Soft tissue coverage of lower and upper extremity wounds following either blunt or penetrating trauma of the extremities has been historically within the domain of the plastic and reconstructive surgeon. In 2018, because of the work of Levin and others, it is generally accepted that any technically proficient surgeon with the appropriate anatomical knowledge can perform innovative and interesting flaps for the soft tissue coverage of extremities. In order to undertake these challenging surgical cases, it is necessary for the treater to be able to 1) assess a wound and its capacity to heal (with an appropriate and acceptable final outcome) in the absence of surgical intervention- that is, to be able to discern the natural history of the wound in question, 2) identify all options available for the coverage of a complex wound, and 3) choose the most appropriate option given the personality of the defect. This third consideration is surgeon, and surgical-philosophy, dependent.

It is helpful to ask the following five questions in order to arrive at an understanding of whether or not surgical coverage of a wound is needed, and also what would could and should be used either locally or from a distant autologous source, to achieve stable coverage. First: Where is the defect? This sets the tone of the discussion to follow, as there will be different local soft tissues available for coverage of a wound of similar size, depth and exposed underlying tissue type about the anterior aspect of the patella as for the anteromedial distal tibia, for example. Second, What is at the base of the defect? Whereas exposed cortical bone with extensive stripping of the overlying periosteum or of tendon devoid of epitenon present obvious necessities of some form of flap coverage, what about an exposed arteriovenous bundle or major peripheral nerve? Even though these structures could potentially support non-vascularized tissue in the form of a split thickness or a full thickness skin graft, it could be argued that secondary procedures on extremities treated this way would be at greater risk of complication and injury to the neural or vascular structures in question. Third, Does the tissue at the base of the defect need to be covered? If the patient is in generally good health, and the wound (if allowed to heal by secondary intention) would not lead to any short or long-term complications, then is there a compelling reason to incur the potential complications of surgical intervention when the natural history of the wound itself might be benign? Fourth, if flap coverage is deemed necessary, what local tissue is available? The local tissue should be outside of the zone of injury, should be soft and compliant, and should be well vascularized. Additionally, its blood supply should be sufficiently well understood (in the case of both muscle flaps and fasciocutaneous flaps) that it can be transferred in a reliable way. Finally, if there is no local tissue that is available for the coverage of the wound, what available distant tissue is suitable? In the lower extremity, distant tissue usually takes the form of free tissue transfers whereas in the upper extremity, it can take the form of either a free tissue transfer or a pedicled axial pattern or perforator dependent flap from the trunk or the abdomen.

A split thickness skin graft (or a full thickness skin graft, although far less frequently) can be utilized to cover muscle, well-vascularized fascia or tendon, as well as possibly peripheral nerve and blood vessels (although, as mentioned earlier, it might be ill-advised given the long term considerations of the reconstruction required eventually). A negative pressure wound device can be helpful to provide suction and application of the graft to an irregular bed, but is not mandatory in all situations. The author prefers grafts of 0.015 inch thickness meshed to a 1:1.5 ratio.

A local flap consisting of skin plus fascia or of muscle should be considered when the defect cannot or should not be closed primarily, should not be allowed to heal secondarily, and cannot (or should not) support a skin graft. In the lower extremity, local muscle flaps that are utilized commonly include the medial gastrocnemius, lateral gastrocnemius, anterograde soleus and retrograde peroneus brevis muscles, as well as propeller flaps based on either the posterior tibial artery or peroneal artery perforators, the reverse sural fasciocutaneous flap, and Keystone flaps based on perforators of medial and lateral sural arteries as well as the major named longitudinal running AV bundles.

A distant flap (although not a free tissue transfer) can be considered for soft tissue defects of the upper extremities wherein local tissues are unavailable and free tissues might be contraindicated. Flaps that have been well-described for hand and forearm coverage include the groin flap as well as flaps based on the peri-umbilical arteriovenous perforators such as the so-called PUP ('peri-umbilial perforator') flap. Since the non-random nature of the arterial supply of the skin has been appreciated and investigated over the past several decades, so-called "random" abdominal wall and chest wall flap design is eschewed in favor of flap design based on audible perforator vessels that can be identified at the flaps' base. These pedicled flaps are typically divided after three to four weeks of vascularization from the peripheral site of flap attachment.

Finally, free tissue transfer is considered when the defect cannot be closed primarily, should not be allowed to heal secondarily, cannot support a skin graft, and when local or distant tissue of sufficient amount or suitable quality and compliance is not available. The most frequently utilized fasiocutaneous flaps used in 2018 are doubtless the anterolateral thigh flap (based on perforators from the descending branch of the lateral femoral circumflex arteriovenous pedicle), the radial forearm flap (based on the radial artery), and the lateral arm flap (based on the posterior radial collateral artery.) Muscle flaps used commonly include the latissimus dorsi muscle flap (based on the thoracodorsal artery), the gracilis muscle flap (based on a branch of the medial circumflex femoral artery) and the rectus abdominis flap (based on the deep inferior epigastric artery.) Advantages of free tissue transfer include a wide variety of available tissue types, the potential availability of a large amount of composite tissue, and the fact that a wide range of tissue characteristics are available, including skin tone and hair-bearing capability. The main disadvantages of free tissue transfer are that it is time consuming and technically demanding, is of greater expense operatively, and has the potential for distant donor site complications such as seroma, hematoma and neuroma development.

To summarize, it is the author's firm belief that orthopedic surgeons can, and should, cover their own wounds. All that is needed is surgical inquisitiveness, anatomic understanding, and technical proficiency. All trauma surgeons have there, in surfeit.

Selected Readings

The Concepts of Propeller, Perforator, Keystone, and Other Local Flaps and Their Role in the Evolution of Reconstruction. Mohan AT, Sur YJ, Zhu L, Morsy M, Wu PS, Moran SL, Mardini S, Saint-Cyr M. Plast Reconstr Surg, 2016 Oct;138(4):710e-29e.

The distally based sural flap. Follmar KE al. Plast Reconstr Surg, 2007 May;119(6):138e-148e.

Experience with peroneus brevis muscle flaps for reconstruction of distal leg and ankle defects. Bajantri B et al. Indian J Plast Surg, 2013, 46(1), 48-64.