

Soft Tissue Coverage at the Resource-challenged Facility

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Abstract Covering soft tissue defects remains challenging for orthopaedic surgeons, especially those in resource-challenged facilities. Covering tissue defects follow a plan from simple to complex: primary closure, local flap, area flap, pedicle flap, and free flap. I will limit my discussion to the role of latter two. At the district-level hospital in Vietnam, pedicle flaps are generally more useful, so I will discuss free flaps only briefly. The choices of pedicle flaps include: kite flap, posterior interosseous flap, radial flap (Chinese flap), neurocutaneous flap, anterolateral thigh fasciocutaneous flap, gastrocnemius flap, sural flap, posterior leg flaps; we typically use a free flap with the latissimus dorsi. Soft tissue coverage with pedicle flaps has many advantages: reliability, relatively easy harvest, and good blood supply. Free flaps with microanastomosis have an important place in covering difficult medium- or large-sized soft tissue defects but also require more instruments and more highly trained surgeons.

Introduction

Soft tissue defects are encountered in many situations: trauma, reconstruction, oncology, neurosurgery, and head and neck surgery. Treatment of soft tissue defects is often challenging for surgeons not specifically trained in plastic surgery who nonetheless must manage these problems. In Vietnam, there are many cases of soft tissue defects caused by traffic accidents. Most traffic accidents involve motorcycles. In 2005, there were over 14,000 traffic accidents and motorcycles made up 73.4% of them. Many of the worst accidents happen in rural or provincial areas where there are not enough specialized medical doctors or appropriate medical facilities to treat them. Almost all of these patients with serious trauma are first stabilized and then are transferred to a city hospital.

In developing countries, soft tissue defect reconstruction, when performed at all, is typically done by plastic surgeons familiar with high technology equipment. In Vietnam, the field of plastic surgery began only in the 1970s and for many reasons did not develop as well as other surgical specialties. Soft tissue defects, therefore, were usually treated by general surgeons, neurosurgeons, and orthopaedic surgeons. Free flaps, pedicle flaps, and modern techniques were normally used in the big hospitals, almost of which are in the big cities. Many patients come to the large city hospitals after long-term treatment in hospitals that do not have the needed resources and equipment to resolve complicated wounds. Many of these cases could be resolved simply and with good outcomes on a more local level if the surgeons at the smaller facilities were trained in the use of pedicle flaps and the principles of basic soft tissue coverage.

The principles of basic soft tissue coverage include proper surgical débridement, early and appropriate

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antibiotics, immobilization of fractures when present, filling dead space, drainage when indicated, and coverage of the wound with appropriate material such as skin flaps or muscle with a good blood supply. The priorities include closing the wounds as soon as possible by primary or secondary closure, restoring anatomy, and restoring function. The approaches from simple to complex are: primary closure, local flaps, skin grafting, pedicle flaps, and finally free flaps.

The pedicle flaps and free flaps require advanced knowledge. The flap is as a unit of tissue transferred from one site (donor site) to another site (recipient site) while maintaining its own blood supply including large blood vessels and also the network of small vessels. Flaps include skin, muscle, bone, or a composite (muscle-skin, muscle-bone). The pedicle flap retains its attachment to its normal blood supply. A distally based pedicle flap is one in which the blood in the pedicle flows in the reverse direction as the original, especially a vein. Free flap (or free tissue transfer) are those in which tissue is transferred from one site of the body to another without retention of the original blood supply and which required microanastomosis.

The distally based pedicle flap was introduced in 1981 by Chinese surgeons using a radial reverse forearm flap. This opened a new chapter in flap reconstruction. Today, reverse flaps provide a solution for many difficult cases. I have used many of distally based pedicle flaps to cover tissue defects, and believe it very useful in extremity reconstruction.

Pedicle Flap

Upper Extremity

Radial reverse forearm flap or Chinese flap [3, 4, 6, 8] (Fig. 1). The indication is coverage of defects of the hand (palm or dorsal) or forearm, especially for thumb when used as a distally based pedicle flap. The defect at distal part of arm or elbow provides the source for a proximally based pedicle flap; this flap can also be used as a free flap. It is only used if the Allen's test is positive, ie, the ulnar artery can supply the blood to the hand. This flap is reliable, provides a large amount of material to cover, and is easy to harvest. A disadvantage is that it sacrifices the main vessel for hand and forearm.

Posterior interosseous flap [7] (Fig. 2). This flap is used to cover defects of the hand and thumb. The flap can reach to the proximal phalanges of the digits. The vascular supply is based on the posterior interosseous artery, originating from the ulnar artery. This flap is more difficult to harvest than the Chinese flap due to the presence of the posterior interosseous nerve.



Fig. 1A–B A skin defect with exposed tendons at the dorsum of hand due to IV transfusion (A) was repaired with a Chinese flap. (B) The 2-week postoperative result is shown.

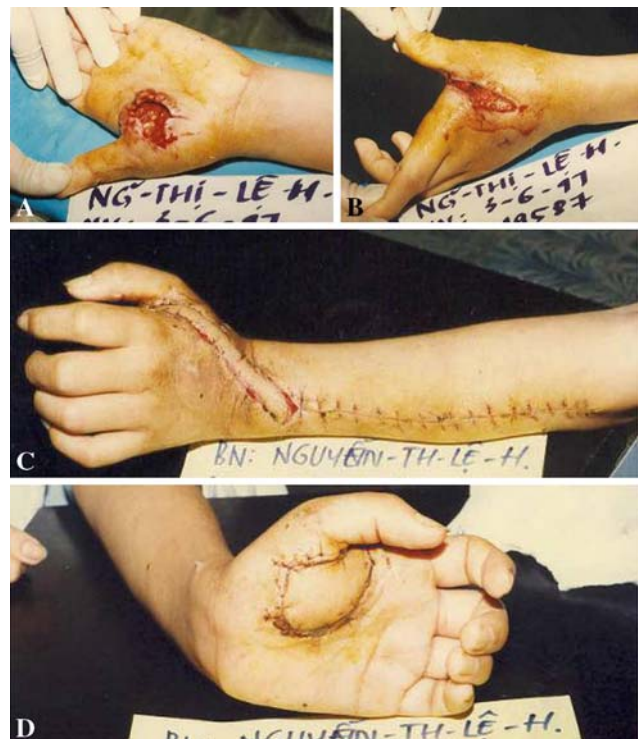


Fig. 2A–D This skin defect at the (A) palm and (B) dorsum of hand occurred from a snake bite. (C) A posterior interosseous flap was used to cover the defect. (D) The results at 10 days are shown.

Neurocutaneous flap at forearm [1, 2] (Figs. 3–5). A neurocutaneous flap has the same indications as a Chinese flap. The pivotal point is about 4 cm proximal from the radial styloid. Advantages are its large skin area, the ease of dissection, and the preservation of main blood vessels. The disadvantage is the uncosmetic appearance due to the wide pedicle (2–3 cm) and the need for skin grafting to donor site when get a large flap.



Fig. 3A–C A neurocutaneous flap was used to cover soft tissue defects at the dorsum of hand. The technique entails (A) designing the flap on the anterolateral part of forearm, (B) harvesting the flap without radial vessels, and (C) and covering the defect.

Fig. 4A–B (A) This injury from a traffic accident was repaired using a neurocutaneous flap to cover the dorsum defect on the hand. (B) The 6-month postoperative results are shown.



Fig. 5A–B A neurocutaneous flap was used to cover this defect after (A) bone was exposed after the hand sustained trauma from a press machine. (B) The result at 8 months is shown.



Fig. 6A–C (A, B) An open fracture of the femoral condyle with a bad scar on the lateral site of knee occurred due to a traffic accident. The scar was excised and ATFF was used to cover the skin defect. (C) The result at 5 weeks is shown.



Lower Extremity

All of these lower extremity flaps are characterized by ease of use.

Anterolateral thigh fasciocutaneous flap (ATFF) [8, 9] (Fig. 6). This flap can be used as pedicle or free flap. The proximal based pedicle flap can cover defects at lower abdominal and peritoneal area; in another way, the distally

based pedicle flap can cover distal part of femur or knee. The free flap is used when a large area needs to be covered. The descending branch of the lateral femoral circumflex artery originating from the profunda femoris artery provides the blood supply.

Sural flap [6] (Fig. 7). The sural flap, based on the vessels of the sural nerve, is used to cover defects at the heel and posterior part of ankle. The pedicle is small at 1 to

2 cm. The anastomoses at the distal part of leg between the peroneal artery and vessels of sural nerve must be intact. The most distal one is located at three-fingers breadth from the tip of lateral malleolus (pivotal point). A disadvantageous is the sacrifice of the sural nerve.

Posterior fasciocutaneous flap at the leg (Fig. 8). This flap is used for the same indications as the sural flap, but can cover large defects. The pedicle is about 3 to 4 cm. Advantage: Can get the skin flap reaching to popliteus. Usually the sural nerve is sacrificed.

Posteromedial fasciocutaneous flap [8] (Figs. 9, 10). Also used for the same indications as the sural flap, the

posteromedial fasciocutaneous flap is based on the septocutaneous vessels from the posterior tibial vessels. The sural nerve is preserved.

Free Flaps

Free flaps have good blood supply and are not restricted in distances to the donor sites as are the pedicle flaps; this allows many more choices of donor locations. However, the hospital must have a trained microsurgery team, appropriate facilities with microscope or loupe, and

Fig. 7A–B (A) The patient had a chronic ulcer form on the lateral side of the leg after a traffic accident. A sural flap was used to repair the skin defect. (B) Pictured are the results at 3 weeks.



Fig. 8A–B (A) The heel and posterior part of ankle were injured in a traffic accident. The tissue defect was repaired with a posterior fasciocutaneous flap. (B) The result at 5 days is shown.



Fig. 9A–B (A) This chronic ulcer at the median malleolus formed after a burn. (B) The result of using a posteromedial fasciocutaneous flap is shown at 9 months.

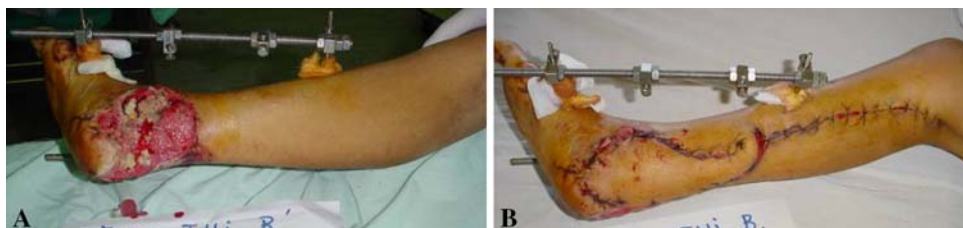
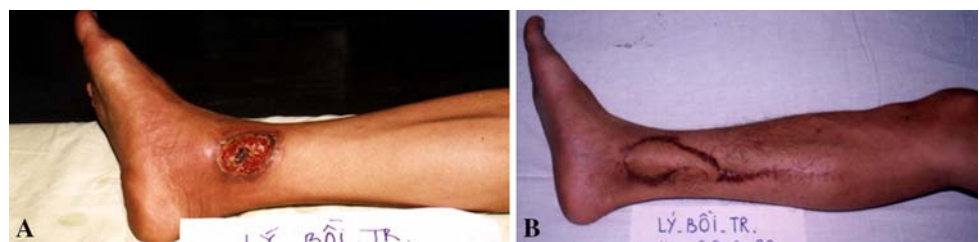


Fig. 10A–B (A) The patient sustained tissue damage at the medial and posterior part of ankle after a traffic accident. The defect was repaired with a posteromedial fasciocutaneous flap. (B) The results after 9 days are pictured.

Fig. 11A–B (A) This tissue defect on the lateral side of the left ankle and foot was caused by a traffic accident. (B) The results 2 months after a latissimus dorsi free transfer are shown.

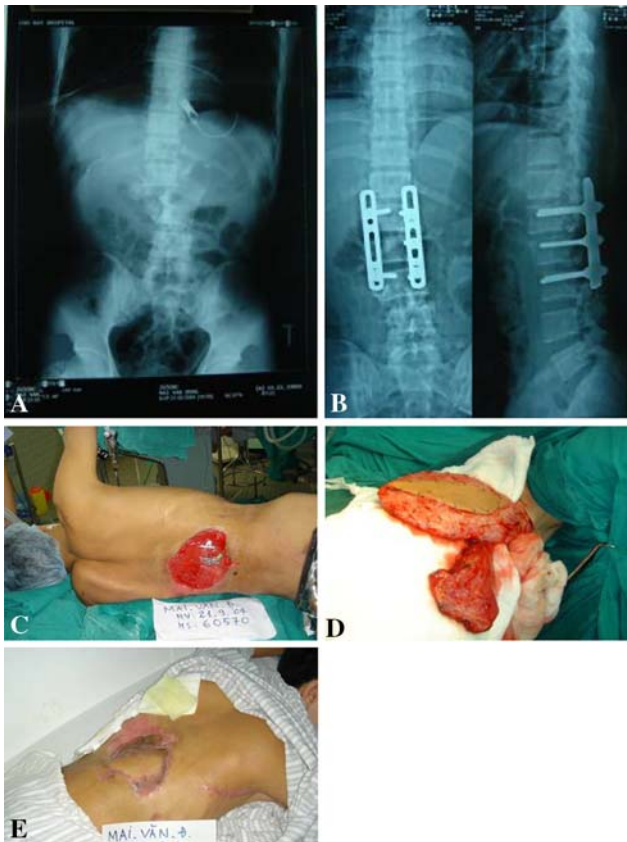


Fig. 12A–E Radiographs of an (A) open, dislocation fracture of the lumbar spine and (B) its fixation with plates are presented. (C) The hardware and bone were exposed revealing a big hole under the skin. (D) A composite flap of skin, latissimus dorsi, and serratus anterior was used to fill and cover the defect. (E) The result at 7 weeks is shown.

microsurgery instruments. This is often not possible in resource-challenged areas. In Vietnam we hope these facilities will be available at the province hospital in the foreseeable future, but they are not currently available. Free flaps are used for coverage of medium or large defects when local or area tissue is not good. The patient should be in stable condition.

Latissimus dorsi flap [3, 5, 6, 8] is a useful and multipurpose choice (Figs. 11, 12). This flap can be either a free flap, pedicle flap, or composite flap (eg,

scapular flap, serratus anterior flap, scapular bone flap). It is used to cover large defects, can be molded to cover any shape and fill in defects, and provide coverage to exposed joints or more than that can be transferred to regain flexion (e.g., the elbow). It has a reliable blood supply from the thoracodorsal artery and provides the largest soft tissue coverage and good material. Further, it is easy to harvest.

Discussion

Pedicle flaps are the frequently the best way to resolve major soft tissue defects because they have a good blood supply and can be performed by surgeons of varying skill. The pedicle flap is especially useful for the provincial hospital where there are no plastic surgeons and no specialized instruments. More importantly, the technique is easy to master. Distally based pedicle flaps have great importance in limb reconstruction. In many cases simple pedicle flaps, such as Chinese, neurocutaneous, ATF, or sural flap, can be the best choice for general surgeons or orthopaedic surgeons.

Advantages of pedicle and free flaps are that the wound can be closed at any time; they fill defects and dead space; have good blood supply (muscle flaps better than skin flaps); and provide good material for coverage. Such soft tissue coverage is important to prevent infection.

Soft tissue defects are usually caused in traffic accidents, of which we have many in Vietnam. Almost all cases are first treated in provincial or district hospitals. Many of these cases have complicated wounds that need to be covered or closed as soon as possible. In most of those cases, the surgeons at provincial hospitals could easily treat the patients if they were trained in the principles of basic soft tissue coverage and built good knowledge about the use of flaps (especially pedicle flaps). This would reduce the number of patients transferred to the city hospitals, which would provide better patient outcomes, save time, and be more economical for patients and society.

Treating soft tissue defects at the district hospital level in Vietnam would require the help of the government,

health ministry, hospitals, and surgeons. Training courses, workshops, and seminars about soft tissue defect treatment with guidance from surgeons trained in and experienced with the use of flaps from city hospitals or from overseas specialists are needed. The medical universities also need departments of plastic surgery or alternative ways to teach the principles of plastic surgery. Providing such training would greatly enhance the treatment of patients with major soft tissue injuries while allowing treatment at the district or provincial levels.

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