Orthoplastic Limb Salvage Division

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Orthoplastic Limb Salvage Faculty

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The Penn Orthoplastic Limb Salvage Center (POLSC) continues to grow strong after four years since its official launch in 2018. Limb reconstruction has been around for ages, but the POLSC officially combines the close collaborative efforts of both orthopedic and plastic surgery into one program to deliver efficient and streamlined care for patients. Dr. Stephen Kovach, Dr. Scott Levin, and Dr. Samir Mehta continue to be at the forefront of innovative strategies to salvage and reconstruct upper and lower extremities. The close collaboration of care between both orthopedics and plastic reconstructive surgery is key in the successful outcomes in patients and restoring limb function. The addition of a nurse coordinator has helped guide patients through the web of appointments, referrals, surgeries, therapies, post-operative appointments, home care, etc. Advanced Practice Providers on our team are performing the complex care management of this patient population. The APPs are at the forefront providing high quality care throughout the continuum of care for our patients.

Since the launch of the program, there have also been two orthoplastic fellowships that have come through the program designed specifically for a year of hands-on experience for limb salvage procedures. Both previous fellows have gone back to their homes in Canada and Israel to work on limb salvage centers for their own. Although the position went vacant this past year, we are happy to have another orthoplastic fellow joining the program this upcoming summer. Dr. Linden Head will join us from Canada. Linden completed medical school at the University of Ottawa (2012 – 2016). He then completed a Plastic and Reconstructive Surgery residency program at the University of Ottawa (2016 – 2021). Following residency, he completed a fellowship in Hand and Upper Extremity Surgery at the University of Pittsburgh (2021 – 2022). We look forward to Dr. Head joining our team as our orthoplastic and limb salvage fellow.

Another addition to POLSC is the use of bi-weekly operating room block time at Presbyterian Medical Center specifically dedicated for the use of the use of combined orthoplastic cases. This has given us more time for the urgent reconstructive cases that need to be added into the already full OR schedule. It has also made scheduling these cases easier as coordinating OR time between the two services can be difficult due to conflicting schedules. The POLSC continues to expand and grow, and has even begun to treat international patients for limb salvage procedures.

Microsurgery is a huge component of the Orthoplastic Limb Salvage Center. Vascularized free tissue transfers are preformed frequently to give patients adequate soft tissue coverage. Patients with extensive limb injuries will not perform well if there continues to be exposed bone and hardware. A wide variety of free flaps are performed at Penn Medicine on a regular basis. Post-operative flap care has been established with dangle protocols. In addition to soft tissue coverage, free vascularized bone transfers are also frequently used to treat non-unions, malunions, avascular necrosis and bone defects in the case of the free vascularized fibula graft (FVFG) and the medial femoral condyle (MFC) flaps. FVFG are used for several reconstructive surgeries, including our hip preservation surgery for patients with AVN of the femoral head without collapse. Orthoplastics at Penn Medicine is ever evolving and continues to look at outcomes to improve the patient experience.

Penn Medicine continues to be at the forefront for the latest advances in extremity care. In addition to the highly skilled microvascular vascularized free flaps that are frequently

performed to provide adequate soft tissue coverage, there are many other advances in surgical procedures utilized within POLSC. On the orthopedic side, Dr. Samir Mehta is utilizing specialized implants to improve outcomes. The limb lengthening nail is implanted into patients' femurs or tibias for limb length discrepancy. The surgery typically involves preforming an osteotomy in the mid shaft of the bone which allows the patient to use an external hand held magnetic device in the convenience of their own home that pairs to the implanted nail to turn the rod. Patients will use this device at home with a prescription for a lengthening program which is set into the machine to bring lower extremities out to length to improve overall gait and function. Dr. Mehta is also using 3D printing technology to take contralateral images of a patient's talus to create a total replacement implant. Several patients have had successful outcomes from the total talus replacement surgery.

On the plastic reconstructive and microvascular side are advancements in Targeted Muscle Reinnervation (TMR). In not always an unfortunate manor, patient's seeking limb salvage end up with an amputation. Amputations can help free patients from long-standing wounds, chronic osteomyelitis, chronic pain and the inability to ambulate and get on with their lives. However, amputations done to alleviate these symptoms are not without their own complications. Amputations are notorious for residual and phantom limb pain, which leads to complex chronic pain and inability to ambulate in a prosthetic. TMR is a nerve transfer that takes the distal end of the nerve, removing any neuromas present, and connecting it to a proximal motor branch. These motor branch nerves are found by using a biphasic nerve stimulator. This technique of TMR helps reduce and eliminate phantom and residual limb pain.

In addition to limb saving procedures is our hand transplant program. Penn Medicine has performed four successful bilateral hand transplants (3 adults and 1 child). Although the global pandemic has put a slight pause on the program, we continue to work and care for our past transplant patients as well as our candidates pending donors. We received heartwarming news from one of our previous bilateral hand transplant female patients who successfully delivered a healthy baby girl in the last few months. She is the first hand transplant patient to deliver a baby after her transplant. She was overly joyed to be able to hold and care for her baby, and despite being on lifelong immunosuppression, had an otherwise healthy pregnancy. Due to the pandemic, one of our international transplant candidates had to put a pause on active donor offers. However, despite travel restrictions, Dr. Stephen Kovach and Dr. Scott Levin went overseas to Switzerland last spring to treat our patient with microvascular surgery to his bilateral lower extremities. The patient underwent bilateral free flaps to his lower extremity amputations for chronic fissuring and wound issues. This permitted our team to better prepare our patient for his upcoming bilateral hand transplant.

POLSC continues to have a presence on social media to promote our accomplishments. Posts include patient testimonials, surgical highlights, and physician spotlights. The goal of the POLSC social media presence is to engage other patients and healthcare facilities to share progress and innovative surgical procedures we have at Penn Medicine to continue to restore function to limbs.

The POLSC continues to grow and expand on future plans. Osseointergration is a procedure on the horizon that is currently being worked on to bring to Penn Medicine. This advancement in amputation care helps amputates improves mobility (control of the prosthetic leg), improves proprioception, reduces nerve pain, and eliminates common problems associated with sockets. Although this is not currently being performed here at Penn Medicine, it is something we hope to have the ability to perform in the near future. The Penn Orthoplastic Limb Salvage Center is making huge strides to save and salvage functional limbs, as well as restore function and mobility to patients who have undergone amputations.

Case to highlight:

We present the case of a 38-year-old who had a left below the knee amputation with residual painful neuroma. The patient initially suffered a traumatic injury of his left lower extremity in an industrial accident. He initially underwent an attempt at

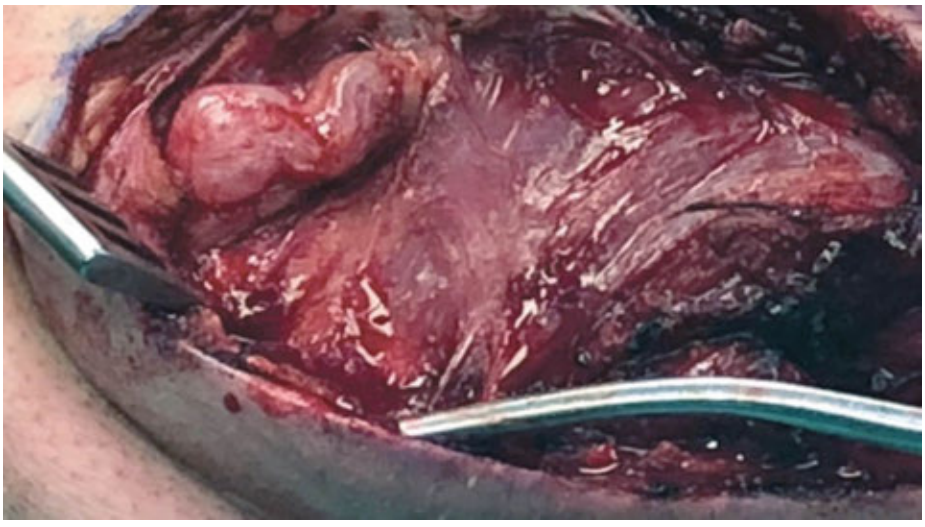

Figure 1. Dissection over the anterior compartment demonstrating large neuroma of the deep peroneal nerve.

limb salvage including microvascular free flap reconstruction of his extremity. He developed recurrent osteomyelitis and elected for a below knee amputation. He was initially able to ambulate in a prosthesis, but developed debilitating pain in the distribution of his peroneal nerve, resulting in inability to wear his prosthesis and pursue his desired functional and recreational activities. Physical exam confirmed the presence of a palpable, exquisitely tender mass overlying his anterior compartment consistent with a neuroma of the deep branch of the peroneal nerve. He underwent a block of his common peroneal nerve with Marcaine™ with complete relief of his pain. Secondary to the complete pain relief with anesthetic blockade, he ultimately decided to pursue TMR for his symptomatic deep peroneal nerve neuroma.

The patient was seen in follow up and is pain free after years of a symptomatic neuroma. He is now back in his prosthesis and has returned to his physical activity without pain.

Figure 2. After dissection and definition of the neuroma of the deep peroneal nerve, the Checkpoint® nerve stimulator was used to map and identify the motor branches. Demonstrated is confirmation of proximal motor branches of the deep peroneal nerve with branches to extensor digitorum muscle body.

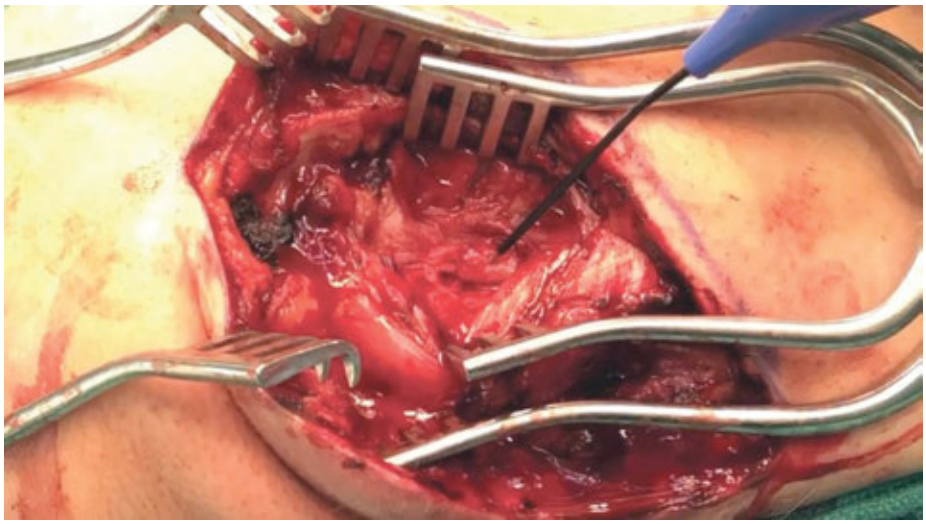

Figure 3. After resection of the neuroma, the proximal deep peroneal nerve is coapted to the motor branch to the extensor digitorum in an epineural fashion with 8-0 nylon with loupe magnification. Shown is the activation of the motor branch with the Checkpoint stimulator by stimulating the deep peroneal nerve proximal to the nerve coaptation demonstrating an intact nerve coaptation and conduction. This is possible due to the close proximity of the target muscle and stimulation through a coaptation to motor nerve recently transected.