The Utility of Ultrasound Guidance in Percutaneous First Annular Pulley Release in a Cadaveric Perfusion Model

USC Plastic & Reconstructive Surgery

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OBJECTIVE

Trigger finger is the most common entrapment tendinopathy, with lifetime-risks of 2-3% (diabetics ~10%).[a] Open tenovaginotomy is the standard surgical procedure with high success rates. Despite percutaneous trigger finger release (PFTR) success rates over 94%, controversy remains due to risk of iatrogenic digital neurovascular injury. This study aimed to assess the utility of traditional percutaneous versus ultrasound-guided (US) first annular (A1) pulley releases performed on a perfused cadaveric model.

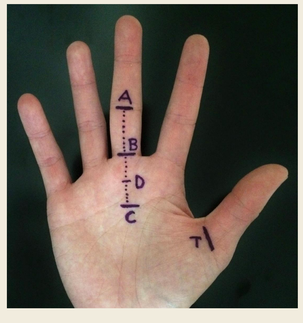
METHODS

155 (124 fingers and 31 thumbs) percutaneous A1 pulley releases were performed on un-embalmed cadavers with restored perfusion using an 18-gauge needle. The A1 pulley of 45 fingers and thumbs were released with US while 110 were released without US. Each digit was dissected and assessed for amount of A1 pulley release as well as neurovascular, flexor tendon, and A2 pulley injury.

Figure 1: Perfused cadaveric model

Cannulation of the brachial artery and vein allowed a dyed perfusate to be pumped through the vascular structures of the cadaveric hand during the procedure. A vortex centrifugal pump achieved mean arterial pressure of 80mmHg and venous pressure of 15 mmHg.

Figure 2: Marking of key superficial landmarks



To determine the entry site of percutaneous release (point D) for the second through fifth digit, we measured the distance between the digital-palmar (point B) and proximal interphalangeal (point A) creases. This distance was then transposed proximally starting at point B, and half the distance was marked as the entry site (point D). For the thumb, the crease of the metacarpophalangeal (MCP) joint on the volar surface was determined as the entry point for the percutaneous release (point T).

Table 1. Success of PTFR by finger

	Complete (%)	Partial (%)	Missed (%)	Average % Released
Thumb	28 (90)	3 (10)	0	98
Index	23 (74)	8 (26)	0	94
Long	23 (74)	7 (23)	1 (3)	92
Ring	15 (48)	15 (48)	1 (3)	86
Little	25 (81)	5 (16)	1 (3)	93
TOTAL	114 (74)	38 (25)	3 (2)	93

Table 2. Injury rates by finger (%)

	FPL/FDS tendon injury	Radial digital artery laceration	Ulnar digital artery laceration	Radial digital nerve laceration	Ulnar digital nerve laceration
Thumb	8 (29)	0	0	0	0
Index	6 (19)	0	0	0	0
Long	6 (19)	0	1 (3)	0	0
Ring	9 (29)	0	0	0	0
Little	6 (19)	0	0	0	0
TOTAL	35 (23)	0	1 (1)	0	0

Table 3. Success of PTFR by method (%)

	Complete	Partial	Missed	
Blind	78 (71)	29 (26)	3 (3)	p = 0.24
US	36 (80)	9 (20)	0	

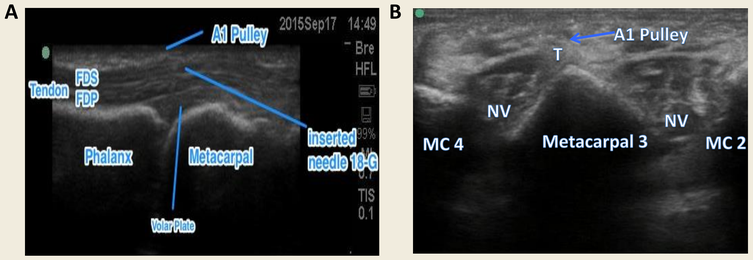
Table 4. Injury rates by method (%)

	FPL/FDS tendon injury	Radial digital artery laceration	Ulnar digital artery laceration	Radial digital nerve laceration	Ulnar digital nerve laceration	
Blind	25 (23)	0	1 (1)	0	0	p = 0.85
US	10 (22)	0	0	0	0	

RESULTS

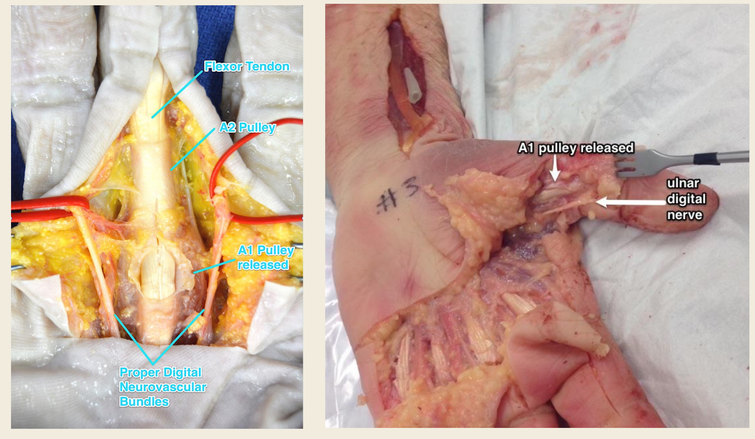
114 (74%) A1 pulleys were completely released. There were 38 (24%) partial releases and three digits were completely missed (2%). Average percent of A1 pulley length released was 93%. No significant flexor tendon injury (partial or complete lacerations) was seen in any digit. Longitudinal scoring was found in 35 fingers (23%). There were no laceration to digital nerves and one ulnar digital artery was partially lacerated (1%) in a middle finger with a partial MCP flexion contracture that prevented appropriate hyperextension. The ultrasound-guided PTFR technique was not significantly more likely to result in complete pulley release compared to the blind technique.

Figure 3: Ultrasound images showing needle tip and visualization of the neurovascular structures



A. Ultrasound allowed visualization of the anatomy of the A1 pulley and surrounding structures before percutaneous release. During release, we were able to visualize the needle tip and ensure its entry into the A1 pulley, as indicated in this image. B. Ultrasound allowed the operator to visualize the proximity of the neurovascular bundles in relation to the A1 pulley and the needle tip (MC 4 = fourth metacarpal; NV = neurovascular bundle; T = tendon).

Figure 4: Assessment of A1 pulley release



Each digit was carefully dissected after percutaneous A1 pulley release. Upon open dissection, we measured the entire length of A1 pulleys and the length of intact pulley for partial releases to determine percent release. We also identified and inspected the A2 pulley, flexor tendon, and digital arteries and nerves.

CONCLUSION

Both traditional and ultrasound-assisted percutaneous releases of the A1 pulley can be performed safely and effectively for all digits. Perfusion of cadaver digits enhances surgical simulation for PTFR training; However, the use of US in PCTFR may have limited clinical value.

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[a]Makkouk AH, Oetgen ME, Swigart CR, Dodds SD. Trigger finger: etiology, evaluation, and treatment. *Curr Rev Musculoskelet Med*. 2008;1(2):92-96.

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