

Interpolation Pedicle Flap Technique in Wound Defect with Tibial Bone Exposed: A Case Report

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ABSTRACT

Interpolation flap is a flap constructed from nonadjacent donor tissue that carry an inherent blood supply (vascular pedicle). They are ideally suitable for reconstruction of large or deep defect. These flaps have their own blood supply therefore they are more likely to survive on exposed bone or cartilage. The use of these technique should result in a bridge of tissue, or pedicle, between the flap base and the surgical defect. A 61-years-old man admitted to the emergency unit 2 hours ago after a traffic accident. Physical examination shows crush injuries on the right lower limb with open wounds exposing the muscles, tendons, and bone. In the distal neurovascular (NVD) obtained capillary refill time < 2 seconds, limited active movement due to pain, and good sensory. After the initial treatment of external fixation and debridement, a week follow up found a wound defect on the medial side of the leg around 10 x 15 cm with tibial bone exposed as a base of wound defect. The usage of Pedicle Interpolation Flap Technique is a better choice to delayed treatment for soft tissue defect with bone exposed. The anatomy of artery is essential as a requirement to obtain the flap needed. Fine and holistic care of the flap shall increase the success rate of regaining and retaining anatomical and physiological, as well as cosmetic, and exponentially lower the probability of complications occurrence by accurate planning and hand in hand care to better strength, motion and functional outcome.

INTRODUCTION

Interpolation flap is a flap constructed from nonadjacent donor tissue that carry an inherent blood supply (vascular pedicle). They are ideally suitable for reconstruction of large or deep defect, when insufficient tissue or mobility in nearby skin prevents the coverage of a surgical defect with primary closure or an adjacent flap. These flaps have their own blood supply therefore they are more likely to survive on exposed bone or cartilage. The use of these technique should result in a bridge of tissue, or pedicle, between the flap base and the surgical defect. Interpolation flap require two stages to perform. In the first stage, the surgeon imports tissue on a vascular pedicle from the donor site to the defect. Then it must be removed after the inoculation and neovascularization between the defect and the flap has been established in the second stage.¹

Interpolated flaps are used when insufficient tissue or mobility in nearby skin or soft tissue prevents the coverage of a surgical defect with primary closure or an adjacent flap. While on the other side this method is contraindicated in patients who are unwilling or unable to tolerate multiple-staged surgical procedure. Likewise, these procedures should be avoided in patients who cannot leave their surgical sites undisturbed, or special measures must be taken to protect the sites in these patients. Actively infected skin should not be used to form a flap or covered with flap. Smoking is relatively contraindicated to the use of staged island pedicle flaps.^{2,3}

CASE REPORT

A 61-years-old man admitted to the emergency unit 2 hours ago after a traffic accident. ago due to

a traffic accident. The incident started when the man riding a motorcycle and hit by a car from the left side causing the patient to lose balance and dragged for about 3 meters, it is followed by a car run over the patient's right leg. Physical examination shows crush injuries on the right lower limb with open wounds exposing the muscles, tendons, and bone. In the distal neurovascular (NVD) obtained capillary refill time < 2 seconds, limited active movement due to pain, with good sensory.

On the first surgery, initial treatment was performed by Open Reduction External Fixation (OREF) for the bone fracture, and artery ligation for controlling haemorrhage. Skin and soft tissue coverage by primary suture, and debridement to avoid infection were performed. After the first surgery, the fracture was stable by external fixation but there was a necrotic wound with about 10 ml pus was produced. After 2 weeks follow up and wound care, the necrotic tissue was removed and leaving a defect 10 cm x 5 cm on the medial side of the leg with exposed of tibial bone.

In the second surgery, the interpolated pedicle flap technique was performed. The surgery removed 15 x 20cm pedicle flap as a donor to 10 x 15 cm defect area. The transposition by tunnelling and rotating 180° the flap over the healthy area to defect area by enclosing a branch of tibialis posterior artery (perforator artery).

2 weeks follow up after the second surgery, the defect was coverable, the fracture was stable, but the flap looked darken, a Prick test was obtained (+). Sign of inflammation was seen around the flap with swelling around flap, but no infection were seen.

A month follow up after the second surgery, the flap was become red, the signs of inflammation were not visible anymore, the defect was totally closed, the

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Table 1. Advantages and disadvantages of each flap technique.

Flap Technique	Advantages	Disadvantages
Rotational Flap	Rotational flaps are advantageous because they have a particularly wide base and thus an excellent blood supply. ^{7,8}	Rotational flaps disadvantage is that they require relatively extensive cutting beyond the defect to develop the flap, thus increasing the risk of nerve damage or bleeding. ^{7,8}
Transposition Flap	Advantages of transposition flaps include less undermining when compared to large, sliding flaps and superior ability to displace tension away from the defect and any nearby free margins, as well as to reorient tension vectors in more favorable directions. ¹¹	Necrosis of the tips of the flaps and formation of undesirable scars. ¹²
Interpolation Flap	The robust blood supply, which can be either axial or randomly based, and the maintenance of the integrity of facial landmarks. ⁹	The frequent need for a multistage procedure, which eliminates some patients from consideration. ⁹
Advancement Flap	Advancement flaps are a relatively easy way to reduce wound tension, which, in turn, reduces the risk of perioperative wound edge necrosis, dehiscence, and scar widening. Advancement flaps can also provide excellent cosmetic results. These flaps allow for excellent matching of skin color, texture, and thickness. Furthermore, when advancement flaps are planned judiciously, the resulting scars can be well hidden in natural boundary lines. ¹⁰	Advancement flap provide relatively little movement compared with other types of flaps and occasionally result in large, geometric scars that may be difficult to conceal. ¹⁰



Figure 1. Clinical picture of the injury at emergency room.



Figure 2. Clinical picture after open reduction external fixation was performed (2 weeks after 1st surgery).



Figure 3. Clinical Picture after interpolated pedicle flap surgery (2nd surgery).

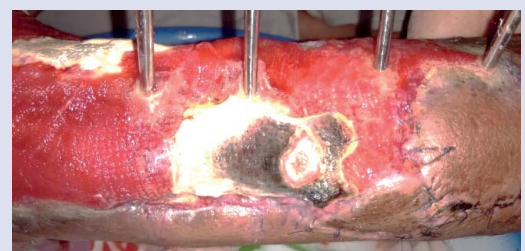


Figure 4. One week observation after interpolated pedicle flap was performed.



Figure 5. A month after interpolated pedicle flap was performed.



Figure 6. Three months after interpolated pedicle flap surgery.

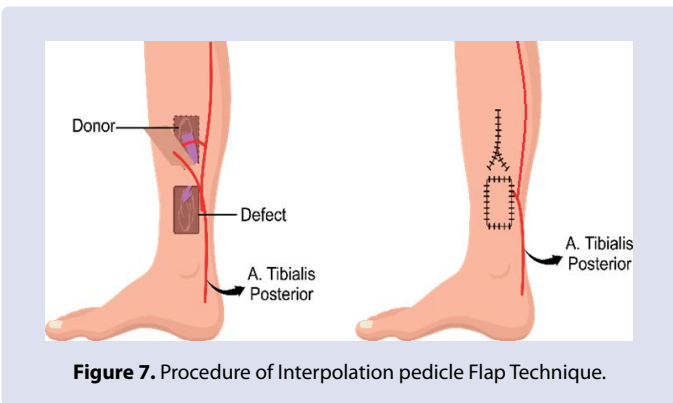


Figure 7. Procedure of Interpolation pedicle Flap Technique.

fracture was stable by external fixation, a Prick test was obtained (+), and no signs of infection were seen.

3 months follow up after the second surgery, a fracture partial union was performed, the external fixation has removed, the flap seemed to blend with the surrounding tissue, and no defects were seen. An area of 10 x 5 cm still uncovered with skin but still in a healthy condition, signed by redness over the area

DISCUSSION

A flap is a piece of tissue that has an integral blood supply at the end of surgery. Flap can be used to:

- cover poor recipient beds
- cover joint contractures
- cover open fractures or joints
- import blood supply in infected or irradiated wounds
- reconstruct specific structures

Composite flaps (combinations of skin, bone, nerve or tendon) have been described but, in general, the more things you ask a flap to do, the less well it does any of them.⁴

The pedicle flap, commonly used by surgeon in the reconstruction of skin and soft tissue defects, differs from the so-called free skin graft in two ways: first, it consists of all of the layers of the skin, with a significant amount of attached fat and subcutaneous tissue; and second, it carries its own blood supply from one or more segments of its periphery. In

this case, we use perforator artery of posterior tibial artery within the flap⁵

In general, it can be said that the pedicled flap should be used in preference to some other type of replacement material wherever skin coverage plus additional soft tissue with or without new blood supply are required. For example, defects over bony prominences such as the elbows and tuberosities of the ischium, where the possibility of damage to the covering structure is significant, require soft tissue padding in addition to the superficial skin.⁵

Avascular tissues such as bone and cartilage are usually unable to support a free skin graft. Their coverage is best obtained by means of pedicles carrying their own blood supply. The repair of severe, chronic, radiation lesions in which deep scarring makes total excision impossible, presents the same problem because of severe loss of vascularity.⁵

The posterior tibial artery passes posterior to the popliteus muscle and pierces the soleus muscle. The posterior tibial artery then descends between the tibialis posterior and flexor digitorum longus muscles. The posterior tibial artery supplies blood to the posterior crural compartment. The artery can be palpated posterior to the medial malleolus to examine for peripheral artery disease. The posterior tibial artery divides into the medial and lateral plantar arteries at the level of the talus. The medial plantar artery is much smaller than the lateral plantar artery and supplies blood to the medial plantar side of the foot. The lateral plantar artery supplies various areas of the heel and lateral plantar side of the foot. At the bases of the first and second metatarsal bones, the lateral plantar artery anastomosis with the dorsalis pedis artery completing the only arterial plantar arch in the foot. The plantar arch provides blood supply to the plantar toes and foot.⁶

The keypoint of this case are how to preserve an artery circulation within the flap and prevent the flap of being infectious by well hand in hand care of the wound. The strengthens of the flap has to maintain by adequate and clean with a moist-sterile condition. The perforator branch should be selected as close as possible to the defect as this denotes the pivot point of the flap. The length of the planned flap is designed and this should correspond to the distance of the pivot point to the furthest edge of the defect. Similarly, the width of the planned flap is determined based on the width of the defect. Design of the flap should also take into account the shape and overall dimensions of the defect. The commonest islanded perforator flap design in the lower limb is the twin-bladed propeller (two blades of unequal sizes). The perforator itself is located at the junction of the two blades with the distal blade representing the skin separating the perforator and the edge of the defect. 180° rotation of the propeller around the axis of the perforator allows the larger proximal blade to cover the defect. The distal blade allows partial or complete closure of the defect left behind by the proximal blade. The other islanded perforator flap designs are used less frequently. In a VY advancement flap, the island is advanced instead of rotated. Unlike the perforator in a propeller flap that needs to be twisted, the perforator in a VY flap is only mobilized and advanced thus reducing the risk of venous congestion. Another advantage of the VY advancement flap is the ease of linear closure of the donor site. The main disadvantage of the VY advancement flap is the limited advancement. The keystone flap is based on a double opposing VY flaps and once again has limited advancement. Hereby the illustration of the interpolation flap:

This technique was performed by numerous criteria based on anatomy and indication and clinical state of the patient. The advantage/disadvantage of each flap technique shown below:

CONCLUSION

The usage of Pedicle Interpolation Flap Technique is a better choice to treat soft tissue defect with avascular wound base. Particularly an

exposed bone. Knowledge of the artery anatomically is essential as a requirement to obtain the flap needed. Fine and holistic care of the flap shall increase the success rate of regaining and retaining anatomical and physiological function, as well as cosmetic. Accurate planning and hand in hand care with better strength, motion and functional outcome will lower the probability of complications occurrence.

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