

The Use of Nitinol Continuous Compression Implants for Midcarpal Fusions

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1. INTRODUCTION

Scaphoid excision and midcarpal fusion is a time-tested and well accepted treatment option for the management of Scapholunate advanced collapse (SLAC) and scaphoid nonunion advanced collapse (SNAC) wrist arthritis, and is the preferred technique of many authors for younger patients and stage 3 disease. The optimal technique for midcarpal fusion in terms of Implant selection and selected carpal bones for fusion remains undetermined with Implants, including K-wires, screws, plates, Implants, and fusion mass to range from isolated capitulate, two-column, three-column and four-corner fusions.

In terms of Implant selection, K-wires alone were found to have unacceptably high rates of nonunion for capitulate fusion.¹ Headless compression screws achieved improved rates of union but violated the remaining articular surface of the lunate when placed antegrade and in up to 30% of cases screw back out has been reported.² Nitinol compression Implants offer

high rates of union, no violation of the remaining articular surface, and avoidance of hardware prominence when troughed, thus minimizing the need for subsequent hardware removal.³

In principle, all surgical techniques are identical in that the scaphoid is removed and the midcarpal joint is stabilized. Proponents of the four-corner fusion cite a larger surface area for fusion as the main advantage. Studies have shown no difference in fusion rates, range of motion, and functional outcomes between the four-corner and isolated capitulate techniques.¹ Advantages of an isolated capitulate fusion include lower risk of subsequent pisotriquetral arthritis, less bone graft needs, less surgical time, and equal outcomes and union rates. Combined, these factors have led me to favor scaphoid excision and isolated capitulate fusion with triquetral retention using nitinol memory Implants.

CASE REPORT

2. CASE REPORT

2.1 Patient History

A 38-year-old right hand–dominant man who sustained an injury to his right wrist playing college football in 2001 noticed progressive loss of motion and increased pain with use, especially during loaded wrist extensions such as push-ups. The patient was otherwise healthy with no medical comorbidities. He is a nonsmoker and does not use alcohol. The patient had been an avid crossfit participant and boxer but had to discontinue those sports due to pain and notes the inability to even play cornhole. He had failed a trial of bracing, NSAIDs, and a cortisone injection in the wrist. Preoperatively he demonstrated 30 degrees of active wrist flexion and 25 degrees of extension.

Preoperative imaging demonstrated an extreme proximal pole scaphoid fracture with stage 2 SLAC wrist arthritis.



2.2 Treatment/Intraoperative Procedure Details

The patient underwent a scaphoid excision and capitulate arthrodesis in January 2020. A dorsal approach to the wrist was made between the second and fourth compartments. The EPL was identified proximally but did not require transposition. An inverted “T”-shaped capsulotomy was made and the scaphoid excised en bloc. The scaphoid was morselized and used for autograft.

The midcarpal surfaces of the capitate and lunate were then denuded of their articular cartilage and subchondral bone using a rongeur and curette (no power to avoid thermal necrosis). The triquetrohamate joint was inspected and noted to be free of degenerative change.

The DISI posture of the lunate was corrected with a palmarly directed force on the capitate (properly restoring the colinearity of the capitate and lunate on the lateral radiograph). This reduction was provisionally held with a K-wire (provided in the set). At this point, bone graft was packed densely into the remaining space between the capitate and lunate as this is not easily achievable after staple fixation has been placed.



CASE REPORT

Next, the “throwing star” was used to template the ideal Implant size, and the decision was made for a 13x10 and 15x10 mm BME SPEED™ Continuous Compression Implant. When possible I always try and use two Implants for improved biomechanical strength (Lee SK, Gaston RG. *J Hand Surg Am.* 2019).

K-wires are then placed into the proposed Implant insertion sites and fluoro checked to ensure the ideal location for the first Implant. Ideally, the proximal leg will rest just beneath the midcarpal surface of the lunate on the lateral and that sufficient space exists to allow a second Implant on the AP image. The cannulated drill is then used over the guidewire. Lastly, before Implant placement, a small rongeur is used to create a “trough” between the two drill holes that will allow the Implant to be recessed beneath the dorsal surface of the fusion mass and avoid impingement on the dorsal rim of the radius with wrist extension.

Final radiographs are obtained confirming proper Implant placement and the wrist is taken into extension passively to ensure the Implants do not impinge.

A standard layered closure is made, and the patient is placed into a short arm splint for 2 weeks.

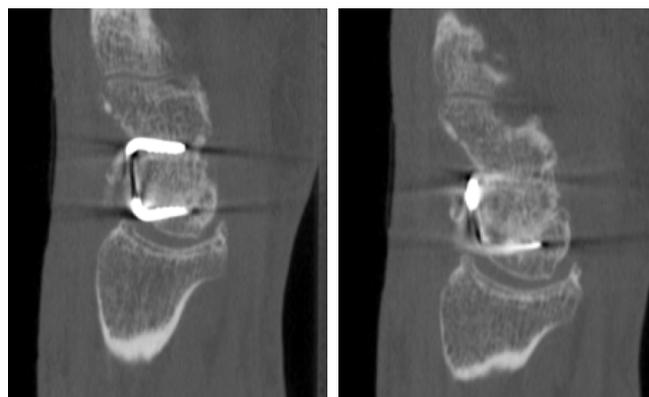
2.3 Postoperative Treatment or Patient Outcome

Following the 2-week period of splinting, a short arm cast is applied for an additional 3 to 4 weeks.

Typically, around week 6, range of motion and strengthening is allowed once clinical and radiographic signs of healing are present. This is often confirmed with a CT scan.

Our patient went on to successful union as evidenced by the CT scan attached.

The patient has regained 25 degrees of flexion and 20 degrees of extension and has resumed crossfit training. He reports no pain.



CASE REPORT

2.4 Product Type: Continuous Compression Implant Type and Size

BME SPEED Implants (13x10 and 15x10 mm) were utilized. Staples are ideal for midcarpal fusions for many reasons: 1) K-wires: portend risks of pin tract infections if left outside the skin and often needed second surgery if buried; 2) Screws: requires violation the articular surface of the lunate when placed antegrade and risks of screw back in nearly one third of cases requiring subsequent screw removal (Gaston GR. *J Hand Surg Am*); 3) Circle plates: much higher reported nonunion rates and complications in the literature.

Additional pearls:

1. When placing two staples it is preferred to have different bridge lengths to avoid the drill holes being side by side (allowing them to be staggered). Recommended space between staples is 5-7 mm.

2. Implant sizes: Typically, Implant bridge lengths of 10, 12, or 15 and Leg lengths of 10 or 12 are used most often.

3. Biomechanical study demonstrated compression by the staples 2 mm beyond the end of the legs, effective leg length for each staple construct extended 2 mm distal to the tip of the shortest staple leg. Two staple constructs more than doubled compressive force and increased bending strength by greater than 90% in all staple types. There was no loss of compressive force before or after loading for single, double, or troughed constructs with any staple type; therefore, the staples only need to be within 2 mm of the far cortex to achieve compression across the entire fusion mass (bicortical leg length is not required).³

Product Benefits: The ability to recess the Implants beneath the surface to avoid impingement, continuous compression resulting in high union rates,⁴ and cannulated guides to ensure proper Implant placement in an area with small real estate.

Results from case studies are not predictive of results in other cases. Results in other cases may vary.
Please refer to the instructions for use for a complete list of indications, contraindications, warnings and precautions.

3. SURGEON PROFILE



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4. REFERENCES

1. Kirschenbaum D, Schneider LH, Kirkpatrick WH, Adams DC, Cody RP. Scaphoid excision and capitulunate arthrodesis for radioscaphoid arthritis. *J Hand Surg Am.* 1993;18(5):780-785. doi:10.1016/0363-5023(93)90042-2
2. Gaston RG, Greenberg JA, Baltera RM, Mih A, Hastings H. Clinical outcomes of scaphoid and triquetral excision with capitulunate arthrodesis versus scaphoid excision and four-corner arthrodesis. *J Hand Surg.* 2009;34A:1407-1412.
3. McKnight RR, Lee SK, Gaston RG. Biomechanical properties of nitinol staples: effects of troughing, effective leg length, and 2-staple constructs. *J Hand Surg Am.* 2019;44(6):520.e1-520.e9. doi:10.1016/j.jhsa.2018.08.017.
4. Tait M, Bracey JW, Lewis DR, Gaston G, Loeffler B. Comparison of early outcomes and complications of scaphoid excision and capitulunate arthrodesis with screws versus staples. *American Association for Hand Surgery*; January 10-14, 2017; Waikoloa, HI, USA.



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