Thumb duplication is a congenital hand difference that results from failure of differentiation in the radial-ulnar axis of the hand plate. Typically described within a broader group of hand and upper limb duplications, including polydactyly and proximal duplications, this difference has an incidence of 0.08 per 1000 live births and is typically sporadic and unilateral. Thumb duplication is classified by level of bony duplication from distal to proximal by the Wassel classification system. In this case study, we present a detailed anatomic description of a Wassel VI thumb duplication and the challenges encountered in correction of this congenital hand difference.

CASE DESCRIPTION
A 5-week-old male infant presented with a right Wassel VI thumb duplication. Examination demonstrated good flexion, extension, and opposition of the larger ulnar digit, but lack of abduction with less purposeful movement of the radial digit (Fig. 1). At 14 months, magnetic resonance imaging (MRI) was performed for operative planning. MRI showed a widened distal trapezium with distinct articular facets to each metacarpal in a roof shape (Fig. 2) as well as splitting of the thenar muscle bellies with flexor pollicis brevis (FPB) and opponens inserting on the ulnar digit and a robust abductor pollicis brevis (APB) inserting on the radial digit.

Reconstruction was performed at 16 months. A racquet incision was planned around the radial digit and extended along the glabellar skin edge. The extensor pollicis brevis (EPB) and APB muscles were encountered at their normal insertions along the dorsal and radial aspects of the radial thumb proximal phalanx, respectively. They were elevated with a periosteal cuff for transfer.

There was a confluence of radial and ulnar thumb flexor pollicis longus (FPL) tendons with a common origin and bifurcated distal tendon. The FPL was freed from fibrous connections that existed between the digits. The hypoplastic radial FPL was excised to promote gliding given the ulnar FPL appeared to be of adequate size with good preoperative flexion of the digit. The abductor pollicis longus (APL) tendon of the radial thumb was reflected proximally with a periosteal cuff, exposing the first carpometacarpal (CMC) joint. The radial digit, stripped of critical structures, was excised for full exposure of the CMC joint. The trapezium had a widened distal pole with two distinct articular surfaces for each metacarpal in a roof shape (Fig. 3) as well as splitting of the thenar muscle bellies with flexor pollicis brevis (FPB) and opponens inserting on the ulnar digit and a robust abductor pollicis brevis (APB) inserting on the radial digit.

The thumb was held in a functional, abducted position. The APL tendon was sutured to the metacarpal base using a nonabsorbable braided suture to support the dorsal radial ligament of the CMC joint. The radial digit APB was transferred to the lateral base of the ulnar digit proximal phalanx while keeping the thumb abducted. EPB was sutured to the ulnar thumb dorsal proximal phalanx. The thumb was noted to have a stable reconstruction with improved positioning. A 0.028-inch Kirschner wire was driven retrograde from the distal phalanx into the
Excess skin was trimmed during closure (Fig. 4). At 4 weeks, the pin was removed and the patient returned to regular activity.

**DISCUSSION**

The Wassel thumb duplication classification system describes seven types of thumb duplication, progressing from distal to proximal bony involvement. The incidence of the rare type VI duplication is unknown, with very few existing case studies. This study is the first that details the abnormal anatomy of the CMC joint and soft tissue attachments in a case of Wassel VI duplication.

Our patient presented with a dominant ulnar digit and hypoplastic radial digit. Assessment of preoperative function of the digits is key to planning successful reconstruction. However, this can be difficult clinically in a young child. In addition, standard radiographic imaging does not allow assessment of CMC anatomy, as the carpal bones are not fully ossified until 6 years of age. By performing preoperative MRI, the unique anatomy of the CMC and soft tissues are better visualized, allowing more precise planning of the reconstruction. The radial digit had distinct EPB, FPL, and APL insertions as well as a robust APB muscle belly. Preservation of these radial digit structures for transfer to the dominant digit is critical for reconstructing a stable ulnar thumb CMC, and for providing abduction function to the digit, which was lacking preoperatively.
this case, there was no significant opponens pollicis to the hypoplastic digit, which contrasts previous descriptions of a robust opponens pollicis. This suggests that there may be significant differences in anatomy across Wassel VI type thumbs despite more consistent bony anatomy.

Preoperative MRI showed that the trapezium was abnormally roof shaped with a widened distal aspect and two distinct facets existing at an oblique angle for articulation with each metacarpal. After removal of the radial thumb, the radial facet was sharply excised to permit tight reconstruction of the CMC dorsal radial ligament with APL and to help better position the ulnar thumb metacarpal. However, the ulnar facet of the trapezium remained in an overall ulnarly canted angle unlike a normal CMC articulation. The extremely small size of the carpal bone at this age made osteotomy to correct this angle a risk that could result in poor healing or devascularization of the bone. We will follow to see if the facet remodels more favorably with growth. This is likely a key component of why reconstruction of Wassel VI thumb duplications has been associated with worse aesthetic outcomes and secondary joint deformities compared with other duplication types.7,8

CONCLUSIONS
The Wassel VI thumb duplication is a rare and challenging congenital hand difference. By combining careful preoperative functional examination, preoperative imaging, meticulous intraoperative dissection, and preservation of anatomic structures for use in reconstruction, good functional results can be achieved.

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