

## EDITORIAL

# Flaps Insetting and Stabilization with External Fixation in Lower Limb Reconstruction: "Thinking Outside the Box"

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Orthopaedics and plastics may resemble "acid and base". But orthoplastic surgery is neither "acid" nor "base". Orthoplastic surgery may resemble "salt". And the future of orthoplastic surgery is dependent on further integration of these two fields.

**Keywords:** flap; inferior limb; external fixation; orthoplastic

Lower limb reconstruction, after traumas or oncological scenarios, is still technically challenging and requires surgeons with orthoplastic skills or a team of orthoplastic surgeons capable of handling combined osseous and soft tissues injuries [1].

The basic principles of external fixation and flaps (pedicled or free) coverage should be fulfilled treating these pathologies; decision toward limb salvage of the severely traumatized or the oncological lower limb is followed by the orthoplastic approach with skeletal and soft tissue reconstruction [2]. Gopal et al. described this as "fix and flap" [3].

Nonetheless we have to think outside the box to reach out a real new orthoplastic approach, melting the basic rules of the two disciplines in order to advance and manage challenging limb threatening conditions, even if initially might seem as the wrong treatment option.

Open fractures require urgent surgical debridement of bone and soft tissues with fracture stabilization according to Damage Control Orthopedics principles (DCO); after debridement surgeons must evaluate tissue defects and plan reconstruction and/or revascularization [4, 5].

Techniques available for reconstructing bone defects include grafting (small defect < 6 cm), microvascular osteocutaneous flap (fibula, iliac crest, scapula) and Ilizarov's distraction osteogenesis (defects > 6 cm); in any case external fixation is needed and positions of pins and rods must be planned accordingly to obtain both bone stability and soft tissue reconstruction.

External skeletal fixation (ESF) as a means of fracture stabilization is defined as the placement of pins transversely into bone which are then held in place by extracutaneous fixation.

External skeletal fixation systems consist of 3 primary components: fixator pins that are inserted transversely into the bone, an extracutaneous "connecting bar" to span the fixator pins, clamps or some other means to firmly connect the pins to the bar.

External fixation is an essential part of 'damage control orthopedic surgery' in polytrauma as it permits rapid stabilization of fractures with minimal additional (surgical) injury. Deformity correction and bone transport are also possible with external fixation by means of the Ilizarov method.

The use of external fixator to assist in the postoperative regimen for free flap coverage in lower limb reconstruction for three main reasons: it prevents motion and deformity of the leg, it maintains extremity elevated without risks of pressure sores in the leg and it is important in bone stabilization in open fractures.

Skeletal stability is the basis for all other reconstructions as well. Just as microsurgery has had a great impact on orthoplastic surgery, the impact of thin wire fixation (the Ilizarov technique) has had a very profound influence on lower extremity and some upper extremity reconstructions. The ability to perform distraction osteogenesis or angular correction of bony deformity and juxta articular deformities, has had a great impact on limb salvage, in providing functioning extremities. This is a very powerful tool, that when it is combined with microsurgery can serve well the needs of injuries and elective reconstruction of the lower extremity.

Furthermore, the treatment of bone tumors in the lower extremity has been treated by the orthoplastic approach; also the use of simultaneous free flaps with tumor extirpation and allograft as well as use of the Ilizarov technique has provided salvage to patients that would have previously undergone amputation [6].

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Protected elevation is a critical component of postoperative care, particularly in posteriorly-located free tissue flaps of the lower extremity; prevents or traction pressure of the vascular pedicle and facilitates successful skin graft take [7].

Common off-loading devices/techniques (heel cushions, specialized mattresses, pressure-relieving ankle-foot orthoses, prone positioning) are difficult to apply and burdensome.

Simple bar external fixator has some advantages, including ease of application and simplicity of construct [7]. Thin-wire ring external fixator allows for mobility of hip and increased patient comfort, more easily mobilized by nursing staff for hygiene and skin checks and bedside removal of thin wires better tolerated.

Management of the injured soft tissue should not err on the side of conservatism, debridement should be adequately performed. Soft tissue defects of thigh are usually covered by regional muscle flaps (rectus femoris, vastus lateralis medialis, sartorius, gracilis, etc) or flaps from adjacent areas (VRAM or TRAM flaps) [8–10].

Regional flap options are less abundant as we move distally in the leg; pedicled gastrocnemius flap (mainly medial head) is the workhorse around the knee and the proximal third of lower leg [11]. Soleus muscle based proximally is the workhorse flap for the middle third, other options are possible only for small defects (sural flap, lateral supramalleolar flap, peroneus brevis flap mainly for distal third) [12]. Middle third and distal third of lower leg usually require a free tissue transfer; the workhorse flaps include latissimus dorsi, rectus abdominis, serratus anterior, anterolateral thigh flap; fibula flap if bone needed, and omentum flap for big circumferential defects of the leg [13].

Local tissue transfer are mainly utilized for small defects of the foot, non weight bearing defects can be covered with skin grafts, while large defects in weight bearing zones require free flaps [14].

In cases of the vascular compromised limb the arterial anastomosis with healthy vessels must be executed, directly or by a venous bypass beside a free flap.

Free flaps in lower limb reconstruction include some basic principles that must be respected to be successful: anastomosis should be located outside the zone of injury, directly or by venous bypass or arteriovenous fistula; end to side anastomosis should be performed to preserve distal blood flow. External fixators should not interfere with microsurgical steps or vice versa, anastomosis should be planned thinking about which kind of bone fixation is necessary.

If we keep in mind these basic principles of traumatology and reconstructive surgery [15], a great number of cases could be fixed; but what we can do for the rest?

Let's think about the box, first, and then let's figure out how and whether to climb out of it. What is the box in lower limb reconstruction? The box is a frame, the traditional way of thinking about a problem in order to get a solution; the basic principles listed above can be considered our box.

Standard operating procedures includes damages, problems and solutions trying to pick the best one for each problem. That's in the box thinking. That is an orthopedic

approach and a plastic/reconstructive approach; if this to field do not melt the entire problem might not be solve which leads to a useless limb.

With a solid basis (basic principles) we should be creative and innovative.

Once we climb outside the box, all sorts of possible surgical solutions emerge.

Getting outside the box means analyzing the problem from a different perspective, and finding a solution looking at it from two sides melted in a new orthoplastic approach.

In conclusion orthopaedics and plastics may resemble "acid and base". But orthoplastic surgery is neither "acid" nor "base". Orthoplastic surgery may resemble "salt". And the future of orthoplastic surgery is dependent on further integration of these two fields.

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### Guarantor

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