

# Keystone Flap Type 2 A in Lower Limb Defects

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## Abstract

Lower limb abnormalities are common after traumatic injury or treatment of infected lesions on the lower limbs. The keystone flap is a novel treatment for limb deformities. It is a simple, less time-consuming, long-lasting, and easily repeatable method of reconstructing most limb abnormalities. The purpose of this paper is to investigate the utility of the keystone flap in the reconstruction of a variety of upper and lower limb deformities.

**KEYWORDS:** Keystone flap; Lower limb defects; Local island flaps.

## INTRODUCTION

Behan first characterised the keystone island flap in 2003. It's a fasciocutaneous perforator flap on the local level.<sup>1</sup> 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. The purpose of this study is to see if the keystone island flap is feasible and safe for treating various limb abnormalities.<sup>2</sup>

## MATERIALS AND METHODS

In our case report, On 5/12/21, a 17 year old kid presented with an alleged history of a road traffic collision resulting in a fractured right tibia and an avulsion injury causing a raw region over the right knee. On 5/12/21, the patient had closed reduction and external fixation for a right tibia fracture. The patient was referred from the orthopaedic department for a residual raw area over his right knee that had not healed after 54 days of routine dressing and conservative care (Figure 1).

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Fig. 1: Raw area over the right knee joint



Fig. 2: Keystone flap type 2A Intraoperative.

There is no pus discharge from the wound, which is healthy and granulating. The defect is transformed to an elliptical shape after excision or debridement to facilitate appropriate closure without cutaneous distortion. The defect's length and width are measured intraoperatively. There's also a remark about the maximum width. The flap donor location is chosen on the side of the defect with the most tissue laxity. If a single flap isn't enough to conceal the flaw, a second flap from the other side of the ellipse is indicated and kept ready. The curvilinear line of the flap outer margin is met by a 90-degree incision at either end of the ellipse. The inner arc of the keystone is formed by one side of the elliptical flaw. The flap's width is the same as the defect's width. The length of the flap is determined by the length of the elliptical excision. As before, an incision is made all the way along the flap's edge. The incision is deepened until it reaches the deep fascia, which is similarly separated all the way around the perimeter. To avoid harm to fasciocutaneous and musculocutaneous perforators, the flap border should not be undermined. If there is any strain in the suture line, minimal undermining can be done on the other side of the defect. The first stitch is placed in the centre of the flap, where the most strain exists. The remaining flap is sutured to the defect appropriately, and the 'Y' limb and the rest of the flap on the outside border are closed using normal techniques.<sup>3,4</sup> On the side of the defect with the most skin expansibility, a keystone flap should be constructed. Larger flaws or areas with less expansibility of surrounding skin may necessitate double flaps. Perforators developing from the underlying tissue allow this flap to survive (Figure 2, 3).



Fig. 3: Keystone flap

The draining of the Keystone island flap is not required on a regular basis.

## RESULTS

The Keystone flap is used extensively in this patient to close the skin defect on the lower limb. The operation has the advantages of a shorter operative time, less tissue dissection, no need for a skin graft, and reduced postoperative pain.

## 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 straight forward. 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, preoperative 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.<sup>5,6</sup>

### *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.<sup>7</sup> 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.<sup>8</sup> 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.<sup>9</sup> 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.

### CONCLUSION

The keystone flap can be utilised to repair a variety of limb abnormalities with low pain, a sensate cover, and great cosmetic results, reducing the requirement for microsurgical procedures and operational time. This case report is based on a single patient study; nevertheless, further research into the keystone flap's utility is required.

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