Completely Displaced Midshaft Clavicle Fractures with Skin Tenting in Adolescents: Results from the FACTS Multicenter Prospective Cohort Study

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Purpose: Skin tenting is a commonly applied "relative indication" for surgery for clavicle fractures. However, the true clinical impact of skin tenting on outcome has not been investigated in adolescents. This study compared the clinical and patient-reported outcomes (PROs) of nonoperatively and operatively treated clavicle fractures with skin tenting in adolescents.

Methods: Data from all 10 to 18-year-old patients with completely displaced midshaft clavicle fractures treated at 8 participating institutions from 2013-2022 was filtered to identify a cohort with either of 2 categories of skin tenting at initial presentation: (1) skin tenting or (2) skin-at-risk for necrosis (tented, white, hypovascular). Demographics, fracture characteristics, treatment, complications, return to sport (RTS) timing, and PROs (American Shoulder and Elbow Surgeons [ASES], QuickDASH [abbreviated version of the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire], Marx shoulder activity, EuroQol Visual Analog Scale [EQ-VAS]) were analyzed for patients with a 1-year follow-up minimum.

Results: 91 of 767 (12%) prospectively enrolled adolescents with completely displaced midshaft clavicle fractures presented with skin tenting. Study patients demonstrated older age, greater comminution, shortening and superior displacement than those without skin tenting. 60 patients (66%) underwent open reduction and internal fixation (ORIF), while 31 (34%) were treated nonoperatively (Non-Op). 3 patients (10%) converted to ORIF at a mean of 27 days (range, 6-62 days) post-injury due to increased symptoms or clinical concern by a provider. The Non-Op cohort was, on average, < 1 year younger than the ORIF cohort (Non-Op 14.5 years; ORIF 15.4 years, $P = 0.02$), but no differences in sex ($P = 0.13$), shortening ($P = 0.10$), superior displacement ($P = 0.06$), or comminution ($P = 0.20$) between cohorts. 64% provided PROs at 1 or 2 years post-treatment, with no differences in response rates, RTS, PROs, or complications between cohorts (RTS: $P = 0.78$, ASES: $P = 0.07$, QuickDASH: $P = 0.06$, Marx: $P = 0.25$, EQ-VAS: $P = 0.65$, complications: $P = 0.83$).

Conclusion: In this study, 12% of adolescents with completely displaced clavicle fractures presented with skin tenting, approximately one-third of whom were treated nonoperatively, demonstrating no differences in complications, PROs, or RTS, when compared to ORIF patients or the small percentage of patients (10%) that converted from nonoperative to ORIF treatment. Despite historical dogma derived from adult studies, current evidence suggests that skin tenting, if monitored appropriately in the early post-injury period, may not be appropriate as a surgical indicator for adolescent clavicle fractures, perhaps due to early fracture settling, enhanced healing capacity, and bony remodeling unique to this younger population, demonstrated in recent studies.

Table 1. Cohort, injury, outcome, and complication characteristics for all tenting subjects and by treatment group.

	All tenting (N=91)		Operative (N=60)		Non-operative (N=31)		
Injury characteristic	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	**P**
Age at injury (*years*)	15.1	1.71	15.4	1.54	14.5	1.86	0.02
Male sex (*freq. (%)*)	80	(87%)	55	(92%)	25	(81%)	0.13
AO Fracture Class							0.40
B1.1 simple, spiral	4	(4%)	4	(7%)	0	(0%)	
B1.2 simple, oblique	21	(23%)	11	(18%)	10	(32%)	
B1.3 simple, transverse	16	(18%)	9	(15%)	7	(23%)	
B2.1 wedge, spiral	1	(1%)	1	(2%)	0	(0%)	
B2.2 bending wedge	28	(31%)	19	(32%)	9	(29%)	
B2.3 wedge, comminuted	15	(16%)	11	(18%)	4	(13%)	
B3.1 segmental, spiral	3	(3%)	3	(5%)	0	(0%)	
B3.2 segmental, transverse	2	(2%)	1	(2%)	1	(3%)	
B3.3 complex comminuted	1	(1%)	1	(2%)	0	(0%)	
Comminution	50	(55%)	36	(60%)	14	(45%)	0.20
Shortening	25.3	(9.9)	26.4	(10.6)	23	(8.1)	0.10
Superior Displacement	18	(7.0)	19	(7.5)	16.4	(5.5)	0.06
Patient Reported Outcomes	**Median**	**(IQR)**	**Median**	**(IQR)**	**Median**	**(IQR)**	**P**
ASES total	100	(98-100)	100	(95-100)	100	(100-100)	0.07
Quick DASH Total	0	(0-2)	0	(0-3)	0	(0-0)	0.06
Marx Total	16	(11-20)	16	(10-20)	17	(13-20)	0.25
EQ5D-3L Total	1	(1-1)	1	(1-1)	1	(1-1)	0.78
EQVAS	95	(90-100)	95	(85-100)	95	(90-100)	0.65
Clinical Outcomes	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	**P**
Weeks to RTS* (median (IQR); N=61)	7	(6-11)	7	(6-11)	7	(6-11)	0.78
Secondary Surgeries							0.76
1	5	(7%)	4	(7%)	1	(3%)	
2	1	(1%)	1	(2%)	0	(0%)	
At least one complication	11	(12%)	7	(12%)	4	(13%)	0.83
Complications	**Freq.**	**(%)**	**Freq.**	**(%)**	**Freq.**	**(%)**	
Number of complications							
0	80	(87%)	53	(88%)	27	(87%)	
1	10	(11%)	6	(10%)	4	(13%)	
2	1	(1%)	1	(2%)	0	(0%)	
Complication type							
Converted from Non-op to ORIF	3	(3%)	0	(0%)	3	(10%)	
Symptomatic Malunion	1	(1%)	0	(0%)	1	(3%)	
Hardware-related Complaints/Symptoms	4	(4%)	4	(7%)	0	(0%)	
Wound Dehiscence	1	(1%)	1	(2%)	0	(0%)	
Delayed Union	1	(1%)	1	(2%)	0	(0%)	
Nonunion	1	(1%)	1	(2%)	0	(0%)	
Refracture	1	(1%)	1	(2%)	0	(0%)	

* Return to sport