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Role of Regulated Oxygen Negative Pressure Therapy for Management of Keystone Design Island Flap in Lower Limb Defect

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Abstract

The keystone flap is a new flap design that has been added to the arsenal of cosmetic surgeons. The keystone flap is a type of flap that can be used to close soft tissue abnormalities using the local skin. It can be employed in a variety of situations. In the care of a keystone flap to repair a deficiency over the lower limb defect following a road traffic accident, we used closed incision negative pressure therapy.

Keywords: Keystone flap; Regulated oxygen negative pressure wound therapy; Lower limb defect.

INTRODUCTION

Negative pressure wound therapy has changed the way ofmanaging acute and chronic wounds.[1,2] Usually after primary closure of the wound, the incision site is covered with an occlusive or semi-occlusive dressing. In recent years negative pressure therapy also has been tried for wound that has been surgically closed primarily, especially in cases that are at high risk of surgical site infection (SSI).[3,4] In this article we share our experience of closed incision negative pressure wound therapy (input) in keystone flap in lower limb trauma.

Cosmetic surgeons have added a new flap design to their toolkit: the keystone flap. The keystone flap is a type of flap that repairs soft tissue abnormalities by using the local skin. It can be applied in a variety of situations. A keystone flap that was used to correct a deficit over a lower limb malformation induced by an automobile accident was treated with regulated oxygen negative pressure therapy.

MATERIALS AND METHODS

The research was carried out in a tertiary care hospital in south India after receiving approval from the institutional ethical council. The patient was a 19 year-old man who had been in a car accident and had a full thickness injury to his lower limb. On post-admission day 7, the lower limb defect was

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debrided, with loss of skin, subcutaneous tissue, and patellar tendon (Fig. 1), because the wound's size would necessitate a huge rotation flap. We opted to proceed with a keystone flap for the lower limb defect.

Flap Planning and Design: The length and width of the defect are measured intraoperatively after excision or debridement. There's also a remark about the maximum width. The flap donor location was chosen as the side of the defect with the most tissue laxity, and a type 2 keystone flap was planned (Fig. 2) One side of the elliptical defect acts as the inner arc of the keystone, and an incision at 90 degrees at either end of the ellipse meets the curvilinear line of the flap outer edge. 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.

Surgical Procedure: As previously marked, an incision was made along the flap's edge. The incision was deepened until it reached the deep fascia, which was divided around the outside border. If there is any tension in the suture line, minimal undermining was done on the other side of the defect. The initial stitch was placed in the centre of the flap, where the most strain exists. The remaining flap was sutured to the defect, the 'Y' limb was closed, and the rest of the flap on the outside border was closed using normal procedure, and closed incision wound therapy was used to heal the wound (Fig. 3). Because the patient was at such a high risk of SSI, it was decided to use a tailored RONPWT. A sterile sponge of the proper size was used. A suction tube with several holes of a small calibre was passed through it. On a closed incision site, a single layer of non-adherent gauze was applied. On the incision site, the sponge with the suction tube in place was put alongwith a separate tube for supplying oxygen. A translucent occlusive dressing that adhered to the skin was applied (Fig. 4). For seven days, steady negative pressure of 100mm Hg was applied alongwith oxygen supply of 8 litre/mt. Every day, the patient was checked for any signs of infection in the system. Every day, a clear dressing was checked for any signs of soakage, erythema, localised pain, or oedema. After 7 days, the dressing was removed and the surgical site was examined. The wound healed without incident (Fig. 5). The keystone flap can be successfully used in difficult to mould areas like the lower limb defect and utilize the local tissue available.

Fig. 1: Lower limb defect with exposed patellar tendon and bone

Fig. 2: Keystone flap-type 2 is planned for the defect

Fig. 3: Keystone flap type 2 done on the patient

Fig. 4: Keystone flap RONPT

Fig. 5: Keystone flap after complete healing

DISCUSSION

A road traffic collision is a serious injury that results in full-thickness tissue loss. The extent of harm is determined by the tissue's resistance to electric flow. Depending on the size of the defect, tiny defects can be closed primarily, moderate to medium defects require locoregional flaps, and large defects may require free flaps such as latissimus dorsi, parascaplar flaps, and others. It has the advantages of being single staged and providing consistent coverage with well vascularized tissues.[5,6]

Behan was the first to explain keystone flaps, and they were used in this case as well.[7] The keystone flap is made up of two V-Y advancement flaps that face each other. Because of the mobility of these advancement flaps, additional tissue next to the defect is available to provide the primary approximation of skin margins. Any superficial/deep venous structures or cutaneous nerves are included in the construction of the flap.[8]

Negative-pressure wound vacuum therapy is a well-known treatment for open surgical incisions that have become infected or have broken down. It has recently been the subject of new research on its use in closed surgical sites. Gomoll et al. published their results using a similarly modified incisional dressing in 2006, which was the first publication on closed incisions employing NPWT (ciNPT). Various mechanisms for NPWT have been proposed.[9]

Macroscopic Effects of NPWT

- Creates and maintains a moist wound environment, shortens time to wound closure
- Reduces wound oedema and reduces seroma formation
- Stimulates wound contracture through macro deformation
- NPWT stabilizes healing tissues through a bolstering Effect
- Provides oppositional forces to both superficial and deeper healing tissues
- Reduces size and complexity of the healing wound

Microscopic Effects of NPWT

- Increased expression of VEGF, IL-8 VEGF gradient increases toward the wound
- Vigorous angiogenesis in a parallel fashion, oriented toward the wound compared to fewer tortuous new vessels observed in controls
- Stimulates cell proliferation through micro-deformation
- Decreases local blood flow in those tissues in closest proximity to the ROCF
- Changes the colonizing flora of the wound, may increase or have no effect on overall bacterial load
- Increased neovascularization

There isa commercially available device for RONPWT. These devices are expensive for routine use in hospitalized patients. We have used a simple way of applying input cost-effectively.

Vascularity is more significantly reliant on the[10] in

the lower limb defect. The posterior larger curvature of the flap can be incised through the aponeurosis if the lateral incisions are made superficial to the aponeurosis in the subcutaneous layer. This combination of incisions allows for progression while maintaining perfusion on the side. The hairline is not affected by the keystone flap since it is closed at the posterior greater curve, unlike other local flaps. It does not require undermining, unlike most local skin flaps, and all fasciocutaneous and musculocutaneous perforators are preserved in the subcutaneous base underneath.

CONCLUSION

We have used RONPWT in keystone flap in the management of lower limb trauma and have found it to be useful. However, this is a single case report and needs a multicentric randomised control trial to be brought into clinical practice.

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