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Assessment of Survival of Keystone Perforator Flap

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ABSTRACT

Objective: To assess the single most important factor affecting the survival of keystone perforator flap.
Study Design: Case series.
Place and Duration of Study: Combined Military Hospital, Quetta Pakistan, from Mar 2021 to Sep 2022.
Methodology: Patients presenting at Plastic Surgery OPD, where resultant wound defects were covered by a keystone perforator flap for wound coverage, above ten years of age were included in the study. They also included proximal forearm self-harm patients. Operated patients were followed up post-operatively for three weeks, and success and complications were noted. The single most important factor for flap complication was noted.
Results: Eleven patients were studied that fulfilled the inclusion criteria. The age range was 11-59 years. Two were cases of pilonidal sinus, 1 was squamous cell carcinoma (SCC) forearm, and 1 was carbuncle back. All the remaining 7 were of self-harm scars/ wounds of the proximal forearm. Two patients developed partial peripheral flap necrosis that later healed with granulation tissue. The reason for partial flap necrosis was recognized to be shearing forces due to early/excessive post-op mobilization.
Conclusion: The keystone perforator flap transposes pliable adjacent tissue, giving the patient the same look and skin texture as the original tissue. The most important factor affecting flap survival in this small case series was shearing forces, and measures to immobilize the operation site could improve results.

Keywords: Keystone perforator flap, Self-harm, Shearing forces

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INTRODUCTION

The keystone flap is named after the important stone in the centre of an arch. If this important keystone is removed, the bridge of the arch collapses, thus emphasizing its importance.[1] Flap design incorporates incising this bridge-shaped arch on one side of the defect and then re-arranging and collapsing the tissue of the arch into an ovoid shape to fill the defect and the flap donor area.[2] The two farther outer donor site corners are stitched back in V-Y advancement flap fashion. Flap undermining is avoided to preserve the integrity of perforators.[3] A recent study identified the benefits of Doppler probe perforator marking as a helpful tool for large-size forearm keystone flaps.[4] It is superior to other wound coverage options like propeller flap because no flap donor site requires a skin graft. [5,6]

Self-harm on the forearm is seen in young teenagers who are under stress or Psychologically disturbed. The individual usually uses a blade razor to make parallel cuts on the forearm close to the wrist or proximal forearm.[7]

Even after trading the self-harm scars with operation scars, they still had to undergo rigorous Psychological assessment and were liable to be declared unfit for induction to uniformed institutes. The reason is that the military/police service requires weapon handling.[8] If a person holding a loaded weapon has a Psychological fluctuation, he could be mortally dangerous for himself as well as his comrades. Therefore, all patients were counselled preoperatively that even with surgery, they are likely to stay unfit for induction into forces on Psychiatric grounds. It was the reason that 3 of the ten reported forearm self-harm cases denied surgery, as it was deemed useless if they were not likely to be inducted even after surgery. The seven that opted for the operation were because they thought they had had enough and wanted to get off their taboos of bullying at least and being side-lined in the college community.[9,10]

Our case series was overwhelmed by self-harm forearm patients whose main reason for presenting was rejection from recruitment into uniformed law enforcing agencies and stress of bullying in their educational institution by peers.

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METHODOLOGY

The case series was conducted at Combined Military Hospital, Quetta, Pakistan from March 2021 to August 2022 after IERB approval. We included 11 cases in the study.

Inclusion Criteria: All self-harm patients above ten years old, psychologically stable, and with lesions with pliable, healthy adjacent skin presenting with a patch of proximal half forearm self-harm scars who already had Dermatology and Psychiatry review and were willing to operative treatment for lesion removal were included.

Exclusion criteria: Patients without enough healthy, pliable adjacent skin, patients that had distal forearm scars, patients with scars extending the entire forearm were excluded.

All the individuals reporting to Plastic Surgery, OPD of CMH Quetta, requesting the removal of self-harm scars on the proximal half of the forearm were identified. These individuals were referred from Dermatology OPD, where either their scars were deemed too deep to undergo dermatologic treatment, or they had not responded to other means like LASER, etc, by Dermatologists. All self-harm individuals underwent psychiatric evaluation, and only Psychologically stable patients underwent surgery. Apart from self-harm proximal forearm patients, all other lesions that had good, healthy adjacent pliable skin that could be advanced as Keystone flap were also studied.

Patients with proximal forearm scars were operated on under general anaesthesia under tourniquet control. All underwent lesion excision and coverage by adjacent tissue with a Keystone perforator flap, resulting in the primary closure of all wounds, including the donor site, without a skin graft. A general plastic surgery operating instruments set was used. Patients were given a single per-operative dose of Co-amoxiclav 1.2g IV and two further doses at eight hourly intervals. Patients were discharged the next day with oral Co-amoxiclav 1.2g BD and Paracetamol 2 tab SOS for the next four days.

Operated patients were followed up post-operatively for at least three weeks, and success and complications were noted. From the data assessment, the single most important factor for flap survival/ loss was searched. Wound healing was assessed, and any complications were noted in the patient data charts. Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis

RESULTS

Two out of 11 cases developed complications of distal flap tip necrosis. The age range of the patients was 11-59 years. (mean age 25.8± 3.0). There were two females, and 9 were males. Two were cases of pilonidal sinus, one was SCC forearm (Figure), and one was carbuncle back. All the remaining 7 were of self-harm scars/ wounds of the forearm. The presentation of these 7 cases was due to their rejection from medical fitness for recruitment into uniform law-enforcing agencies. There were an additional 3 cases that refused surgery, knowing that they could remain unfit for induction into forces after surgery on Psychiatric grounds. So, they were not included in the study.

Figure (A, B, C): Wide Local Excision of Post Squamous cell Carcinoma Excision Biopsy that Showed Involved Margins. Defect Closure with Keystone Perforator Flap.

All these patients underwent the excision of lesions and reconstruction with a keystone perforator flap and primary wound closure. Two of 11 patients undergoing keystone flaps after scar excision developed partial peripheral flap necrosis that later healed with granulation tissue. One was a child with a pilonidal sinus coverage operation where patient compliance was poor, and she did not follow restriction of movement advice and started sitting on a chair and walking from the first post-op day. Another was a self-harm forearm patient who had a maniac depressive illness and post-operatively had an attack of mania where he kept swinging his arm while imitating bowling in the World Cup final cricket match and lifting a heavy weight mattress, imitating lifting his team-mate to winning the World Cup. The other nine patients had uneventful healing. Flap tissue helped replace like with like tissue. All patients got rid of the

lesions/self-harm cut scar lines / deep acid burnt areas and had overall good cosmetic results and a Psychological boost to be free from objectionable self-harm scarring. However, the operative scar lines around the flap remained visible. The resultant coverage flap skin was of the same texture, pliability and colour as the surrounding native skin. This was an advantage of this flap to be replaced like with like tissue. 2 patients had a slight objection to the presence of flap circumferential operation healed scar lines and wished for a scar-less forearm. However, they were at least satisfied that their original parallel cut lines were no longer visible and hoped to be free of bullying at college.

The main reason for partial flap necrosis was recognized to be shearing forces due to early/excessive mobilization.

DISCUSSION

Keystone flap is reliable for trading wounds/ scars with like tissue.[11] It has been used in multiple tissue defect types in varied anatomical types. In a recent systematic review, keystone flap reconstruction demonstrated excellent success rates and versatility.[12]

However, our study needed more proximal forearm coverage. It had a minimal complication rate, and most patients had a Psychological boost with good satisfaction. There have been studies regarding the comparison of defect coverage with keystone flaps and with skin grafts. One such study compared radial forearm free flap donor site coverage with skin grafts to coverage with keystone flap. It showed reduced healing time and more acceptable results with keystone flaps.[13]

Researchers have worked to increase the reliability of this flap utilizing certain interventions.[14] One previous study preoperatively marked the perforators with a Doppler probe to increase reliability.[15]

Options for wound coverage techniques include skin graft (split-thickness - meshed/unmeshed, full thickness), propeller flap, random pattern flap, hatchet flap, transposition flap, semi-circular flap, local flap, regional flap, acellular dermis with a skin graft. Most of the studies, however, have compared flap coverage with skin grafts.[16,17] The use of artificial dermis or collagen matrix associated or not with skin grafting may allow for a reduction of scarring complications.[18]

Our study was limited to using a keystone flap as a coverage option and showed good cosmetic results and minimal complications acceptable to most patients. The two patients who developed peripheral flap necrosis were the ones who excessively mobilized immediately after the operation. These complications may have been avoided if steps to immobilize, like splinting the forearm, could have been taken. Our study did not compare other options/flaps for wound coverage. However, an extended study in future could frame a comparison of keystone flaps for the same location coverage with other options as described above. This could include the outcomes, complications, operating time, difficulty level, technical requirements, and patient satisfaction.

CONCLUSION

The keystone perforator flap transposes pliable adjacent tissue, giving the patient the same look and skin texture as the original tissue. The most important factor affecting flap survival in this small case series was shearing forces, and measures to immobilize the operation site could improve results.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

AMB, RSA & GA: Conception, study design, drafting the manuscript, approval of the final version to be published.

JA, RB & SI: Critical review, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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