

# Operative Versus Nonoperative Treatment of Z-Type Comminuted Clavicle Fractures in Adolescents: A Substratified Cohort Analysis

Coleen S. Sabatini, MD, MPH; Eric W. Edmonds, MD; Elizabeth Liotta; Katelyn Hergott; Donald S. Bae, MD; Michael T. Busch, MD; Henry Bone Ellis, MD; Mininder S. Kocher, MD; G. Ying Li, MD; Jeffrey Jerome Nepple, MD; Nirav Kiritkumar Pandya, MD; Andrew Pennock, MD; Crystal Perkins, MD; David D. Spence, MD; David Williams, PhD; Samuel Clifton Willimon, MD; Philip Wilson, MD; Benton E. Heyworth, MD; FACTS

Function After Adolescent Clavicle Trauma & Surgery (FACTS) Study Group

**Recipient: Coleen S. Sabatini, MD, MPH**

**Purpose:** There has been a recent shift towards operative management of mid-shaft clavicle fractures in adults and adolescents. This has been largely based on studies in the adult population that showed reduced rates of nonunion, symptomatic malunion and better short-term functional outcomes. For injuries with a comminuted “Z-type” fracture pattern, characterized by vertical positioning of a segmental fragment, it is commonly accepted to treat surgically due to concerns about healing and bony prominence. The purpose of this study was to assess the clinical, radiographic, and patient-reported outcome measures (PROs) in adolescents with comminuted Z-type mid-shaft clavicle fractures by comparing an operative and nonoperative cohort.

**Methods:** Patients aged 10 to 18 years treated for a diaphyseal clavicle fracture between August 2013 and February 2016 at one of eight geographically diverse pediatric centers were screened and enrolled at the time of injury. Inclusion criteria were a comminuted Z-type fragment  $\geq 1$ cm in size, with  $>35$  degrees of angulation relative to the long axis of the clavicle, and  $>100\%$  fracture displacement at time of presentation. Clinical course, complications, validated PROs, quality of life metrics, and satisfaction scores were analyzed and compared between the operative (Op) and nonoperative (NonOp) cohorts.

Patient Reported Outcome Instrument	Non-Operative (n=26)	Operative (n= 34)	p-value <sup>1</sup>
<b>ASES</b>			
Mean Score (SD)	99.0 (4.8)	97.0 (8.1)	1.00
Patients (%) with Score $<90^{\dagger}$	1 (4.2%)	2 (5.7%)	
<b>QuickDASH</b>			
Mean (SD)	0.4 (1.8)	2.2 (4.6)	0.50
Patients (%) with Score $>10^{\dagger}$	0 (0.0%)	2 (5.9%)	
<b>EQ-VAS</b>			
Mean (SD)	94.5 (5.6)	92.6 (7.4)	0.50
Patients (%) with Score $<80^{\dagger}$	0 (0.0%)	2 (5.9%)	
<b>EQ-5D Score</b>			
Mean (SD)	0.98 (0.1)	0.95 (0.1)	1.00
Patients (%) with Score $<0.80^{\dagger}$	1 (3.8%)	1 (2.9%)	
<b>General Satisfaction</b>			
Mean (SD)	1.5 (0.8)	1.4 (0.7)	0.39
Patients (%) with Score $>2^{\dagger}$	4 (15.4%)	2 (5.9%)	
<b>Marx Shoulder Activity</b>			
Mean (SD)	11.8 (5.5)	12.9 (5.8)	0.53
Patients (%) with Score $\leq 7^{\dagger}$	4 (10.9%)	8 (17.8%)	

<sup>1</sup> p-values represent outcomes for bifurcated PRO scores only, e.g. “Patients (%) with score...”

**Results:** Eighty-two patients (37 NonOp, 45 Op) were included, 60 (73%) of whom provided 2-year PROs with similar response rates between treatment cohorts. There were no significant differences in demographics or fracture characteristics in the two cohorts other than fracture shortening being greater in the operative cohort

(mean 29mm) compared to the nonoperative cohort (mean 23mm,  $p=0.01$ ). This confounder was controlled for in both regression analysis and propensity score matching. There was no statistically significant difference in the rates of nonunion (none), delayed union (Op 2%, NonOp 0%,  $p=1.0$ ), symptomatic malunion (Op 0%, NonOp 3%,  $p=0.4$ ), refracture (Op 4%, NonOp 3%,  $p=1.0$ ), unexpected surgery (Op 11% vs. NonOp 5%,  $p=0.45$ ), or clinically significant complications (Op 16%, NonOp 5%,  $p=0.17$ ) between cohorts. There were no differences in PROs (Table 1), even when controlling for fracture shortening.

**Conclusions:** Z-type mid-shaft clavicle fractures are one of the most severe fracture patterns seen in adolescent shoulders. Yet, in this comparative investigation of 2-year PROs and complications, surgery appears to offer no benefit over nonoperative management.

**Significance:** The comparable natural histories between this study's operative and nonoperative cohorts are critical for surgeons and their adolescent patients to understand when deciding appropriate management, particularly when reviewing what are often very concerning appearing initial radiographs.