

Association of Disability Benefits and/or Litigation With Time to Return to Work After Tibia Shaft Fracture Fixation

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Objectives: We explored the association of compensation status with return to work (RTW) after tibial fracture. **Methods:** Eligible patients were adults with tibial shaft fractures enrolled in the Trial to Re-evaluate Ultrasound in the Treatment of Tibial Fractures. We explored the association between disability benefits and/or litigation and RTW using multivariable discrete interval hazard analysis, adjusting for sex, age, country of residence, smoking status, body mass index, polytrauma, fracture severity, fracture gap, pain severity, and physical functioning. **Results:** Of 330 eligible patients, 111 (34%) had not returned to full-time work 1-year after surgery. In our adjusted model, receipt of disability benefits and/or involvement in litigation was associated with delayed RTW (HR = 0.71, 95% CI 0.52-0.96). **Discussion:** Tibial shaft fracture patients receiving disability benefits and/or involved in litigation are less likely to RTW.

Keywords: disability, discrete interval hazard analysis, intramedullary fixation, litigation, return to work, tibial fracture

Tibia fractures represent 37% of all long-bone fractures^{1,2} and account for ~500,000 hospital admissions per year in the United States.^{3,4} Most tibial shaft fractures are managed surgically, and the large majority (~85%) are treated with intramedullary nailing.^{5,6} Outcomes after surgical fixation are variable and approximately a third of patients do not return to full-time work at 1-year post-surgery.^{7,8} In the United States, the direct and indirect costs due to loss of productivity following tibial fracture approximates \$1.4 billion annually.^{9,10}

Receipt of disability benefits and involvement in litigation are negatively associated with functional recovery and return to work (RTW) following lumbar fusion, subacromial decompression, and shoulder arthroplasty.¹¹⁻¹⁴ Moreover, a systematic review of

129 studies found surgical patients receiving disability benefits or engaged in litigation were almost four times more likely to report unsatisfactory outcomes versus similar patients not in receipt of disability benefits or pursuing litigation.¹⁵

The relationship between the compensation and/or litigation and RTW in tibial fracture patients is not established. If an important association exists, fracture patients presenting with this feature could be identified and targeted for concurrent interventions in an effort to improve prognosis. Using data from the Trial to Re-evaluate Ultrasound in the Treatment of Tibial Fractures (TRUST),¹⁶ we evaluated the association between receiving disability benefits and/or involvement in litigation and time to return to full time work without limitations among tibial fracture patients.

METHODS

We reported our findings in concordance with the Strengthening the Reporting of Observational studies in Epidemiology statement.¹⁷

Study Design and Participants

We used data from TRUST, a randomized controlled trial of 501 adult patients with unilateral open (Gustilo grade I-IIIB) or closed tibial shaft fractures managed with intramedullary nailing, recruited from 43 trauma centers across the United States and Canada.¹⁶ Outcome data were collected at 6, 12, 18, 26, 38, and 52-weeks after surgery. The TRUST trial evaluated the effectiveness of low-intensity pulsed ultrasound (LIPUS) versus a sham device and found no benefit on functional recovery or time to radiographic healing. The TRUST trial was approved by the Hamilton Integrated Research Ethics Board and local ethics boards, and registered at www.clinicaltrials.gov (NCT00667849).

Outcome

Our outcome was return to full-time work with no restrictions or limitations within 1-year of surgical fixation.

Measuring Disability Benefit Status and Involvement in Litigation

In the TRUST trial, data for receipt of disability benefits and involvement in litigation were collected separately. For this study, guided by the literature,¹⁵ we combined disability benefits and litigation into a single variable. Thus, patients who were receiving disability benefits and engaged in litigation only counted as one observation to avoid double counting.

Selection of Independent Variables

We selected 10 factors previously reported as predictors of delayed physical recovery or RTW after surgery: (1) female sex, (2) older age, (3) residing in Canada versus the United States, (4) positive smoking status, (5) greater body mass index (BMI), (6) polytrauma, (7) open or comminuted fracture, (8) fracture gap greater than 1 cm after surgery, (9) greater pain severity at 6-weeks after surgery, and (10) lower physical functioning at 6-weeks after surgery.^{8,18} We measured pain with a 0 to 10 numeric rating scale

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TABLE 1. Baseline Characteristics

Characteristics	Patients Who Had Returned to Work by 1 year (n = 219)	Patients Who Had Not Return to Work by 1 year (n = 111)	Total Patients (n = 330)
Country of residence, n (%)			
Canada	53 (24.3%)	28 (25.0%)	81 (24.5%)
United States	166 (76.2%)	83 (74.1%)	249 (75.5%)
Age, mean (SD)	37.9 (6.3)	35.9 (11.2)	37.2 (12.1)
Female sex, n (%)	74 (33.9%)	23 (20.5%)	97 (29.4%)
Current smoker (%)	51 (23.4%)	45 (40.2%)	96 (29.1%)
Body mass index, mean (SD)	27.5 (6.3)	27.3 (6.1)	27.5 (6.2)
Diabetes Mellitus (%)	14 (6.39%)	2 (1.8%)	16 (4.84%)
Poly-trauma, n (%)	41 (18.8%)	31 (27.7%)	72 (21.8%)
Fracture gap > 1 cm, n (%)	1 (0.5%)	1 (0.9%)	2 (0.6%)
Open fracture, n (%)	39 (17.9%)	34 (40.4%)	73 (22.1%)
Randomized to low-intensity pulsed ultrasound, n (%)	116 (53.2%)	49 (43.8%)	165 (50%)
Receiving disability benefits or involved in litigation, n (%)	80 (36.7%)	51 (45.5%)	131 (39.7%)
Pain severity at 6-weeks post-surgery on an 11-point NRS, mean (SD)	3.28 (1.15)	3.69 (0.96)	3.42 (1.10)
Physical function at 6-weeks post-surgery on the 100-point SF-36 PCS score, mean (SD)	31.71 (7.81)	30.27 (7.91)	31.22 (7.86)

NRS, 0 to 10-point numeric rating scale for pain, higher scores are worse; SD, standard deviation; SF-36 PCS, 0 to 100-point short form-36 physical component summary score, higher scores are better.

(NRS), higher scores are worse, and physical function with the 0 to 100 short form-36 physical component summary (SF-36 PCS) score, higher scores are better. Tibial fracture patients with an additional injury, such as another fracture, dislocation or vascular injury of the upper or lower extremities, were considered as a poly trauma patient.

Statistical Analysis

For our analysis, we considered patients who were working before their injury and had not returned to work by 6-weeks post-surgery. We excluded patients who resumed employment within 6 weeks of surgery, as collecting predictors and outcomes at the same time precludes confident assessment of the direction of association. Patients whose disability or litigation status was not reported at 6-weeks post-surgery were excluded from analysis. We reported the mean and standard deviation (SD) of continuous variables, and the number of occurrences and percentages for categorical variables. We used discrete time survival analysis to explore the association between receipt of disability benefits and/or involvement in litigation and time to RTW without limitations over 1-year post-tibial fixation. We performed discrete time as opposed to time-to-event analysis as we collected outcome data for TRUST patients at set intervals, and so the exact time of RTW was unknown. Discrete time survival analysis accounts for this limitation, whereas Cox proportional hazard modeling does not.¹⁹ We adjusted our regression model for follow-up time, the 10 covariates described

above, and receipt of either LIPUS or sham therapy, which were administered in the TRUST study.¹⁶

To avoid over fitting, we required at least 10 events and 10 nonevents per independent variable, for a minimum of 90 patients who returned to work, and 90 that did not by 1 year after surgical fixation.²⁰ We excluded independent variables with fewer than 50 occurrences, unless we were able to collapse them with other related variables to exceed this threshold, to provide reassurance that each variable had sufficient discriminant power to detect an association with full-time RTW if such an association existed. We produced Kaplan-Meier curves to depict the rate of return to full time work among fracture patients with and without disability benefits and/or engaged in litigation. We used the log-rank test to examine the relationship between disability and/or litigation and full time RTW. Participants who had not returned to work at 12 months were censored, as were patients who had not returned to work at their last visit and for whom we did not have complete follow-up. We performed time-to-event analyses using discrete interval hazard models to quantitatively assess the association between the independent variables and time to return to full-time work without limitations. We calculated adjusted hazard ratios (HRs) for our time-to-event analyses, and the associated 95% confidence intervals (CIs) and P values. The significant of the difference between pain intensity and SF-36 PCS scores at 12 months, between fracture patients that had and had not returned to work, was assessed with an independent samples t-test.

TABLE 2. Frequency of Return to Work

Follow-up	Total RTW, n (%) (n = 330)		RTW Among United States Patients, n (%) (n = 249)		RTW Among Canadian Patients, n (%) (n = 81)	
	By Follow-up	Cumulative	By Follow-up	Cumulative	By Follow-up	Cumulative
Week 12	43 (13.0%)	43 (13.0%)	38 (15.3%)	38 (15.3%)	5 (6.2%)	5 (6.2%)
Week 18	64 (19.4%)	107 (32.4%)	47 (18.9%)	85 (34.1%)	17 (21.0%)	22 (27.2%)
Week 26	51 (15.5%)	158 (47.9%)	39 (15.7%)	124 (49.8%)	12 (14.8%)	34 (42.0%)
Week 38	43 (13.0%)	201 (60.9%)	33 (13.3%)	157 (63.1%)	10 (12.4%)	44 (54.3%)
Week 52	18 (5.5%)	219 (66.4%)	9 (3.6%)	166 (66.7%)	9 (11.1%)	53 (65.4%)

RTW, return to work.

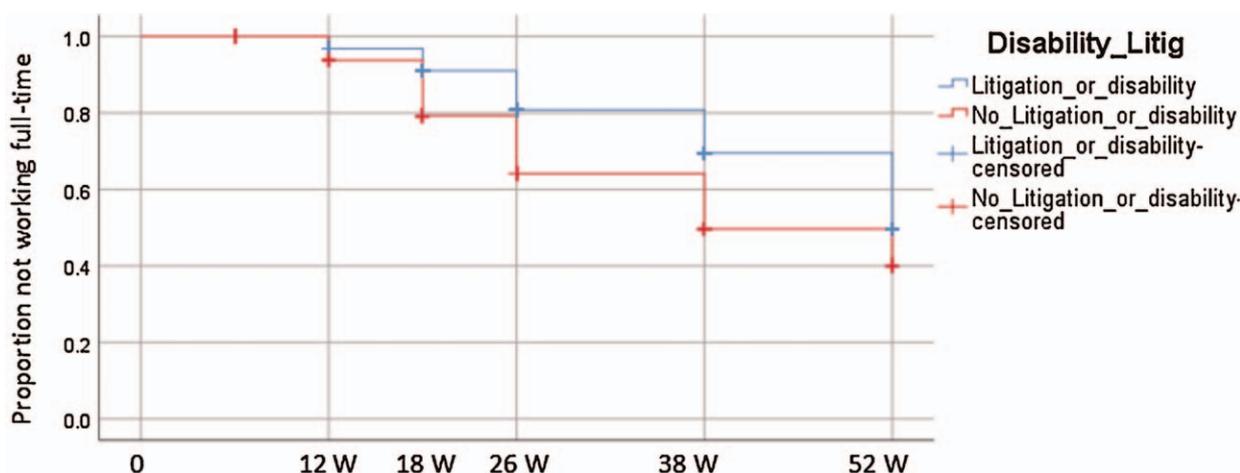


FIGURE 1. Kaplan-Meier curve for receipt of disability benefits and/or involvement in litigation.

To confirm the proportional hazards assumption was met for each variable in our model, we calculated its interaction with time, while entering the remaining variables in the model without interactions.²¹ We considered *P* value of ≤ 0.05 for the interaction term as significant. We planned to report the HRs for independent variables that violated the proportional hazards assumption at 60 days, 6 months and 1 year. The goodness-of-fit of the model was determined by visual inspection of the log-log plot, and outliers were explored with deviance residuals (DRs).^{22–24} All analyses were performed with IBM SPSS Statistics for Windows, version 25.0 (IBM Corp, Armonk, NY) using two-tailed tests with $\alpha = 0.05$.

RESULTS

Of 501 patients enrolled in TRUST, 338 patients were eligible for our study. We were missing disability benefits/litigation status for eight patients (2%), leaving 330 available for analysis (Appendix Figure 1, <http://links.lww.com/JOM/A719>). Characteristics of patients who did and did not return to full time work with no restrictions, and the rate at which they returned to work, are reported in Tables 1 and 2. The mean age of participants was 37.2 (SD 12.1) and 29% of participants (97 of 330) were female. Approximately

22% of patients (72 of 330) suffered poly trauma, and fibular fractures were the most common additional injury. At 6-weeks after surgery, the mean pain severity among patients on the NRS for pain was 3.42 (SD 1.10) and mean physical function as per the SF-36 PCS score was 31.22 (SD 7.86). One-third of patients ($n = 111$, 34%) had not returned to full-time work without restrictions 1-year after surgical fixation (Table 2). Figure 1 presents the Kaplan-Meier curve for time to return to work, which shows that patients receiving disability benefits and/or engaged in litigation were significantly less likely to resume employment ($P < 0.001$). Compared to individuals who returned to work within a year of surgery, those that did not reported greater pain (mean NRS score 2.22 [SD 0.91] vs 3.15 [SD 1.05]); mean difference 0.93 [95%CI 0.78-1.08]) and worse physical functioning (mean SF-36 PCS score 49.20 [SD 7.04] vs 36.93 [SD 8.96]; mean difference -12.27 [95%CI -13.51 to -11.10]).

Characteristics Associated with Return to Work

In univariate analysis, positive smoking status, open fracture, receipt of disability benefits and/or involvement in litigation, greater pain severity and higher physical function at 6-weeks post-operatively,

TABLE 3. Factors Associated With Return to Full-Time Work Without Limitations Within 1 year

Factor	Univariable Analysis		Multivariable Analysis	
	Hazard Ratio (95% CI)	<i>P</i> Value	Hazard Ratio (95% CI)	<i>P</i> Value
Canadian vs American (ref)	0.93 (0.81, 1.07)	0.33	0.78 (0.56, 1.10)	0.16
Older age (10 per years)	0.95 (0.81, 1.10)	0.50	0.95 (0.81, 1.10)	0.505
Female sex vs male (ref)	1.21 (0.90, 1.62)	0.19	1.27 (0.93, 1.72)	0.12
Current smoker	0.71 (0.51, 0.99)	0.04	0.87 (0.61, 1.24)	0.46
Body mass index	0.99 (0.97, 1.01)	0.77	0.99 (0.97, 1.01)	0.62
Poly-trauma	0.72 (0.57, 1.02)	0.07	0.72 (0.50, 1.03)	0.07
Open vs closed fracture (ref)	0.69 (0.48, 0.99)	0.04	0.73 (0.50, 1.07)	0.11
LIPUS vs sham therapy	1.14 (0.87, 1.51)	0.33	1.20 (0.90, 1.60)	0.19
Disability benefits and/or litigation	0.70 (0.53, 0.94)	0.01	0.71 (0.52, 0.96)	0.02
Greater pain severity at 6-weeks after surgery (per point)*	0.81 (0.71, 0.91)	<0.01	0.83 (0.72, 0.96)	0.01
Higher physical function at 6-weeks after surgery (per point)†	1.02 (1.01, 1.04)	<0.01	1.02 (1.00, 1.04)	0.04
Follow-up duration	1.27 (1.20, 1.35)	<0.01	1.33 (1.25, 1.41)	<0.01

Ref, reference factor; LIPUS, low-intensity, pulsed ultrasound.

*Pain severity was measured with a 0 to 10-point numerical rating scale.

†Physical functioning was measured with the 0 to 100-point SF-36 physical component summary score.

were significantly associated with RTW at 12 months. Our adjusted regression analysis shows that receipt of disability benefits and/or involvement in litigation (HR = 0.71, 95%CI 0.52-0.96), and greater pain severity at 6-weeks post-surgery (HR = 0.83 for each point, 95% CI 0.72-0.96) were associated with delayed return to full-time work. Higher functional ability at 6-weeks after surgery (HR = 1.02 for each point, 95% CI 1.00-1.04) was associated with faster return to full-time work. Country of residence (Canada vs United States), older age, sex, smoking status, BMI, polytrauma, and fracture severity were not associated with time to RTW (Table 3). The proportional hazards assumption was met for all independent variables (Appendix Figure 2, <http://links.lww.com/JOM/A719>). Goodness of fit of our model was confirmed (DR = 1.03).

DISCUSSION

Our analysis of tibial shaft fracture patients who remained off work at 6-weeks after intramedullary nailing found a third had not returned to full-time work without limitations at 1-year. Patients receiving disability benefits and/or engaged in litigation, and those reporting higher pain 6-weeks after surgery, were less likely to resume employment. Patients who reported higher physical function 6-weeks following surgery were more likely to be working at 1-year. Patient sex, age, country of residence, BMI, smoking status, and injury severity were not associated with time to RTW.

Strengths of our study include adjustment of our regression model for clinically relevant patient and injury characteristics, and very little missing data (2%). Inclusion of American and Canadian patients increases the generalizability of our findings. Further, our patients were part of a randomized controlled trial, in which the surgical procedure and postoperative care were standardized, which limits the impact that these variables may have had on resuming employment.

Our study also had limitations. Our adjusted analysis did not control for all potential prognostic factors (eg, psychological and workplace factors). Secondly, one of our a priori independent variables, fracture gap greater than 1 cm, had fewer than 50 observations, which precluded inclusion in our regression model exploring associations with RTW.

A 2015 systematic review found moderate to strong evidence of an association between compensation status and legal representation with poorer psychological and physical function among patients with musculoskeletal injuries.²⁵ The role of compensation and litigation and RTW has been less studied. A 2010 systematic review of employment following acute orthopedic trauma identified two studies that explored receipt of injury compensation and found an association with increased time off work, and two studies that explored involvement in litigation and reported inconsistent results.²⁶ Subsequent to this review, a cohort study of 334 individuals who experienced motor vehicle related orthopedic trauma found no association with either receipt of disability benefits or retaining legal representation within 6 months and RTW over 2 years; however, this study reported a 46% loss to follow-up.²⁷

Clinical Significance

Our findings add to the current literature suggesting an important association between receiving disability benefits and/or engagement in litigation and less likelihood of RTW among tibial fracture patients. Moreover, injury severity and polytrauma were not associated with RTW. These findings suggest that the decision to resume employment after tibial fracture is strongly influenced by psychosocial factors and improving the chances of RTW among high risk patients may require interventions beyond optimal surgical management.

Conclusions and Future Research

Our study found that one-third of workers who undergo surgical fixation for tibial fracture do not return to full-time work by 1 year, and that receipt of disability benefits and/or engagement in litigation are associated with delayed RTW. Our findings should be confirmed in additional large, cohort studies, that include adjustment for psychological and workplace factors.

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