Healthcare Costs Associated with Long bone Fracture Non-Union – A US Claims Database Analysis

Mari F. Vanderkarr[1], Jill W. Ruppenkamp[1], Mollie Vanderkarr[2], Chantal E. Holy[1], Michael Blauth[3]

1: Epidemiology & Real-World Data Sciences, Johnson and Johnson MedTech, New Brunswick, NJ – USA;
2: Health Economics Market Access, DePuy Synthes, West Chester, PA – USA;
3: Medical Affairs, DePuy Synthes, Zuchwil, SO - Switzerland

OBJECTIVES

- Few contemporary long bone non-union cost analyses have been performed in the United States.[1,2]
- Our Objective was to analyze the healthcare burden of non-union from the perspective of the US payer.

METHODS

Study Design: Retrospective cohort analyses

Data Source: IBM® MarketScan® Commercial Claims and Encounters database

Study Population: All Patients with femur, tibia or humerus fractures treated in the inpatient setting and requiring surgical fracture repair, from Q4 2015 to Dec 31, 2021.

- *Index:* Defined as date of surgical intervention for fracture repair.

- *Exclusion criteria:* polytrauma, revision of prior trauma, continuous enrollment < 30 days and long-bone fracture site amputation at time of index surgery.

Study Duration: 2 years from index.

Outcomes: Healthcare cost of non-union, infected non-union and reoperated non-union.

Variables: Patient demographic and comorbid factors, fracture location and severity of soft tissue trauma.

Statistical Analysis: Crude and adjusted rates of non-union at 1- and 2-years using Poisson regressions with log link; Marginal, incremental cost of care associated with non-union, infection and reoperation, using a Generalized Linear Model (GLM) with log link and gamma distribution.

RESULTS

- 31,079 Patients were identified, as shown in Table 1

***Table 1**: Demographic, clinical and fracture characteristics of patients with femur, tibia, and humerus fractures requiring surgical repair.*

	Femur	Tibia	Humerus
N	12,770	13,504	4,805
Gender: Male (vs Female)	6,435 (50.4%)	7,026 (52.0%)	2,159 (44.9%)
Age (Mean (SD))	44.17 (19.46)	42.21 (16.03)	36.26 (22.19)
Elixhauser Index (Mean (SD))	1.61 (2.20)	1.04 (1.60)	1.16 (1.77)
Fracture Type			
Trochanteric Fracture	4,607 (36.1%)	NA	NA
Neck Fracture	6,417 (50.3%)	NA	844 (17.6%)
Shaft Fracture	4,844 (37.9%)	7,715 (57.1%)	1,933 (40.2%)
Condylar Fracture	1,120 (8.8%)	3,709 (27.5%)	1,858 (38.7%)
Other / Unspecified	987 (7.7%)	162 (1.2%)	82 (1.7%)
Pilon /Malleolus Fracture	NA	2,832 (21.0%)	NA
Proximal End Fracture	NA	2,643 (19.6%)	1,662 (34.6%)
Distal End Fracture	NA	2,770 (20.5%)	1,614 (33.6%)
Tuberosity Fracture	NA	NA	399 (8.3%)
Clinical Presentation			
Displaced Fracture	9,531 (74.6%)	12,054 (89.3%)	3,938 (82.0%)
Comminuted Fracture	2,299 (18.0%)	3,509 (26.0%)	1,283 (26.7%)
Fracture Gustilo Classification			
Closed	11,088 (86.8%)	9,857 (73.0%)	4,027 (83.8%)
Open Type I or II	1,034 (8.1%)	2,268 (16.8%)	697 (14.5%)
Open Type III	351 (2.7%)	1,315 (9.7%)	12 (0.2%)
Unknown	297 (2.3%)	64 (0.5%)	69 (1.4%)
Fixation Type			
Internal Fixation	4,987 (39.1%)	7,226 (53.5%)	3,638 (75.7%)
Intramedullary Fixation	6,127 (48.0%)	3,635 (26.9%)	304 (6.3%)
External Fixation	193 (1.5%)	2,466 (18.3%)	110 (2.3%)

- Two- year rates of non-union ranged from 7.2% (humerus) to 9.1% (tibia), as shown in Table 2.
- Infected non-unions were rare, affecting only 0.6% of femur fractures and up to 2% in tibial fractures.
- By the end of the 2-year study period, not all patients with femoral or humeral nonunion had been reoperated. However, all patients with tibial non-union were reoperated.

***Table 2:** Rates of non-union (all cases), deep infected non-union, and reoperations with diagnosis of non-union, at 365 and 730-day follow-up.*

	Femur		Tibia		Humerus	
Complication	365-Day	730-Day	365-Day	730-Day	365-Day	730-Day
All Non-union Cases	7.5% (7.0%-8.0%)	8.5% (8.0%-9.1%)	8.3% (7.8%-8.8%)	9.1% (8.6%-9.7%)	6.4% (5.6%-7.1%)	7.2% (6.4%-8.1%)
Infected Non-Union	0.6% (0.4%-0.7%)	0.6% (0.4%-0.7%)	1.9% (1.7%-2.2%)	2.0% (1.7%-2.3%)	0.9% (0.6%-1.2%)	0.9% (0.6%-1.2%)
Reoperated Non-Union*	4.7% (4.3%-5.1%)	6.0% (5.5%-6.5%)	7.0% (6.5%-7.4%)	9.1% (8.5%-9.7%)	3.8% (3.2%-4.4%)	4.9% (4.2%-5.7%)

*By end of 730-day follow-up period

***Table 3:** Incremental cost of care of patients with non-union (vs no non-union), and additional marginal costs for concurrent deep infection and reoperations.*

Anatomy	2-year Outcome	Marginal Incremental Cost, by Diagnosis/Procedure Type	
		365-Day	730-Day
Femur	Nonunion	$ 27,982 ($ 17,816-$ 38,148)	$ 45,633 ($ 23,913-$ 67,352)
	Deep Infection	$ 63,908 ($ 42,404-$ 85,413)	$ 86,983 ($ 42,399-$ 131,566)
	Reoperation	$ 22,865 ($ 15,671-$ 30,060)	$ 25,941 ($ 11,914-$ 39,969)
Tibia	Nonunion	$ 31,502 ($ 25,818-$ 37,185)	$ 40,409 ($ 30,295-$ 50,523)
	Deep Infection	$ 52,016 ($ 43,456-$ 60,576)	$ 71,235 ($ 56,363-$ 86,107)
	Reoperation	$ 33,550 ($ 29,588-$ 37,511)	$ 34,327 ($ 27,543-$ 41,112)
Humerus	Nonunion	$ 20,925 ($ 9,101-$ 32,748)	$ 33,308 ($ 14,603-$ 52,013)
	Deep Infection	$ 34,580 ($ 11,815-$ 57,345)	$ 46,325 ($ 12,189-$ 80,461)
	Reoperation	$ 16,775 ($ 9,484-$ 24,067)	$ 16,183 ($ 4,723-$ 27,643)

CONCLUSIONS

Non-union is associated with significant incremental costs. Without concurrent infection, non-union conditions add between $33K-$46K costs. Concurrent infection results in an additional $46K-$87K.

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