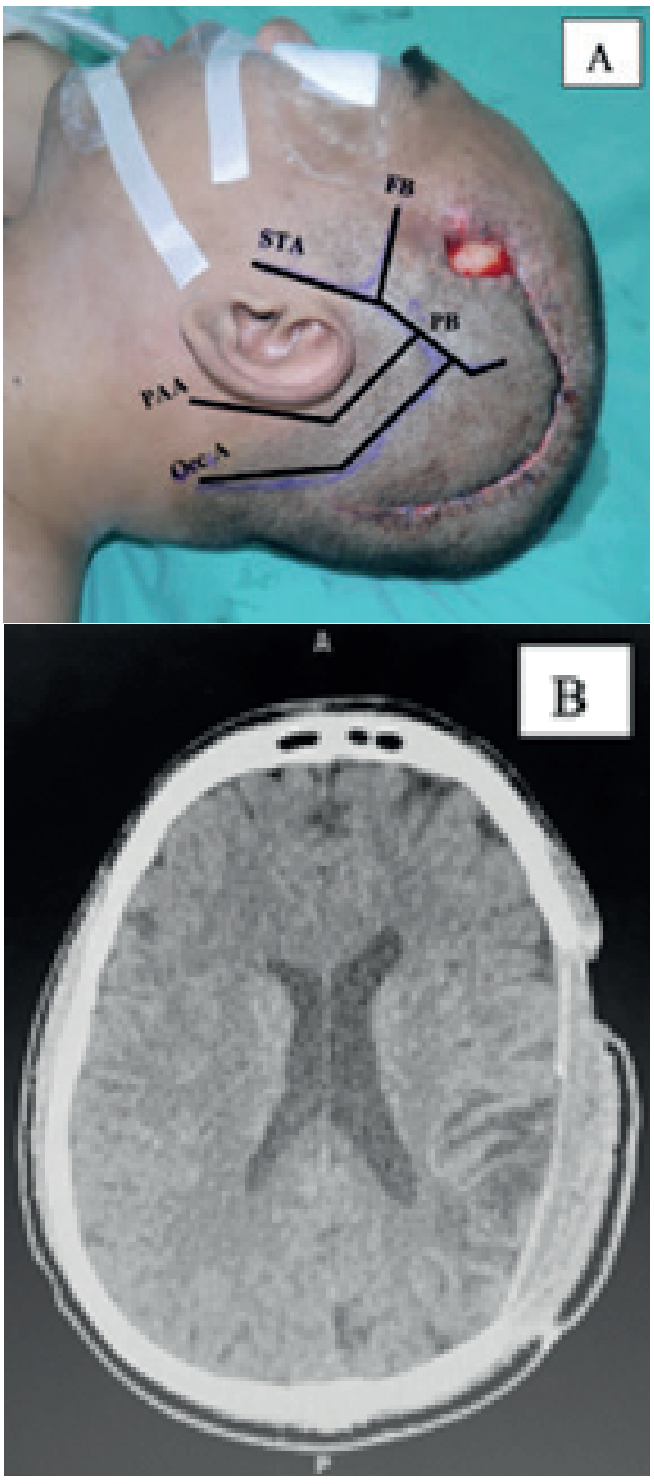

Fig 1 Pre-operative left fronto-temporal wound with exposed acrylic implant and previous craniectomy scar with Doppler guided marking of perforators. STA branches; frontal branch (FB), parietal branch (PB), posterior auricular artery (PAA) and occipital artery (Occ A) **(A)**.

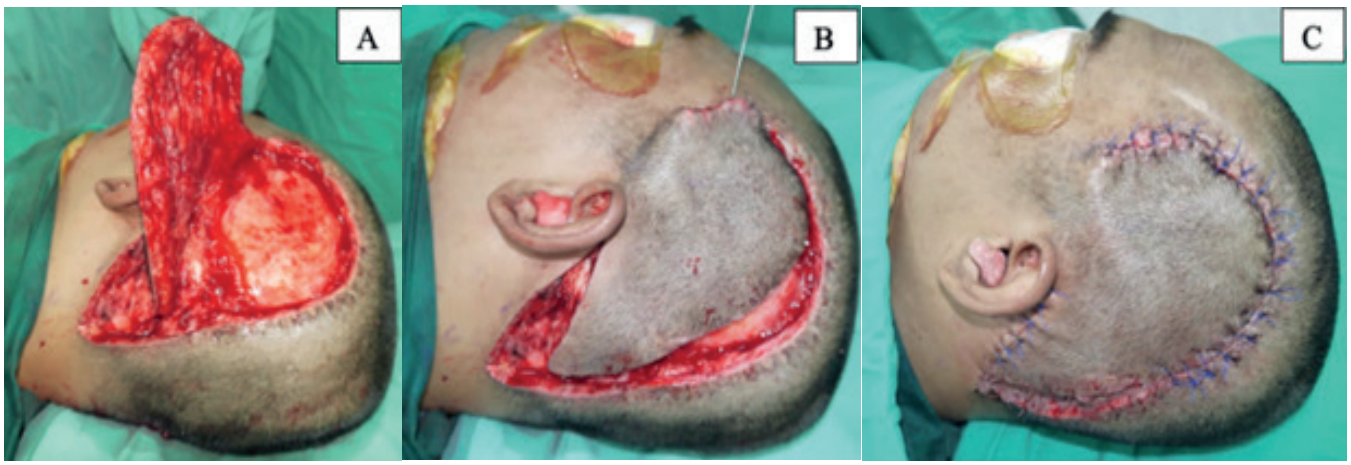

Fig 2 Intra-operative elevation of flap from cranial to caudal aspect **(A)**. Advancement, rotation, and transposition of flap to cover the scalp defect **(B)**. Insetting of flap with sutures in a V-Y pattern **(C)**.

brain showed left fronto-parieto-temporal subgaleal soft tissue inflammation with no obvious collection. The patient was discharged with empirical antibiotic coverage.

In his latest presentation, a year later, with wound gapping at the previous surgical site, associated with pus discharge. There was no documented fever or symptoms of raised intracranial pressure. Neurological examination was normal. Upon inspection, there was a wound measuring 3x3 cm over the left frontotemporal area with exposed acrylic implant (Fig 1A). There was no active discharge from the wound site. CT brain showed a left frontotemporal craniectomy defect with left fronto-parieto-temporal subgaleal collection (Fig 1B).

Pre-operative CT brain showing left frontotemporal craniectomy defect with left fronto-parieto-temporal subgaleal collection. **(B)**.

The neurosurgical team performed removal of the acrylic bone flap and attempted primary closure. The wound was reopened along the previous surgical incision, acrylic implant extracted, and a thorough washout done with a gentamicin-saline solution and povidone-iodine and hydrogen peroxide mixture. After wound debridement, an attempt to approximate the wound defect failed. The wound bed contained artificial dura with a thin layer of fibrotic granulation tissue and a surrounding thick capsule with dense fibrotic tissue that was scored vertically parallel to the direction of muscle fibers. Periosteal layer was seen, with minimal skin paddle expansion. In view of the inability to achieve tensionless closure, plastic surgery was referred and a local flap involving the STA was performed for optimal wound coverage.

The STA, along with its tributaries were marked using a Doppler device (Fig 1A). The flap design involved the left frontotemporal scalp, bordering along the previous craniectomy incision and extending downward to the postauricular region. The size of the flap was around 18x10 cm.

Once the skin incision was made, the subcutaneous tissue was dissected up to the level of the left ear lobule. The STA with its branches was identified, and the flap; comprising temporal fascia, raised from cranial to caudal direction, cautiously avoiding any injury to the pedicle entering the flap (Fig 2A). Further division and subgaleal undermining extended the flap up to the scalp defect, allowing tension-free advancement. The flap was then rotated to an angle of 15°, transposed upon the area of defect (Fig 2B), inset with sutures and the donor site closed in a unilateral V-Y fashion (Fig 2C). A minimally exposed area of scalp, along the galeal plane adjacent to the flap, was covered with a split-thickness skin graft (SSG) harvested from the patient's left thigh. Dressing was done with minimal compression at the flap site.

The patient's post-operative course was uneventful, with no further complications. All tissue cultures of specimens taken intra-operatively showed no growth. Upon wound inspection on day five post-surgery, the

sutures were intact with no wound gapping or discharge. The patient was discharged with scheduled clinic visits and regular dressing change. A couple months following the operation, the wound appeared to heal well with adequate hairline and growth (Fig 3).

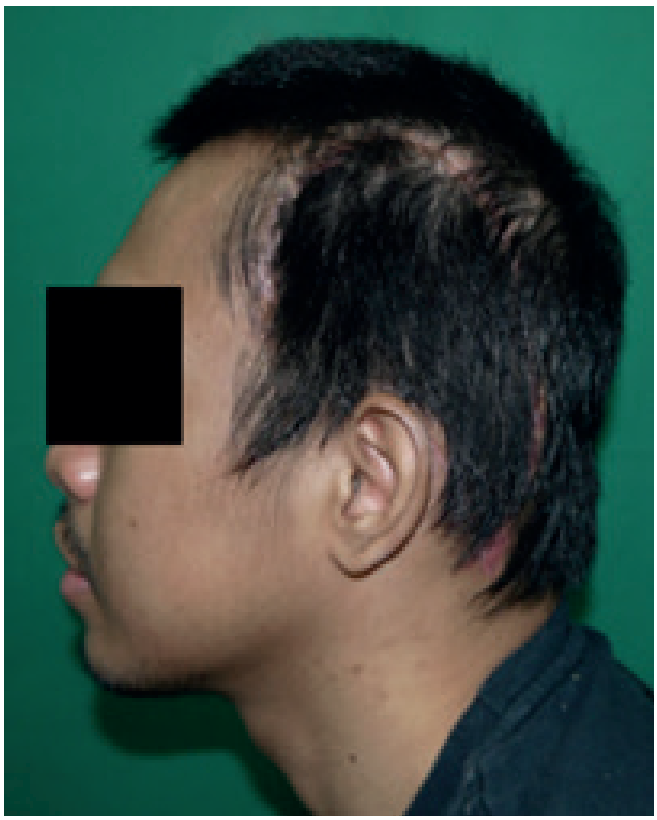

Fig 3 Post-operative follow up visit after 2 months showing good flap healing.

DISCUSSION

Various methods of reconstruction for scalp defects are available based on the extent of defect[4]. Starting with primary closure of the wound, for defects less than 2 cm^2. Secondary closure with healing by secondary intention is the next step, after which full and split-thickness skin grafts are considered. These procedures are commonly suited for patients with relative contraindications for major reconstructive surgery. Local and regional flaps are used when defects are greater (2-25 cm^2), and of full thickness, as in the case reported. Lastly, more complex defects require free tissue transfer, which often results in unfavourable cosmetic and functional outcomes like alopecia at the surgical site[1, 4].

Flaps can be further divided based on blood supply. Random pattern local flaps are supplied by microvessels and are indicated for defective areas having a length to width ratio greater than 2 to 1. Axial pattern local flaps consist of a single arteriovenous pedicle and are used for areas with a ratio less than 2 to 1. Venous flaps may also be considered[4].

The patient's scalp defect was in a difficult location at the frontotemporal region with underlying artificial dura and extensive fibrosis following multiple craniectomies in the past with incisions made over the same scar each time. The drawbacks associated with artificial duraplasty also include excessive scarring, wound dehiscence, and longer duration of wound healing, as compared to autologous grafts[5], however, there are limited studies.

This required extensive flap planning with consideration of many key factors. Thorough knowledge of anatomy, awareness of optimal closure of donor site and restoration of skin contour and function remain vital in adapting the best possible reconstructive method[3, 4].

An STA based local flap was used to cover the defect. With extensive flexibility, mobility, and rich vascular network, it is widely used in scalp and face reconstruction[1]. The STA and its perforators were mapped with a Doppler device and care was taken to not injure the surrounding vessels, nerves, and hair follicles during dissection. TPF is a fine layer of connective tissue continuous with the galeal aponeurosis, lying between the subcutaneous layer and innominate fascia, which separates it from the deep temporal fascia. The STA, which is the main artery supplying the area, and subsequently the flap, originates from the external carotid artery and courses past the parotid gland; beneath the facial nerve, extending up to the preauricular region lateral to the temporomandibular joint. It enters the TPF about 1.5 cm anterior to the tragus, superior to the zygomatic arch, and then divides into frontal and parietal branches, 1 cm further above[1]. The frontal branch joins the supraorbital and supratrochlear arteries at the frontal scalp, permitting reverse flow flap elevation. It is necessary to dissect with caution at this point due to proximity with the facial nerve's temporal branch[1]. The parietal branch extends to the midline, towards the vertex. Further posterior divisions of the STA form a network with the posterior auricular and occipital arteries. The superficial temporal vein is commonly found posterior to the artery[1]. The flap in this case was harvested with pedicle and the overlying scalp, making it a suitable option for coverage of the

defect in a hair-bearing area, and with its widespread vascular network, in preventing flap necrosis[6]. A few common limitations of such flaps include size, space between the donor site and recipient site, and venous congestion[2]; however, these were not encountered in the case reported.

The most common type of local flaps for closure of scalp defects use rotation and bipedicle advancement techniques. Particularly for the frontal scalp, due to the need for maintaining the hairline and redirecting hair follicles, local transposition flaps are preferred for moderate to large defects, with the posterolateral scalp used as the donor site. Rotation and transposition flaps frequently cause dog ear formation, excessive tension and sometimes leave an exposed area at the donor site, which, if not suitable for primary closure, must be skin grafted[6]. Although rotation of the flap in this case allowed defect coverage, there was chance of a secondary defect forming. Due to this, transposition was attempted to minimize and relocate the secondary defect to a more graftable area towards the occiput, while ensuring an adequate hairline.

V-Y advancement flaps contain either a unilateral or bilateral pedicle. The method involves transfer and conversion of a V-shaped flap to a Y-shape at the defect site and can be used to reconstruct small to medium sized wounds of the scalp, face, trunk, and limbs; especially when the affected area necessitates lengthening or release of tension[7]. With less tension, there is less chance of hypertrophy or widening of the scar in the future. These flaps also minimize scar tissue in the surrounding area, reducing the risk of a trap-door deformity, as compared to transposition flaps. In addition, with less dead space, the risk of developing a collection in the postoperative period is minimal[7]. Studies have also shown a successful combination of two V-Y advancement flaps, forming a trapezoid shape keystone flap that results in improved vascular flow and survival[8]. Tension-free closure over the artificial dura in this case was achieved with the help of a unilateral V-Y advancement, with no hematoma or seroma formation post-operatively. Good flap healing was seen in the weeks following the operation.

CONCLUSION

In conclusion, for patients with complicated post-traumatic scalp defects who have undergone numerous craniectomies, some of the challenges that lie in wound closure include fibrosis and planning a flap over artificial dura. Local STA-based flaps have gained much popularity in scalp reconstruction due to their pliability and vascularity. A modified approach combining rotation, transposition and V-Y advancement proves to be a reliable solution in the closure of such scalp defects.

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AUTHORS' CONTRIBUTION:

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