ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 04 | April - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EXPLORING THE APPLICATIONS OF ISLANDED KEYSTONE FLAP IN THE INDIAN POPULATION

Plastic Surgery

Dr Panchapakesan Krishnan Assistant Professor, Government Kilpauk Medical College, Chennai, India.
Dr Reshma Gopakumar Senior Resident, Government Kilpauk Medical College, Chennai, India.
Dr Angeline Selvaraj Professor, Government Kilpauk Medical College, Chennai, India.

ABSTRACT

This study aims to explore keystone flap for various soft tissue defect reconstruction, demonstrating its flexibility, efficiency, reliability and practicality in the Indian population. 30 flaps were performed to cover various soft tissue defects. All flaps were planned according to the original flap design and standard post-operative patient and flap care was given. All the flaps were easy to perform and gave satisfactory 'like tissue' replacement for the defects. Intra-operative and post-operative period was uneventful. After being discharged with necessary advice, patients were followed up regularly for up to a period of six months. All flaps settled well with tissue match in function, texture, colour and sensitivity. Hence keystone flap can be considered as a versatile and sturdy one with a short learning curve and can be useful tool for even novice surgeons.

KEYWORDS

Keystone flap, Behan's flap, soft tissue defect, local flap, reconstruction

INTRODUCTION

The 'keystone island flap' which was first described in 2003 by Behan, is a relatively new concept in soft tissue defect reconstruction (1). The name was suggested by Alan Breidahl for Behan's flap as it resembled a wedge shaped 'keystone' of arches in Roman architecture (Fig 1). It is based on fascio-cutaneous perforators and uses the adjacent tissue for reconstruction of defects (1,2,3). Thus, it has the ease and colour match of local tissue rearrangement as well as the sturdy vascularity of perforator flaps.

The golden rule of plastic surgery is that, the simplest procedure that effectively solves the problem is the ideal solution (4). Abiding by this principle, the keystone islanded flap was used in various instances of soft tissue defect reconstruction. This patient case series reports our experience in an Indian population, in terms of its flexibility, efficiency, reliability and practicality.

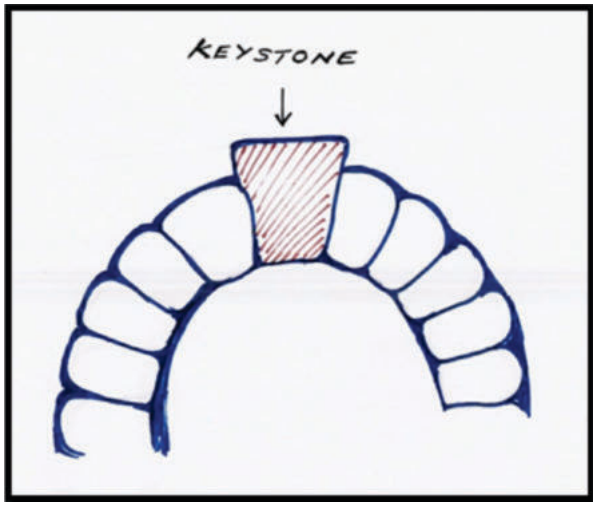

Figure 1 :keystone In Roman Arch

MATERIALS AND METHODS

This is apatient case series involving 29 patients with soft tissue defects reconstructed with 30 keystone flaps from February 2021 – January 2022. The study was conducted at the Department of Burns and Plastic & Reconstructive Surgery at Government Kilpauk Medical College Hospital, Tamil Nadu, India. The patients' demographic details, medical history, details of the tissue defect, surgical details, follow up and necessary photographs were collected with prior consent from the patients.

Inclusion Criteria

1. Patients who are above 18 years
2. Patient of sound mind and able to give an informed consent
3. Patient with haemoglobin greater than 10 g/dL
4. Wound is healthy with no frank pus or other signs of active infection.

Exclusion Criteria

1. Patients less than 18 years of age
2. Non-consenting patients
3. Patient with anaemia
4. Patient with serum albumin less than 3.5 g/ dL
5. Patient with infected / damaged donor area.

Flap Planning (2-9)

The soft tissue defect was first converted into an ellipse. The flap was planned on the defect's edge with maximum skin laxity. Perforators were not identified with Doppler prior to planning. The flap was marked by drawing a line at the ends of the defect at an angle of 90degrees (tangent), such that the width of the raw area and width of the flap planned were in the same ratio (1:1). However, in the lower leg, where there is less skin laxity, the ratio had to be altered to 1:2 or 1:3 according to the defect size and skin tension. Then, a curvilinear line was drawn which connected the two lines, forming the outer edge of the flap (Fig 2,3)

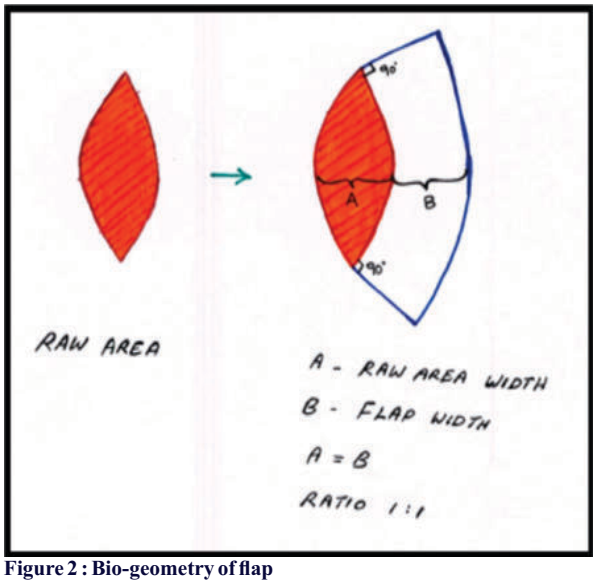

Figure 2 : Bio-geometry of flap

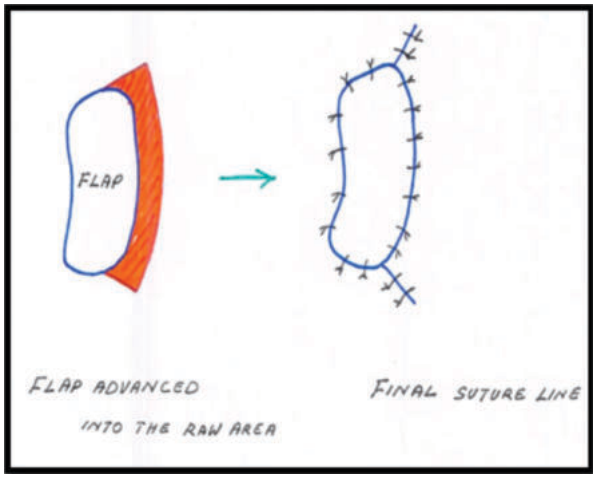

Figure 3 : Final Suture Line After Advancement Into The Defect

Flap Elevation And Inset

First, tumescent infiltration was done along the flap incision marking. Then the incision was made which was deepened up-to the sub-fascial plane. Care was taken not to disrupt fascio-cutaneous perforators by making sure never to undermine the flap. Once the flap was islanded, it was advanced into the defect and inset given using standard suturing technique (vertical mattress sutures). The donor site was closed primarily, except in cases of large defects, where skin grafting was required to ensure closure without tension (Fig.4.).

Figure 4:the Width Of The Defect On Left Forearm Was Measured, Flap Marked, Elevated And Inset Given. Donner Area Covered With Skin Graft.

RESULTS

A total of 30 flaps, performed on 29 patients (26 male and 3 female) are included in this case series. Age of patients ranged from 18 to 60 years with a mean age of 40.86 years. Of the 29 patients, 8 were diabetic, 1 had PVOD and 6 suffered from electrical burns. The different causes of soft tissue defects included in the study are as shown in (Fig.5). The anatomical distribution of flaps that had been performed include, 9 in upper limb, 10 in lower limb, 8 on the trunk and 3 on amputated stumps. The mean size of defect closed using the Keystone flap was 56.1cm^2, the smallest being 8cm^2 in size and the largest being 216 cm^2 in size. Of the 30 flaps performed, 4 (13%) were type I, 9(30%) were type IIA, 11(37%) were type IIB and 6(20%) were type III flaps. In this case series type IV flaps were not performed.

All flaps survived without any complications and were followed up regularly for six months of the post-operative period. There was no event of patient dissatisfactions. By the end of six months the flaps had settled in well with minimal scar and good colour and texture match.

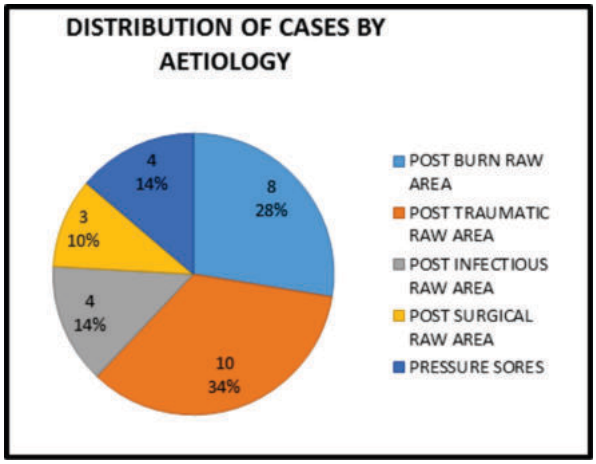

Figure 5: Pie Chart Showing Case Distribution Based On Aetiology.

DISCUSSION

Loco-regional flaps have been of great interest to plastic surgeons considering its superior aesthetic results with "like to like replacement" as compared to distant flaps (4,5). The need for nerve repair to provide protective sensitivity in case of distant flaps is also another factor in favour of loco-regional flaps. The Keystone flap is a versatile local flap wherein the adjacent lax tissue is recruited into the desired area for reconstruction. The flap is designed based on the fact that the skin contains perforators capable of cutaneous supply irrespective of the body part (6,7).

The design of the flap consists of two opposing V-Y advancement flaps(7,8). This unique movement of advancement gives more lax skin at the centre of the defect and also helps in better approximation of skin edges. Thus, it has minimal donor area morbidity.

Behan originally described 4 types of keystone flaps (2,8,9).

They are as follows:

- **Type I:** The deep fascia on the convex border of the flap left intact.
- **Type II:** The deep fascia on the convex border is divided.
- ✓**(Type II a)** secondary defect is closed primarily
- ✓**(Type II b)** secondary defect closed with a splint skin grafting.
- **Type III:** Double flaps one on either side of the defect.
- **Type IV:** A portion of the flap is undermined, raised in the sub-fascial plane and mobilized to facilitate easy closure.

In our centre we have used all of the above variations except type four pattern. The most commonly used being type II-b flap pattern.

(a) **(b)**

Figure 6: Patient is 32/m with Post Traumatic Raw Area of left forearm .

(a) Sizeof defect was measured. Flap planned and elevated (Type IIA). Inset given.

(b) 5 month post operative image with a well settled flap.

(a) **(b)**

Figure 7: Patient is a 52/M with Post Traumatic Raw Area with exposed fracture segment of the lower third of the left leg.

(a) Wound debridement was done, raw area made into an ellipse. The flap ratio altered to 1:3 from the classical design to adjust to the decreased skin laxity of the leg.
(b) Flap islanded and inset given. The donor area was grafted. (Type IIB flap). Flap at six months follow up.

Figure 8: 28/M Patient is a case of Post Burn raw Area (electrical arc Burn) involving anterior abdomen and post amputation stump right upper limb.
a) Keystone flap for raw area on abdomen
b) Keystone flap for raw area of stump
c) 4 month post operative image

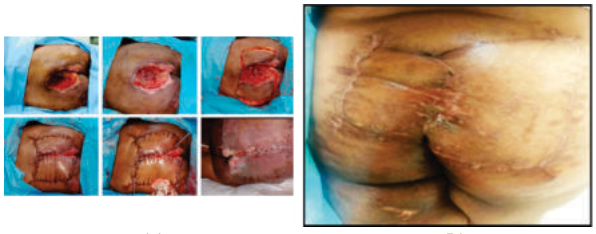

Figure 9: 59 year female patient with sacral pressure sore
(a) Underwent wound debridement and reconstruction of defect with type III keystone flap.
(b) Six month follow up picture shows a well settled flap.

Figure 10: 46 year female patient with an exposed pacemaker underwent keystone flap cover showing immediate post operative picture.

Since most of the literature on keystone flaps is focussed on the Western population, our study becomes relevant as it focuses on the Indian population. The patients in this study are mostly from lower socio economic background. In such patients, providing a sturdy flap cover with shorter hospital stay and recovery time is essential. So we saw the need to use keystone flap for various soft tissue reconstruction. In our study we have observed that the flap design is easy and with a substantially low learning curve. Hence, this method can prove to be an essential tool in the armoury of even a novice surgeon. The duration of the procedure was short and most of the surgeries could be performed under loco-regional anaesthesia. The areas with most ease of advancement were the abdomen, gluteal region, thighs and upper limb in the following order. Though leg defects were challenging, a minor alteration of the flap design proved to be helpful in the execution of the flap with good end results. Overall, with the use of this flap, a simple and elegant solution was found, with minimal donor morbidity and a shorter surgery time. It is also a viable option in extremes of ages as one can mitigate microsurgery and thus reduce anaesthesia time and its complications.

Even though a minor drawback of the flap design is that the scars extend beyond the defect, our long term follow-up showed that patient satisfaction was optimal as it was aesthetically acceptable and economically viable in terms of hospital expenditures when compared to free flaps. The shorter and easier post surgical care was also much appreciated by the patients who could return to their normal routine faster.

CONCLUSION

This case series explores the use of keystone islanded flap in a south Indian population for soft tissue defects of different parts of the body. We have been able to conclude that it gives similar tissues in terms of function, texture, colour, and sensitivity, irrespective of the area. Additionally, it has minimal aesthetic or functional morbidity of donor areas in any of the patients. It has a shorter surgical duration and a short learning curve.

Hence, it can be considered a versatile option for soft tissue reconstruction.

REFERENCES

1. Behan F, Lo C. Principles and misconceptions regarding the keystone island flap. Ann Surg Oncol 2009;16:1722-3
2. Behan FC. The keystone design perforator island flap in reconstructive surgery. ANZ J Surg. 2003;73:112–120.
3. Behan FC, Rozen WM, Kapila S, et al. Two for the price of one: a keystone design equals two conjoined V-Y flaps. ANZ J Surg.2011;81:405–406
4. Mardini S, Wei FC, Salgado CJ, et al. Reconstruction of the reconstructive ladder. PlastReconstr Surg. 2005; 115(7): 2174
5. Mohan AT, Rammos CK, Akhavan AA, et al. Evolving concepts of keystone perforator island flaps (KPIF): principles of perforator anatomy, design modifications, and extended clinical applications. PlastReconstr Surg. 2016;137:1909–1920.
6. Douglas CD, Low NC, Seitz MJ. The keystone flap: not an advance, just a stretch. Ann Surg Oncol. 2013;20:973–9
7. Behan FC, Terrill PJ, Breidahl A, et al. Island fl aps including the Bezier type in the treatment of malignant melanoma. Aust N Z J Surg. 1995;65(12):870-80.
8. Behan F, Findlay M, Lo CH, eds. The keystone perforator island fl ap concept. Elsevier Australia 2012; 3-9 Chen HC. Precautions in using keystone flap. J PlastReconstrAesthet Surg. 2010;63:720.
9. Behan FC, Rozen WM, Tan S. Yin-Yang flaps: the mathematics of two keystone island flaps for reconstructing increasingly large defects. ANZ J Surg. 2011;81:574–575.