Bone Morphogenic Protein 2 Use for the Surgical Treatment of Acute Scaphoid Fractures and Scaphoid Nonunions
Desraj Clark, Andres Piscoya, Marvin Dingle, John Dunn, Leon Nesti

INTRODUCTION:
Despite many treatment options, scaphoid fractures have the potential to present a significant challenge, and there is a need to investigate alternative treatment strategies that may provide more consistently acceptable outcomes without increasing the procedure’s complexity or risk. Bone morphogenic protein 2 (BMP-2), an osteoactive protein, has demonstrated promise as an adjunct to treating fractures in both the upper and lower extremities while avoiding the need for vascularized bone grafts or bone transport. However, its reported use in the upper extremity has been limited. The purpose of this study is to report our experience with a relatively large, series of patients who underwent scaphoid fracture treatment augmented with BMP-2. We hypothesize that utilizing BMP-2 in surgical treatment of scaphoid fractures will result in high union rates for both acute injuries and prior nonunions. We also report our complications and available functional outcome data to provide insight into the potential results of using this technique.

METHODS:
A retrospective review of scaphoid fractures treated surgically in a single region of the military health system from January 2009 to October 2019 was conducted to identify patients who received adjunctive BMP-2. Vascularized grafts were excluded. Adult patients who underwent fracture fixation with adjunctive BMP-2 use for acute scaphoid fractures or previous nonunions were included. Vascularized bone grafts were excluded. Secondary outcomes included union rates for prior nonunions, union rates at 4 and 6 weeks, and functional outcomes. Fracture healing was determined on computed tomography when >50% bridging was present on multiple views. Complications and functional outcomes were obtained from chart review. Times to union were calculated as both median and mean. Proportions were calculated at percentages. Means of continuous data were compared with Mann-Whitney U tests.

RESULTS:
Fourteen patients met inclusion criteria with mean age 23.7 years and 85.7% male predominance. Prior nonunions accounted for 50% of included fractures. The total fracture union rate was 92.8% with mean time to union of 6.2 ± 2.5 weeks and median time to union of 5 weeks. All acute fractures healed with mean time to union of 4.8 ± 1.8 weeks and median time to union of 4 weeks. Prior nonunions had a union rate of 85.7% with mean time to union of 7.7 ± 2.5 weeks and median time to union of 7 weeks. At 4 weeks, 38.5% of all fractures had healed, and at 6 weeks 61.5% of all fractures had healed. Four patients (28.6%) appeared to develop heterotopic ossification (HO), which was always in the dorsal soft tissues. Mean wrist flexion and extension was not significantly different between patients without HO (Flexion= 44.1°, Extension= 39.6°) or with HO (Flexion= 65.0°, Extension= 60.0°). Thirteen patients (92.8%) were able to resume taking the push-ups portion of the military fitness test. No major complications or unplanned interventions were identified.

DISCUSSION AND CONCLUSION:
Employing BMP-2 in operative fixation of scaphoid fractures resulted in high union rates for acute fractures (100%) and prior nonunions (85.7%) without requiring vascularized grafts. There were no major complications or unplanned interventions (0%), and range of motion was not affected by the presence of HO. Adjunctive BMP-2 may help safely augment healing in patients with difficult scaphoid fractures with limited morbidity or technical expertise required.