Orthoplastic Approach to Limb Salvage: The University of Pennsylvania Fellowship Experience

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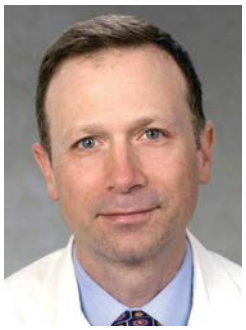
Orthoplastic Limb Salvage Faculty



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Reconstruction of complex extremity defects is a challenge for both Plastic and Orthopedic surgeons. Effective management and good patient outcomes rely on joint expertise, meticulous planning and a collaborative surgical approach. Despite being advocated as early as 1993, Orthoplastic limb salvage has not been universally adopted and remains the exception, rather than the norm.1 In most university healthcare centres worldwide, bony and soft tissue components of extremity wounds are being management separately, with little communication between the Orthopedic and Plastics teams and without clear inter-departmental treatment guidelines.

The Orthoplastic and Limb Salvage Surgery fellowship at the University of Pennsylvania is a new and unique training program aimed at bridging this gap. It provides graduating Plastic and Orthopedic surgeons the necessary skills and knowledge to develop a dedicated Orthoplastic division at their home institution. The fellowship covers the entire spectrum of extremity pathologies, including open fractures, chronic infections and osteomyelitis, infected prosthesis, post-extirpative defects, diabetic wounds and vascular wounds. In addition, aesthetic microvascular soft tissue resurfacing, vascularized bony reconstruction of hip avascular necrosis and vascularized composite allotransplantation of upper extremities are covered.

From the Orthopedic perspective, the fellow is exposed to the principles and techniques of skeletal stabilization using external fixation devices, internal fixation systems and intramedullary nailing. In addition, the fellow becomes accustomed to the surgical management of bone and joint infections and the use of antibiotic beads and spacers. From a reconstructive standpoint, restoration of segmental bone defects of using bone grafting and autologous free osseous flaps are implemented. Lastly, in case of failed salvage or patients not being candidates for complex reconstructive procedures, the Fellow is exposed to below knee amputations along with ancillary procedures such as targeted muscle reinnervation and regenerative peripheral nerve interface, which have been shown to decrease neuromas and phantom limb pain. 2

From the Plastic Surgery perspective, the fellow is exposed to the principles and techniques of adequate soft tissue debridement and coverage. There is ample opportunity to utilize the full spectrum of reconstructive techniques, ranging from local flaps, to regional flaps to microvascular free tissue transfer. The reconstructive elevator principle is applied to each case, warranting consideration of all reconstructive options, and choosing the one most likely to achieve the best long term functional as well as aesthetic outcomes.

In nearly 20 weeks of Fellowship, I participated in 26 flap procedures for extremity coverage, including 24 free and two pedicled flaps. The etiology of wounds stemmed from chronic infection / osteomyelitis (9), post trauma (9), infected prosthesis (4), post extirpative (3), diabetes (1). The wounds were located all over the body, including the arm (1), elbow (3), forearm (4), hand (3), knee (3), leg (7) and foot and ankle (5). This allowed familiarization with most major recipient sites, including the brachial, radial and ulnar arteries in the upper extremity and femoral, posterior and anterior tibial arteries in the lower extremity. Flaps consisted of the ALT (13), latissimus dorsi (6), lateral arm (3), radial forearm (1), medial femoral condyle (1), second toe (1) and gracilis (1). Harvesting these flaps provided invaluable experience in perforator dissection and subsequent microvascular

anastomosis, both under loupe magnification and the operating microscope. Limb salvage was successful in all but one patient, who developed persistent distal ischemia due to poor microcirculation, caused by end stage renal disease and poorly controlled diabetes.

In summary, this one-of-a-kind fellowship provides the necessary knowledge and skill in both Plastic and Orthopedic surgery aspects of limb restauration to successfully implement the Orthoplastic approach at an outside institution and develop a designated centre for limb salvage. Due to the complexity of these cases and the many intricacies and nuances they involve, the Penn Orthoplastic and Limb Salvage Fellowship program is an invaluable experience for anyone seeking to push the boundaries of extremity reconstruction.

References

1. Levin LS. The reconstructive ladder. An orthoplastic approach. *Orthop Clin North Am.* 1993 Jul;24(3):393-409.

2. Woo, SL, Kung, TA, Brown, DL, *et al.* Regenerative Peripheral Nerve Interfaces for the Treatment of Postamputation Neuroma Pain: A Pilot Study, Plastic and Reconstructive Surgery—Global Open: December 2016 (4);12:e1038.