**RAHUL KASUKURTHI:** My name is Dr. Rahul Kasukurthi. I'm a Hand and Microvascular Surgery fellow at the University of Washington in Seattle. And today we'll be reviewing a case of thumb reconstruction using microvascular second-toe-to-thumb transfer, performed by Drs. Douglas Hanel and Jeffery Friedrich at Harborview Medical Center here in Seattle, Washington, a fireworks-related blast injury to left hand. Underwent revision amputation of the acute phase, leaving with the left thumb revision amp through the MP joint as well as index, middle, and ring finger ray amputation.

Small finger retained its normal length. In preparation for ultimate thumb reconstruction, previously underwent groin flap surgery to left hand for soft tissue coverage. Today this video demonstrates a left thumb reconstruction using a second toe transfer with microvascular anastomosis.

Skin markings are demonstrated in preparation to harvest a right second toe through the metatarsophalangeal joint. A thigh tourniquet was inflated to 275 millimeters of mercury. Skin incisions were made in a V-shaped fashion, crossing the first and second web space with the skin bridge designed proximally, extending approximately 1 centimeter proximal to our intended level of bony harvest. The incision was extended as well on the dorsum of the foot in a proximal direction in a curvilinear fashion as well as volarly approximately two more centimeters.

We dissected through the skin and subcutaneous tissue with a 15 blade, elevating a thin flap. We first started by identifying the first dorsal metatarsal artery in the first web space as seen here. It was followed distally, where it branched into its proper digital arteries to the lateral aspect to the great toe and the medial aspect the second toe. There was no distal communicating branch to the plantar artery system.

We did ultimately visualize a separate plantar artery system. But based on comparing sizes, we ultimately determined that this was a dorsal-dominant system. We therefore clipped the dorsal proper digital artery at the lateral aspect of the great toe, leaving a branch to the second toe connected.

Here we are identifying superficial dorsal foot veins coming from the medial and lateral aspect from the second toe, which joined at the arch and then drained into the dorsal saphenous vein in the foot. This was dissected free, and side branches are clipped. The first dorsal metatarsal artery and vein were freed on all surfaces proximally for approximately 12 centimeters. We then were able to identify the deep peroneal nerve, which was running with the FDMA. And here, we see it being dissected free preserved.

Dissection is taken as far proximally as feasible. And here the deep peroneal nerve is being divided proximally and set aside for later coaptation. We then identified the extensor digitorum longus to the second toe here, then worked to carefully dissect it, again, as proximally as we were able.

Here we are testing the tension of the extensor digitorum longus to the second toe. And ultimately it was cut, leaving approximately 7 centimeters of length. The short extensor tendon was divided sharp.

After freeing the extensor tendons, we turned our attention back to the web space in order to identify the intermetatarsal ligaments on both the medial and lateral aspects of the second toe. After careful dissection, we divided both intermetatarsal ligaments on each side of the toe in order to achieve some mobility and expose the next phase of dissection of critical structures.

We then continued our dissection through the plantar tissues and identified the lateral and medial plantar proper digital nerves of both aspects of the second toe. These were neurolysed for several centimeters to allow for adequate length. We divided branches of the plantar proper digital arterial system to the second toe, leaving only the dorsal metatarsal arterial system intact, as again, we deemed this is a dorsal-dominant system.

The interossei were removed from the metatarsal, and the long flexor tendon to the second toe was isolated, and it was transected 8 centimeters proximal. Here you see the second toe, sharply disarticulated through the metatarsophalangeal joint. After confirming the length of the tendons, nerves, and vessels were adequate by discussing with the recipient team, the toe was completely freed, and we prepared the proximal aspect of the proximal phalanx perfusion. Here an oscillating saw is used to remove articular cartilage down to healthy subchondral bone. Copious irrigation is used to prevent overheating of osteocytes.

After confirming the recipient site was ready for flap transfer, we transected the flap artery and vein, which were at this point the only remaining structures attached to the donor site. Prior to ligation of the pedicle, we had confirmed good end flow by visualization of the pedicle with normal capillary refill of the toe skin and an audible signal using a hand-held Doppler. Here we see our toe flap on the back table with the associated digital nerves, the arterial and venous pedicle, as well as the extensor and flexor tendons labeled.

We then made markings on the left hand, turning our attention to the site where the previous groin flap had been placed to plan our approach. This was done in the form of a sagittal incision using a 15 blade down through skin, straight down through subcutaneous tissue onto bone in order to shell out the metacarpal. This incision was carried down through the radial aspect of the metacarpal, down over the FCR tendon proximally as well. We elevated these flaps and identified the FCR tendon as well as the radial artery.

We were able to identify a superficial branch of the radial sensory nerve and tagged this for coaptation. We then prepared for our osteotomy by performing a slightly volar oblique osteotomy in order to allow for the metacarpal head to have a surface that would allow the toe flap to be in some slight flexion and facing the small finger in order to facilitate opposition and ultimate function.

We took a 2.3 millimeter plate from the hand set, placed this along the metacarpal in the axis we felt would be best to facilitate opposition to the remaining small finger. This plate was placed provisionally on the recipient site metacarpal. We then took our toe flap on the back table, flushed it with heparinized saline, and then we completed our osteosynthesis by lining up the proximal phalanx on the toe flop onto our recipient site metacarpal, finishing the synthesis with 2.3 millimeter locking screws.

We then started with our tendon coaptations. We turned our attention to the dorsal surface of the hand. And here you see us transecting the EIP tendon in preparation for a Pulvertaft weave.

The EIP tendon was then coapted to the extensor tendons of the toe, using a Pulvertaft technique in the standard fashion. A total of three passes were performed. We plicated the weave until we got good tension, as evidenced by the tenodesis effect.

We then turned our attention to the flexor tendons and identified an FDS to the middle finger that we had previously tagged during our dissection. The middle finger, again, had been traumatically amputated, and we performed another Pulvertaft weave.

We then turned our attention to the microvascular anastomosis. We identified a dorsal branch of the radial artery in the snuffbox and ligated this distally to perform an end-to-end anastomosis, as demonstrated here.

Flap veins were sized, and a 2.0 millimeter flow coupler was selected. The recipient vein was the cephalic vein, which had been previously dissected and tagged for coaptation and anastomosis. And finally we turned our attention to the nerve coaptations. The previously-dissected deep peroneal nerve was coapted to a branch in the superficial radial sensory nerve.

Digital nerves on the toe flaps were coapted to digital nerves found from the carpal tunnel. And finally sheet grafts were placed with pie crusting. In terms of the final preparation of the donor site, we performed a ray amputation of the second metatarsal using an oscillating saw.

The intermetatarsal ligament was reapproximated using a 3-0 Ti-Cron suture. We then placed two divergent 0.062 K-wires in the great toe metatarsal into the third metatarsal. And a 1/4-inch Penrose drain was placed and removed, and the skin was closed.

Here we see final x-rays of the toe flap with osteosynthesis completed. The 2.3 millimeter plate has helped facilitate an MCP fusion between the recipient site metacarpal and the proximal phalanx of the second toe flap.