Rates of Hardware Removal and Refracture after Clavicle Fractures: A National Propensity Matched Cohort Study

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INTRODUCTION: Implant removal after clavicle open reduction and internal fixation (ORIF) is frequently performed for pain, prominence, or patient preference. This study evaluates the ten year refracture risk following ORIF with versus without subsequent hardware removal and compares these outcomes to the baseline risk observed following nonoperative treatment. We hypothesized that hardware removal would be associated with significantly increased ipsilateral refracture rates at both one and ten years.

METHODS: A retrospective cohort analysis was performed using a multi-institutional electronic medical record database. Patients undergoing ORIF or closed treatment of clavicle fractures between January 1, 2003 and January 1, 2023 were identified using procedure and diagnosis codes. Separate cohorts were created for right and left clavicle fractures. For each clavicle side, patients who underwent hardware removal after index ORIF were compared to those who did not undergo removal. Ipsilateral refracture was defined as a new clavicle fracture on the same side occurring at least 90 days following the index date. Refracture incidence was assessed at one and ten year timepoints. A separate cohort of patients treated nonoperatively was analyzed to determine baseline ipsilateral refracture risk. Hazard ratios with 95 percent confidence intervals were calculated using Cox proportional hazards regression.

RESULTS:

Among patients with closed treatment of left clavicle fractures (n = 6706), one year and ten year refracture rates were 1.31 percent and 2.85 percent respectively. For the right clavicle closed treatment cohort (n = 6222), one year and ten year rates were 2.60 and 5.05 percent respectively.

6,375 patients underwent ORIF of the clavicle, with overall rate of hardware removal at 1 and 10 years being 3.15/3.33% and 5.31/5.55% respectively for right and left clavicles. Among right clavicle ORIF patients, hardware removal was associated with significantly elevated refracture rates at both timepoints. At one year, refracture occurred in 11.95 percent of patients who underwent hardware removal (n = 703) versus 2.36 percent in those who retained hardware (n = 5212; hazard ratio 5.13, 95 percent CI 3.89 to 6.77). At ten years, refracture incidence was 16.78 percent in the removal group versus 4.47 percent in controls (hazard ratio 3.90, 95 percent CI 3.12 to 4.86). A similar pattern was observed in left clavicle fractures. One year refracture incidence was 8.99 percent with removal (n = 267) versus 3.27 percent without removal (n = 1163; hazard ratio 2.69, 95 percent CI 1.61 to 4.48). At ten years, incidence increased to 19.10 percent with removal and 6.19 percent without (hazard ratio 3.15, 95 percent CI 2.20 to 4.51).

DISCUSSION AND CONCLUSION: 5.5% of patients who undergo clavicle ORIF will have their hardware removed within 10 years. Patients undergoing hardware removal after clavicle ORIF have a significantly increased risk of ipsilateral refracture compared to patients who do not have hardware removed, especially within one year post hardware removal. Refracture risk remains substantially lower in patients who retain their implants and in those treated nonoperatively. These findings suggest that hardware removal carries a significant risk for refracture, and patients who elect for operative fixation of clavicle fractures should be counseled on the long term risk of hardware removal and possible refracture.

Table 1: Ipsilateral Clavicle Refracture Rates at One and Ten Years Following Closed Treatment

Clavicle	Timepoint	N (Patients in Cohort)	Ipsilateral Refractures	Incidence (%)
Left	1 Year	6,706	88	1.31%
Right	1 Year	6,222	162	2.60%
Left	10 Years	6,706	191	2.85%
Right	10 Years	6,222	314	5.05%

Table 2: Ipsilateral Clavicle Refracture Rates at One and Ten Years Following ORIF With and Without Hardware Removal

Clavicle Side	Timepoint	Cohort	Patients (n)	Refractures (n)	Incidence (%)	Hazard Ratio (95% CI)
Right	1 Year	ORIF with Hardware Removal	703	84	11.95%	5.127 (3.885–6.766)
		ORIF with Hardware Retained	5,212	123	2.36%	
	10 Years	ORIF with Hardware Removal	703	118	16.78%	3.896 (3.122–4.862)
		ORIF with Hardware Retained	5,212	233	4.47%	
Left	1 Year	ORIF with Hardware Removal	267	24	8.99%	2.688 (1.612–4.481)
		ORIF with Hardware Retained	1,163	38	3.27%	
	10 Years	ORIF with Hardware Removal	267	51	19.10%	3.147 (2.198–4.505)
		ORIF with Hardware Retained	1,163	72	6.19%	

Table 3: Clavicle Hardware Removal Rates at One and Ten Years Following ORIF

Clavicle Side	1 Year Hardware Removal Rate	10 Year Hardware Removal Rate
Right	3.15%	5.31%
Left	3.33%	5.55%