

# Partial Hand Transplant: Lessons Learned from Cadaveric Dissections

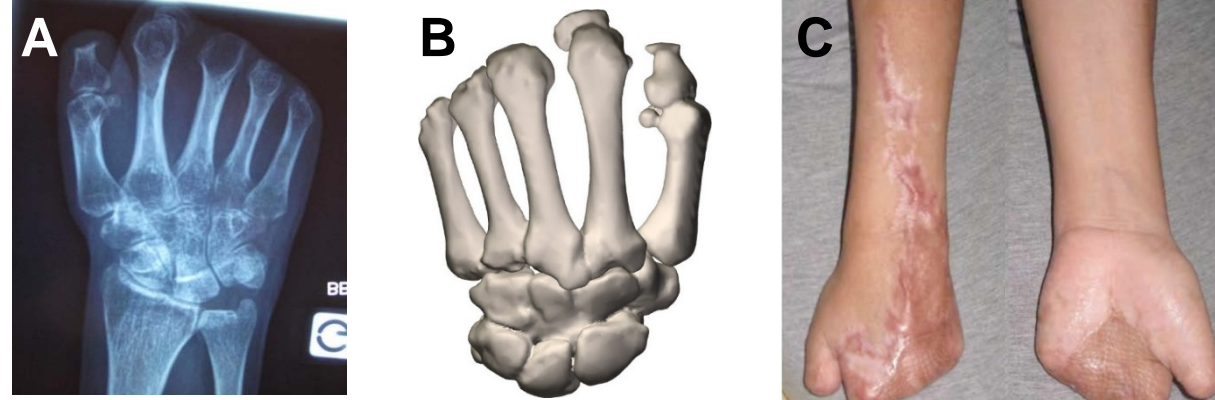


Valeriy Shubinets MD<sup>1</sup>, Benjamin Chang MD<sup>1</sup>, L. Scott Levin MD<sup>2</sup>, Ines C. Lin MD<sup>1</sup>

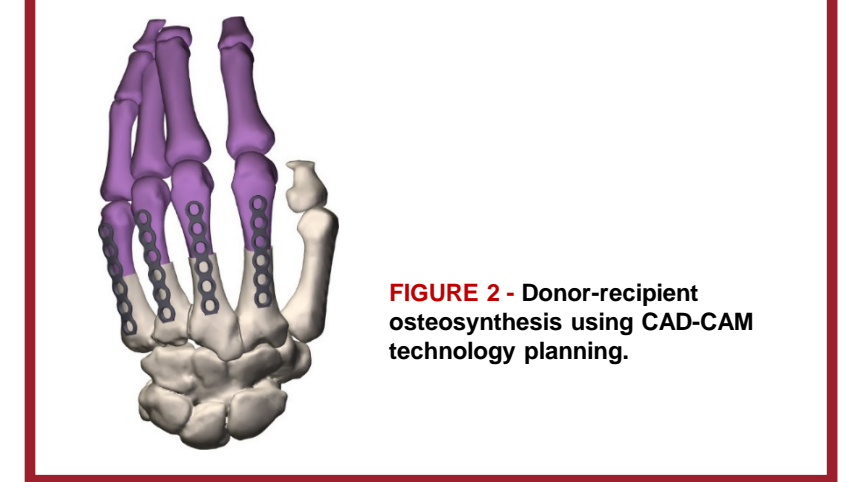
<sup>1</sup>Department of Surgery, Division of Plastic Surgery, University of Pennsylvania, Philadelphia, PA; <sup>2</sup>Department of Orthopaedic Surgery, University of Pennsylvania, Philadelphia, PA

## INTRODUCTION

As the field of vascularized composite allotransplantation continues to grow, new upper extremity transplant candidates are being considered on a regular basis. We recently evaluated a patient who had a right mid-forearm level amputation and a contralateral left metacarpal level amputation of digits with a preserved partial thumb. In the latter “partial hand” limb, native thumb was amputated at the proximal phalanx base with retained opposition and adduction, and the patient strongly desired to maintain these functions. Transplants at the hand level have reportedly been performed, but limited information exists on the technical details of such operations. This study aims to assess the feasibility of a partial hand transplant using cadaveric dissections, focusing on anatomic and functional concerns of a metacarpal-level transplantation.



**FIGURE 1** - Preoperative evaluation of transplant candidate's left hand. **A)** X-rays of left hand. **B)** 3D CAD-CAM reconstruction of patient's bony framework. **C)** Photographs of patient's left hand.



**FIGURE 2** - Donor-recipient osteosynthesis using CAD-CAM technology planning.

## MATERIALS AND METHODS

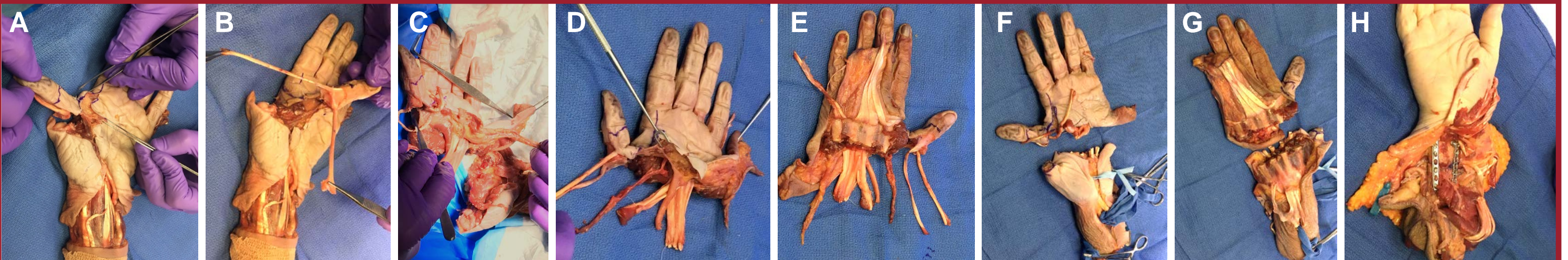
Five cadaveric dissections were performed. A transplant approach was evaluated in which the donor hand would be fixated to the recipient hand at the metacarpal level, while attempting to preserve native innervation to adductor pollicis and thenar muscles. The distal donor thumb would be transplanted to the native thumb “en bloc” with the rest of the donor hand to improve thumb length, while the vascular anastomoses would be performed at the distal forearm level (radial and ulnar vessels).

## RESULTS

Several concerns were realized during cadaveric dissections. Despite the use of CAD-CAM technology and patient-specific bone cutting guides, osteosynthesis for 4 metacarpals and thumb proximal phalanx was significantly more time-consuming than osteosynthesis for radius and ulna in the typical forearm transplant. Preserving the native thumb and thenar muscles required extensive dissection. Transplanting the distal donor thumb “en bloc” with the rest of the donor hand was challenging in terms of maintaining the distal donor thumb's blood supply. The recipient's intrinsic muscles also presented a challenge, as they were expected to be severed and atrophied. Certain structures such as palmar arches would have to be “doubled” if the anastomoses were performed at the distal forearm level, which added significant bulk to the final hand.

## CONCLUSION

Based on our simulation dissections, mid-metacarpal partial hand transplantation with “en bloc” distal thumb transfer is associated with a tedious osteosynthesis and dissection, high risk of donor distal thumb ischemia, added bulk, and likely poor intrinsic muscle function. Amputation and transplantation at the distal forearm level was concluded to be a more favorable option in this particular candidate, especially given the high rate of intrinsic muscle recovery in forearm-level transplant patients to date.



**FIGURE 3** - Photographs from cadaveric dissection sessions. **A-B)** Dissection of distal donor thumb. **C)** Dissection of donor palmar space. **D-E)** Donor hand fully dissected. While osteosynthesis was planned at the metacarpal level, the microvascular anastomoses were planned more proximally at the wrist. **F-G)** Donor and recipient hands prior to osteosynthesis. **H)** Contralateral distal forearm transplant osteosynthesis for comparison.