

# Proximal Pole Scaphoid Fractures: A Computed Tomographic Assessment of Outcomes

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**Purpose** To report on union rates and times for a cohort of acute nondisplaced or minimally displaced proximal pole fractures evaluated with serial computed tomography (CT) scans.

**Methods** All patients with isolated acute proximal pole scaphoid fractures (< 6 weeks from injury) who presented at our institution between 2006 and 2013 were identified. Each subject's health record, CT scans (performed at initial assessment and serially to document healing), and x-rays were retrospectively reviewed to determine details of injury, treatment course, and treatment outcome. Union incidence and time to union were determined based on CT scan results. The effect that each predictor variable had on union, nonunion, and delayed union was assessed.

**Results** This cohort consisted of 53 patients with proximal pole scaphoid fractures (47 males and 6 females; mean age,  $30 \pm 17$  years). The overall union incidence with cast treatment was 90% (47 of 52). The study was underpowered to detect any factors that were predictive of developing a nonunion with cast treatment with the exception of a slight delay to seeking treatment. Average time to union was  $14 \pm 8$  weeks for cases treated with surgical fixation ( $n = 4$ ; cases that failed casting and were subsequently treated surgically) and  $14 \pm 12$  weeks for cases treated with casting alone. Factors found to be correlated to longer union times included fracture translation ( $r = 0.30$ ) and the presence of cysts or comminution.

**Conclusions** The reported union incidence and union times in this study compared favorably with the literature. Risk factors that were associated with a significantly greater time to union included fracture comminution, the presence of cysts, and fracture translation. Our sample size was relatively small, and other limitations inherent in the retrospective design must be considered. (*J Hand Surg Am.* 2016;41(1):54–58. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)

**Type of study/level of evidence** Prognostic IV.

**Key words** Computed tomography, proximal pole, scaphoid fracture, union, outcomes.

PROXIMAL POLE SCAPHOID FRACTURES have the worst prognosis of any scaphoid fracture.<sup>1</sup> However, a review of the literature reveals few reports that focus specifically on examining their outcomes, particularly with cast treatment.<sup>2</sup> One reason for this is that they occur much less frequently than waist or distal pole

fractures. Their reported incidence varies between 6%<sup>3</sup> and 20%.<sup>4</sup> In fact, some of the largest series reporting outcomes of scaphoid fractures have few proximal pole fractures represented, and those that do focus on proximal pole fractures have small sample sizes ( $n = 4$  proximal pole to 100 scaphoid fractures<sup>5</sup>;  $n = 7$  proximal

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pole to 323 scaphoid fractures<sup>6</sup>;  $n = 22$  proximal pole to 248 scaphoid fractures<sup>3</sup>).

Achieving union can be challenging for proximal pole scaphoid fractures owing to the small fragment size and poor vascularity. The literature reports varied union incidences and times with casting. Nonunion incidence varies between 5% and 50%.<sup>3,5,7</sup> Union times also vary. Most report union times for cast treatment average 3 to 6 months,<sup>7–12</sup> but 1 report indicated union times as high as 9 months.<sup>13</sup> These numbers have predominantly been extracted from review papers with limited hard data supporting these values.<sup>7–9</sup> The purpose of this study was to report on union incidence and union times for a cohort of acute proximal pole fractures ( $< 6$  weeks from injury) that were non-displaced or minimally displaced ( $\leq 1$  mm displacement) and were evaluated with serial computed tomography (CT) scans.

## METHODS

After obtaining approval by our institution's review board, a departmental radiology CT database was searched for all scaphoid CT scans conducted between January 2006 and December 2013 inclusive. Because this project involved primarily a chart review, informed consent from each patient was not required by our institutional review board. All scaphoids were scanned using a CT scanning technique previously reported.<sup>14</sup> All proximal pole scaphoid fractures were identified, and each subject's x-rays, CT scans, and health record were reviewed to determine the details of injury, treatment course, and treatment outcome.

A total of 531 scaphoid fractures were identified, of which 87 involved the proximal pole (16%). Fractures presenting greater than 6 weeks from initial injury ( $n = 27$ ) and those that were loss to follow-up before union or nonunion could be confirmed ( $n = 5$ ) were excluded. Fractures with angular deformity in the sagittal plane ( $n = 1$ ) or displacement greater than 1 mm ( $n = 1$ ) were also excluded. This resulted in 53 subjects for inclusion in this study.

All CT scans were reviewed by 1 of 2 observers (a senior orthopedic resident [K.L.] and hand surgery consultant [R.G.]). The percentage of bone bridging for each scan was determined based on the method described by Singh et al.<sup>15</sup> If bridging was 50% or greater, we considered the fracture to be united and determined the time from injury to union.<sup>16</sup> If at least 50% bridging was not achieved and cast treatment was abandoned as per the discretion of the treating surgeon, cast treatment was deemed a failure and surgery was offered. Union times for both surgically

**TABLE 1. Description of Cohort**

Mean Age (y)	30 ± 17 (range, 13–80)	
Sex	47 males	6 females
Hand dominance	23 nondominant hand affected	20 dominant hand affected (10 unknown)
Mean time between injury and treatment (d)	6 ± 11 (range, 0–35)	
Smoking	8 smokers	33 nonsmokers (12 unknown)
Comorbidities	2 diabetics	

and nonsurgically treated fractures were calculated separately. There was 1 case in which the nonunion was accepted after 3 months of casting. Because the patient was 80 years old and asymptomatic, no additional treatment was offered. Because union was not achieved or attempted, this case was excluded from the time to union calculations. Additional details such as orientation of fracture line, translation of fracture fragments, presence of a humpback deformity, presence of comminution, features associated with avascular necrosis, cysts, and/or sclerosis along the fracture line were assessed on the CT scan.

## Statistical methods

The effect that each predictor variable had on union, nonunion, and time to union was assessed. Categorical variables were assessed with a chi-square test (Fisher exact where appropriate) and continuous variables were compared with a *t* test or an analysis of variance test where appropriate.

## RESULTS

### Description of cohort

This cohort consisted of 53 patients with proximal pole scaphoid fractures. Descriptive details are outlined in Tables 1 and 2. All fractures were given a trial of cast immobilization (short-arm thumb spica cast [SATSC]) except for 1 patient who was treated with open reduction internal fixation (ORIF) after the initial assessment because he was an elite athlete who was interested in optimizing his chances for an early recovery (non-displaced fracture; union time, 6 weeks).

**Nonunion:** The overall union incidence for cast treatment alone in this cohort was 90% (47 of 52). The study was underpowered to detect any factors that were predictive of developing a nonunion with cast treatment (Table 3), other than a slight delay to seeking treatment ( $P = .03$ ). Fractures that were successfully

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