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Role of Platelet Rich Fibrin Matrix in Keystone Perforator Flap

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ABSTRACT

Flaps are important part of reconstruction ladder for wounds and defects following trauma, burns, surgery and infection. Keystone flap is a fasciocutaneous perforator flap on the local level. The robust vascularity of perforator flaps, relative ease of technique, quick operative time, good reproducibility, convenience of usage, and local tissue aesthetic similarities are all advantages of the keystone island flap. Platelet rich fibrin matrix (PRFM) is a fibrin matrix gel comprising platelets, leucocytes, cytokines, and circulating stem cells polymerized in a tetra molecular structure. In this article we employed platelet rich fibrin matrix in the wound bed to prompt the adherence of a type 4 keystone flap in a patient with scalp defect post electrical burn.

Keywords: Platelet Rich Fibrin Matrix; Keystone; Flap; Plasma.

INTRODUCTION

Flaps are important part of reconstruction ladder for wounds and defects following trauma, surgery and infection. Behan first characterised the keystone island flap in 2003. It's a fasciocutaneous perforator flap on the local level.[1] The robust vascularity of perforator flaps, relative ease of technique, quick operative time, good reproducibility, convenience of usage, and local tissue aesthetic similarities are all advantages of the keystone island flap. This approach eliminates the need for microsurgery, extra skin grafts, and lengthy operative time. The keystone flap gets its name from its resemblance to the architectural keystone that marks the arch's middle section. It uses nearby skin and soft tissue to produce a good colour match while also recreating the defect's contour, resulting in a considerably improved cosmetic result.

Platelet rich fibrin matrix, which is rich in growth factors, has been demonstrated to be beneficial for the adherence of the flap to the bed in recent research.

We employed platelet rich fibrin matrix (PRFM) to prompt the adherence of a type 4 keystone flap to the bed in a patient with scalp defect.

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Materials and Methods

This study was conducted in a tertiary care hospital after obtaining approval from department scientific and ethical committee. This is a prospective, descriptive, observational case study. Informed consent was obtained from

the patient. This case report is about a 45 year old male who sustained electrical burn injury by 220 volts alternating current to the vertex region of the scalp (entry zone) and the left leg (exit zone). The patient was disoriented and unconscious at the time of admission with a Glasgow score of 12 and was intubated. Multiple second degree superficial burns were present over the face, neck, chest and anterior aspect of abdomen, bilateral arms, bilateral thighs and second-degree deep burns involving frontoparietal region of scalp at the vertex (fig. 1). CT skull showed small ill defined hypodense area with loss of grey white differentiation noted in the left frontal region suggestive of left frontal infarct. He was resuscitated with the standard WHO burn protocol. Serum electrolytes, urea and creatinine, urine analysis, and electrocardiogram were normal, urine myoglobin negative. Patient was asymptomatic with no seizures, syncope, focal neurological deficits. He was managed conservatively with prophylactic antiepileptic Phenytoin. The patient was extubated after three days of intensive care. According to the manual muscle test, both upper and lower extremities were normal. Sensory function was intact, muscle stretch reflexes were normoactive, no pathological reflexes were identified, and all the other cranial nerve and cerebellar functions were normal. Debridement of scalp wound was done after demarcation of necrotic patch. Once the wound bed showed healthy granulation, perforator based type 4 keystone flap was done. To enhance to adhesion of flap to the wound bed and for the nutriment of the flap Platelet Rich Fibrin Matrix was made. Ten millilitres of venous blood were taken under rigorous aseptic conditions and placed in a sterile centrifugation tube devoid of anticoagulant. For 10 minutes, centrifugation was performed at 3000 rpm (about 400 g). Upper straw-colored platelet deficient plasma (PPP), lower red-colored fraction containing red blood cells (RBCs), and intermediate fraction containing PRFM were obtained. The upper layer of straw colour (PPP) was discarded. Using sterile forceps and scissors, PRFM was removed from red corpuscles at the base, leaving a thin RBC layer measuring roughly one millimetre in length that was deposited onto sterile gauze (fig. 2). The PRFM was applied to the wound bed before the inset of the flap.(fig. 3) study was conducted in the department of Plastic Surgery at tertiary care center after getting the departmental ethical committee approval. Informed written consent was taken from the patient. The details of the patient in study are as follows: 56 yrs gentle man with c/o feeling of being aged more than his age came to the OPD for skin rejuvenation (fig. 1). The patient was advised to use golden ion massage bar for skin rejuvenation. The golden ion massage bar (fig. 2) consist of T shaped instrument with gold plating over the shot limb. The massage bar weighs about 120 grams, dimension of 15.24*2.54*2.54 cm in size and has a handle for strong grip with a vibration frequency of 6000.

Results

There was good adherence of the flap to the bed and good take of type 4 keystone perforatorflap. (fig. 4)

Fig. 1: Scalp electrical burn wound at presentation

Fig. 2: Platelet rich fibrin matrix made

Fig. 3: applied platelet rich fibrin matrix in the wound bed before flap inset

Fig. 4: Flap adherent to the wound bed and good flap take

Discussion

The keystone flap is made up of two V-Y advancement flaps that face each other. The migration of these advancement flaps results in the availability of additional tissue adjacent to the defect, allowing for main skin edge approximation. Younger surgeons can simply replicate this method because it is straightforward. In order to follow the chosen nourishing vessels for a short tract into the muscle belly or into the septa, microsurgical expertise is frequently required during the vasculature dissection phase of loco regional flaps, which should be performed under loupe magnification. There is also aesthetic morbidity in the donor area of loco regional flaps due to skin grafts. In loco regional flaps, pre-operative Doppler flow is frequently used to locate perforator arteries in the anatomical area. The location of the perforating vessels is operator dependent, time demanding, and not always exact. Donor site morbidity is low with the keystone flap. Only one of our instances required a little skin graft. The donor locations were mostly closed in the remaining cases.[2,3]

Types of Keystone Island Flaps

Type I: Standard flap design with no deep fascia segmentation.

Type II: The convex side of the flap's deep fascia is separated to improve mobilisation. The secondary defect is closed predominantly in Type II a, and the secondary defect is closed with a splint skin graft in Type II b.

Type III: Two keystone flaps, one on each side of the defect, are designed to aid closure.

Type IV: The flap is undermined up to two-thirds of the way. The mobilisation of the flaps is maximised.

In regions where skin expansibility is limited, such as around the knee, ankle, elbow, plantar aspect of foot, and palmar aspect of hand, the keystone flap should be used with caution. We had to raise the distal end of the flap to cover a defect below the knee in our patients since there was less skin laxity.[4] We incised the flap's edges through deep fascia on a regular basis. This will make it easier for the flap to move around and fill the defect. The flap's mobility is equivalent to that of a tree top, and it's only achievable after cutting the deep fascia all the way around the flap's convex border. In situations where the deep fascia was not incised, we saw shearing of the flap and increased strain in the suture line. We did not incise the skin over the central part of the convex surface of the flap to retain more vascularity in the flap when closing smaller defects and in the presence of sufficient laxity, but we did incise the deep fascia underneath the skin to retain more vascularity in the flap when closing smaller defects and in the presence of sufficient laxity. Splints were worn for 3-4 days to aid soft tissue healing in the upper and

lower limbs. In cases when skin grafting has been performed, physiotherapy will be required.[5] In none of the patients was long term splinting used. As a result, bilateral limb surgeries can be completed in one session. Traditional skin grafts, whether with or without a local flap, result in substantial scarring, post-operative immobility, prolonged physiotherapy, graft pressure therapy, and other complications. We operated on an instance of a raw region over the knee joint on the right side of the knee. Four days following surgery, the patient was advised to move his lower limb. Within 9 days, the wound was completely healed. However, unlike a free flap, key stone flaps have minor limitations such as lengthy scars beyond the defect's bounds and a limited arc of rotation. It's critical to make sure the keystone flap's blood supply hasn't been harmed by either cancer ablation surgery or radiation therapy.[6] Despite these drawbacks, keystone flaps provide primary wound healing for a wide range of abnormalities with minimum pain, a sensitive cover, and great cosmetic results. It's been utilised to treat malformations in the head and neck, as well as parotid and trunk deformities. This method can eliminate the requirement for microsurgical flaps. When compared to perforator flaps and microvascular free flaps, the keystone flap has a shorter learning curve. This flap could be a valuable tool in the hands of a plastic surgeon.

Platelets have a vital part in wound healing as well as haemostasis. Platelets emit cytokines and growth factors, which help keratinocytes, fibroblasts, and endothelial cells migrate, proliferate, and function better.[7] Fibrin is a type of fibrinogen that is active. Thrombin converts fibrinogen to insoluble fibrin, which aids platelet aggregation. Platelet concentrates are frequently devoid of coagulation components, hence platelet-rich fibrin matrix (PRFM) was created to address the expected features in tissue regeneration and wound healing. Fibrinogen is concentrated in the upper section of the tube during centrifugation and combines with thrombin to create a fibrin clot. The release of these factors begins 5-10 minutes after clotting and lasts at least 60-300 minutes, resulting in a slow and steady release.[8]

PRFM is a fibrin matrix gel comprising platelets, leucocytes, cytokines, and circulating stem cells polymerized in a tetra molecular structure. PRFM preparation is simpler, requires less handling, and does not require the use of an anticoagulant or thrombin activator.[9] In a hospital; all of the necessary items are readily available. When opposed to the liquid formulation of APRP, the gel form of PRFM is easier to apply to the raw region. After fibrin formation, the action of autologous growth factors and the biomechanical rigidity of plasmatic proteins provide a unique architecture that aids in the healing process. Growth factors from activated platelet alpha-granules, as well as others like fibrin, fibronectin, and vitronectin, play a crucial part in this process. Vessel endothelial growth factor (VEGF), fibroblast growth factor-b (FGFb), Platelet Derived Growth Factor (PDGF), hepatocyte growth factor (HGF), Epidermal Growth Factor (EGF), and angiopoietin-I are examples of these growth factors.[10]

Conclusion

This is a preliminary study to evaluate the role of platelet rich fibrin matrix (PRFM) in adhesion of keystone flap to the wound bed and good take of the flap and it has been demonstrated to be helpful. To confirm the findings, a large multicentric, double blinded control research with statistical analysis is needed.

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