

An anthropometric assessment of the proximal hamate autograft for scaphoid proximal pole reconstruction

Kitty Wu MD, Clare Padmore MEng, Emily Lalone PhD, Nina Suh MD
Roth | McFarlane Hand and Upper Limb Centre, Western University, London, Ontario, Canada



INTRODUCTION

- Fragmentation of the scaphoid proximal pole presents a difficult surgical problem¹
 - Ipsilateral proximal hamate autograft has been described for complete osteochondral scaphoid proximal pole reconstruction²
- Objectives**
- Assess the utility of the ipsilateral proximal hamate autograft for proximal scaphoid arthroplasty
 - Define imaging criteria for patient selection for this procedure

METHODS

- Twenty-nine frozen cadaveric specimens underwent computed tomography and 3-D reconstruction of carpus and distal radius
- Hamate rotated 180° to match capitohamate articular surface to scaphocapitate articular surface
- Scaphoid height was measured and a third of its height used to simulate resection of the proximal scaphoid pole and extent of hamate osteotomy (Figure 1)

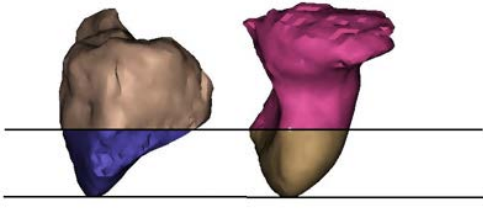


Figure 1. Illustration of proximal pole of scaphoid and extent of hamate osteotomy. Simulated cutting plane at one-third of height from scaphoid proximal to distal pole.

- Proximal scaphoid and hamate divided into 6 sections for comparison (Figure 2)
- Iterative point-to-point distance algorithm³ used to determine absolute mean distance between surfaces in each of 6 segments
- Absolute distance > 1mm between surfaces considered poor-fitting
- Inter-bone algorithm used to assess radioscapoid joint congruency
- Centroid of articular contact area patch calculated for intact and reconstructed scaphoid

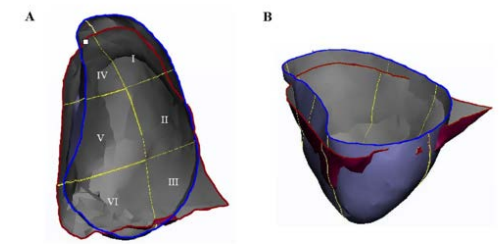


Figure 2. Division of the proximal scaphoid into six regions for comparison. Proximal scaphoid fragment (blue outline) and proximal hamate autograft (red outline) seen from superior and volar aspects. Both divided into six sections: dorsal (I), middle (II), and volar (III) radioscapoid, and dorsal (IV), middle (V), and volar (VI) scaphocapitate.

RESULTS

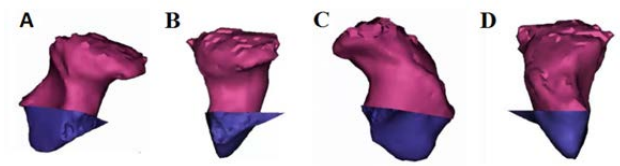


Figure 3. Representation of reconstructed scaphoid with opposed hamate autograft. Viewed from the scaphocapitate (A), volar (B), radioscapoid (C), and dorsal (D) surfaces

- Mean height of scaphoid pole excision and proximal hamate autograft is 9.3 ± 1.0 mm.
- At cut surface, scaphoid wider than hamate in volar-dorsal (V-D) dimension (24/29 specimens) but hamate wider than scaphoid in radio-ulnar (R-U) dimension (28/29 specimens)

- Mean absolute differences greatest in volar radioscapoid (0.736 ± 0.290 mm) and dorsal radioscapoid (0.751 ± 0.316 mm) segments (Figure 4)
- 9 specimens classified as poor-fitting
- Poor fitting specimens had greater radial styloid to DRUJ distance ($p=0.004$), wider hamates in R-U dimension ($p=0.007$), wider scaphoids in the R-U dimension ($p=0.004$), and wider scaphoids in the V-D dimension ($p=0.0005$)
- No difference in lunate type between specimens of good and poor fit (Fischer's exact = 0.126)

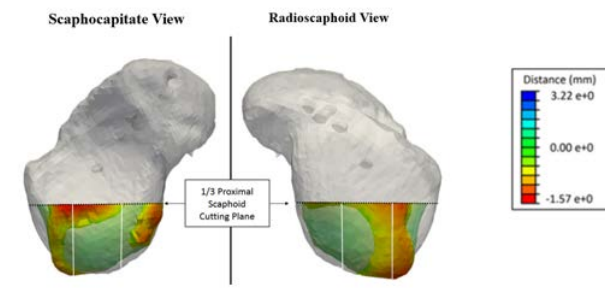


Figure 4. Native scaphoid with overlaid proximal hamate autograft. Hamate autograft (colour map) overlaid with native scaphoid. Green is areas of almost perfect match. Red highlights areas where hamate is oversized compared to the native scaphoid.

- Proximity color maps of radioscapoid joint calculated from inter-bone algorithm show impaction of dorsal radial aspect of distal radius in 6 of 9 poor fitting specimens (Figure 5)

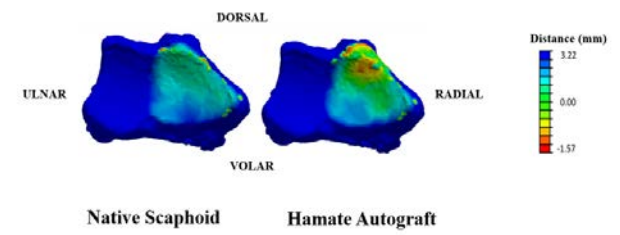


Figure 5. Effect of hamate autograft on radioscapoid joint congruency. Inter-bone algorithm generated color maps of distance of native scaphoid or hamate autograft to distal radius articular surface. 6 of 9 poor-fitting specimens would have impaction of the hamate autograft on the dorsal radius aspect. Red indicates negative inter-bone distances.

- Hamate autograft shifted the centroid of articular contact area 1.99mm towards dorsal radial aspect ($p < 0.05$) (Figure 6)

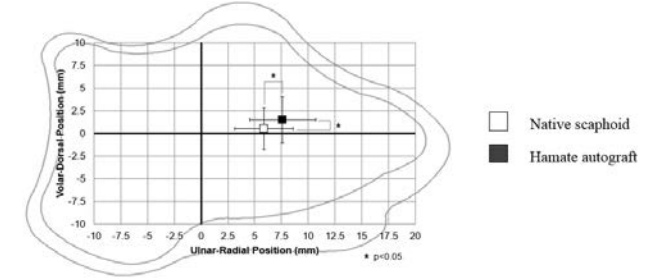


Figure 6. Effect of hamate autograft on articular contact location. Hamate autograft shifts the centroid of articular contact location 1.99mm towards the dorsal radial aspect ($p < 0.05$).

CONCLUSIONS

- Proximal hamate autograft is suitable for proximal pole scaphoid reconstruction with careful patient selection

Selection Criteria

- Radial-styloid-DRUJ distance < 32mm
- At the level of intended osteotomy:
 - R-U hamate width < 10mm
 - R-U scaphoid width < 10mm
 - V-D scaphoid width < 16mm

REFERENCES

- Grewal R, Lutz K, Macdermid JC, Suh N. Proximal Pole Scaphoid Fractures: A Computer Tomographic Assessment of Outcomes. *J Hand Surg Am.* 2016;41(1):54-58.
- Elhassan B, Noureldin M, Kakar S. Proximal Scaphoid Pole Reconstruction Utilizing Ipsilateral Proximal Hamate Autograft. *HAND.* 2016.
- Lalone E, Shannon H, Deluce S, Giles J, King GJ, Johnson J. Effect of radial head implant shape on radiocapitellar joint congruency. *J Hand Surg Am.* 2017;42(6):476.e1-476.e11