Published in final edited form as:

Clin J Pain. 2016 March ; 32(3): 196–202. doi:10.1097/AJP.0000000000000246.

Clinical significance of pain at hospital discharge following traumatic orthopaedic injury: general health, depression, and PTSD outcomes at 1 year

Kristin R. Archer, PhD, DPT,
Department of Orthopaedic Surgery, Department of Physical Medicine and Rehabilitation, Vanderbilt University, School of Medicine, Nashville, TN

Sara E. Heins,
Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Christine M. Abraham, MA,
Department of Orthopaedic Surgery, Vanderbilt University, School of Medicine, Nashville, TN

William T. Obremskey, MD, MPH,
Department of Orthopaedic Surgery, Vanderbilt University, School of Medicine, Nashville, TN

Stephen T. Wegener, PhD, and
Department of Physical Medicine and Rehabilitation, Johns Hopkins Medicine, Baltimore, MD

Renan C. Castillo, PhD
Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Abstract

Objectives—The purpose of this study was to determine whether pain at hospital discharge is associated with general health and depression and post-traumatic stress disorder (PTSD) at 1 year following traumatic orthopaedic injury.

Methods—This study prospectively enrolled 213 patients, 19 to 86 years of age, admitted to an Academic Level 1 trauma center for surgical treatment of a traumatic lower-extremity or upper-extremity orthopaedic injury. Pain at hospital discharge was measured with the Brief Pain Inventory. At 1 year follow-up, physical and mental health was assessed with the SF-12 and depressive and PTSD symptoms with the 9-item Patient Health Questionnaire (PHQ-9) and PTSD Checklist-Civilian Version (PCL-C), respectively. Cut-of scores of 10 on the PHQ-9 and 44 on the PCL-C classified patients as having depression or PTSD.

Results—133 patients (62%) completed follow-up at 1 year. Responders and non responders did not differ significantly on baseline characteristics. Multivariable regression found that increased

Corresponding Author: Kristin R. Archer, PhD, DPT, Department of Orthopaedic Surgery, Vanderbilt University, School of Medicine, Medical Center East, South Tower, Suite 4200, Nashville, TN, 37232, phone: 615-322-2732, fax: 615-936-1566, kristin.archer@vanderbilt.edu.

This work was presented in part at the Orthopaedic Trauma Association 29th Annual Meeting, Phoenix, Arizona, October 12, 2013.

pain at discharge was significantly associated with depression (OR = 3.3; $p < 0.001$) and PTSD (OR = 1.4; $p = 0.03$) at 1 year, after controlling for age, education, injury severity score, and either depressive or PTSD symptoms at hospital discharge. Early postoperative pain was not a significant risk factor for long-term physical and mental health.

Discussion—Findings highlight the importance of early screening for uncontrolled postoperative pain to identify patients at high risk for poor psychological outcomes and who could benefit from more aggressive pain management. Results suggest early interventions are needed to address pain severity in patients with orthopaedic trauma.

Keywords

Postoperative Pain; Depression; Post-Traumatic Stress Disorder; Quality of Life; Trauma

Introduction

The persistence of moderate to severe pain is widespread in patients following traumatic orthopaedic injury. Studies report levels of moderate to severe pain in 48% to 59%[1,2] of trauma survivors at hospital discharge and in 30% to 37%[2-5] of patients within 6 months post injury. Elevated pain early in the recovery process has been found to predict chronic pain. Studies by Williamson et al.[2] and Clay et al.[5] demonstrated that high pain intensity at hospital discharge and at 2 weeks postinjury, respectively, is a significant risk factor for pain at 6 months following acute orthopaedic trauma. Pain at 3 months has also been found to predict chronic pain at 1 year and 7 years.[3,6]

Despite the importance of persistent pain following orthopaedic trauma, limited research has examined the relationship between pain during the acute postoperative period and long-term health outcomes. The Lower Extremity Assessment Project (LEAP), which enrolled patients between 1995 and 1999, found that higher levels of pain at the preceding time point were related to lower levels of functioning at 6 and 12 months following high-energy trauma,[7] while increased pain at 3 months was found to be a highly significant predictor of lower rates of return-to-work within 84 months postinjury.[8] The LEAP study group has also noted a longitudinal relationship between 3 month pain scores and depression and anxiety symptoms during the first year following surgery.[9]

The primary objective of the current study was to determine whether pain at hospital discharge was associated with outcomes at 1 year following traumatic orthopaedic injury. We hypothesized that increased early postoperative pain would be associated with decreased general health and the presence of depression and post-traumatic stress disorder (PTSD) after controlling for demographic and injury characteristics.

Materials and Methods

Participants

This study prospectively enrolled 213 patients, 19 to 86 years of age, admitted to an Academic Level 1 trauma center for surgical treatment of a traumatic lower-extremity (87%) or upper-extremity (13%) orthopaedic injury. Patients with intracranial hemorrhage indicating moderate to severe brain injury, spinal cord deficit, history of schizophrenia or other psychotic disorder, a Glasgow Coma Scale (GCS) score less than 14 on admission, surgery for an extremity amputation, or length of stay (LOS) less than 24 hours were excluded. This study was reviewed and approved by the participating site's Institutional Review Board.

Procedures

Patient recruitment occurred between November 2009 and March 2011. Participants were enrolled on the orthopaedic unit within 48 hours after surgery. Patients were asked to complete a baseline self-report assessment containing questions on marital status, education, pre-injury employment, comorbid conditions, and preinjury psychological conditions. Demographic, injury, and surgery characteristics, such as age, sex, race, insurance status, height and weight, mechanism of injury, injury severity score (ISS), GCS score, surgery type, length of hospital stay and body region of injury were abstracted from patient medical records.

Pain intensity was measured at hospital discharge with a modified version of the Brief Pain Inventory (BPI).[10] The pain intensity scale includes 4-items assessing current, worst, least and average pain, with ‘0’ being no pain and ‘10’ being severe pain. The instructions were modified for use in the hospital setting by asking patients to describe their pain during the hospital stay. The BPI has proven reliable (Cronbach's alpha > 0.80) and valid (highly correlated with the SF-36 brief pain scale, the Roland Disability Questionnaire, the McGill Pain Questionnaire, and the Visual Analog Scale for pain) in surgical patients.[11,12] Depressive and PTSD symptoms were also measured at hospital discharge using well-established and validated questionnaires.

A follow-up assessment was conducted at 1-year after hospital discharge to gather data on general physical and mental health and depressive and PTSD symptoms. Assessments were mailed to those patients not returning to the clinic. If a person did not respond within one week after mailing the questionnaire, patients were contacted by telephone, and requested to complete and return the questionnaire within 5 days.

Outcome Measures

General physical and mental health was measured with the physical and mental component scales of the SF-12.[13] The physical component scale (PCS) assesses the four subdomains of physical functioning, role-physical, bodily pain, and general health and the mental component scale (MCS) assesses the 4 subdomains of vitality, social functioning, role-emotional, and mental health. The PCS and MCS of the SF-12 have demonstrated responsiveness, good test–retest reliability (Pearson's r > 0.75), good internal consistency (Cronbach's alpha > 0.70), and validity with correlations greater than 0.90 with the SF-36 in generalized and various patient populations.[13-15]

Depressive and PTSD symptoms were measured with the 9-item Patient Health Questionnaire (PHQ-9) and PTSD Checklist-Civilian version (PCL-C), respectively.[16,17] Both instruments were developed using the diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The PHQ-9 scores each of the DSM-IV criteria as '0' (not at all) to '3' (nearly every day) and a total score ranges from 0 to 27. PHQ-9 scores of 5, 10, 15, and 20 represent mild, moderate, moderately severe, and severe depression, respectively. [18] In a psychometric study of the PHQ-9 compared to independent diagnoses made by mental health professionals, the instrument was both sensitive (0.75) and specific (0.90) for the diagnosis of major depression.[19] Internal reliability scores have been estimated at 0.89 in a primary care population.[18] A score of 10 or higher has been recommended as a cut-off for clinically significant depression and has been found to have sensitivity and specificity of 88% for major depression.[18]

The 17-item PCL-C rates how much patients were bothered by a particular symptom during the last month (from '1' (not at all) to '5' (extremely)) and a total score ranges from 17 to 85. The PCL-C has demonstrated good reliability and convergent validity with moderate to high correlations with the Clinician-Administered PTSD Scale and the Mississippi PTSD Scale and measures of anxiety, depression, hostility, and physical and emotional functioning.[20] A score of 44 or higher has been found to have high sensitivity (.94) and specificity (.86) for the diagnosis of PTSD and is recommended for individuals in specialized medical clinics. [21]

Statistical Analysis

Descriptive statistics were used to summarize all study variables (means, medians, standard deviations, frequency). All continuous variables were examined for the assumptions required for parametric analyses. Differences between survey responders and nonresponders at 1 year after hospital discharge were examined with Student's t-tests and Chi-Square tests. Analysis of variance (ANOVA) and Chi-Square tests assessed differences in demographic and injury characteristics and pain intensity at hospital discharge by type of surgical procedure (acute vs. revision vs. infection) to support combining patients into a single group for subsequent analysis.

Pearson correlation coefficients with a Bonferroni correction were used to examine associations between pain and depressive and PTSD symptoms at hospital discharge and pain at hospital discharge and outcomes at 1 year. Separate bivariate and multivariable regression analyses were used to determine whether pain intensity at hospital discharge was associated with the outcomes of physical and mental health and the presence of depression and PTSD. Linear models were used for general physical and mental health and logistic models for depression and PTSD outcomes. Cut-off scores identified from the literature, 10 for the PHQ-9 and 44 for the PCL-C, were used to classify participants as having clinically significant depression and PTSD. All models controlled for the *a priori* variables of age, education, and ISS. Depression and PTSD models also controlled for psychological symptoms of interest at hospital discharge. Additional variables of insurance, comorbid conditions, preinjury psychological conditions, body mass index (BMI), presence of multiple injuries, surgery type and mechanism of injury that were significant at $p < 0.05$ in bivariate regression analyses were included in final multivariable models. Stata statistical software (Version 11.0; Stata Corp, 4905 Lakeway Dr, College Station, TX 77845) was used to analyze the data. The level of significance was set at $\alpha = 0.05$.

Results

Out of 384 eligible patients approached, 213 (55%) agreed to participate in the study and completed a pain assessment at hospital discharge. There were no significant differences in age, sex, insurance status, surgery type, mechanism of injury, and length of hospital stay between eligible patients who were enrolled and those who were not enrolled ($p > 0.05$). However, enrolled patients compared to non-enrolled patients were more likely to be White (93% vs. 85%) ($p < 0.01$). One hundred and thirty-three patients (62%) completed a 1 year follow-up assessment. Patients who were lost to follow-up at 1 year did not differ significantly on any measured demographic, injury, or health status characteristics compared to patients with complete data (Table 1). The majority of participants were White (93%), male (56%), and had less than or equal to a high school education (53%). Eighty-seven percent of the primary orthopaedic injuries were lower-extremity, with 9% pelvis/acetabular, 28% femur, 31% tibia, and 19% foot/ankle. The remaining thirteen percent were humerus (7%) and forearm (6%) injuries.

Preliminary analyses determined that patients having surgery for acute trauma, revision or infection were not significantly different on baseline characteristics or pain intensity at hospital discharge. All patients were combined into one sample for further analyses.

Hospital Discharge

Average pain intensity on the BPI was 6.3 (SD: 2.4) at hospital discharge. Twenty-eight percent of patients reported having mild pain (BPI < 5), while 28% reported moderate pain (5≤ BPI<7), and 44% severe pain (BPI ≥ 7). The average scores on the PHQ-9 and PCL-C at hospital discharge were 8.4 (SD = 5.9) and 29.7 (SD = 11.8). Fifteen percent of patients reported moderate depressive symptoms (PHQ-9 = 10-14) and 9% and 7% reported moderately severe (PHQ-9 = 15-19) and severe depressive symptoms (PHQ-9 ≥ 20), respectively, at hospital discharge. Twenty-seven patients (13%) scored greater than or equal to 44 on the PCL-C and 89% of these patients displayed comorbid depressive symptoms. Statistically significant correlations were found between pain and depressive symptoms ($r = 0.61$; $p < 0.0001$) and pain and PTSD symptoms ($r = 0.46$; $p < 0.0001$) at hospital discharge (Table 2). A strong correlation was noted between depression and PTSD ($r = 0.70$; $p < 0.0001$).

1 Year Follow-up

At 1 year after hospital discharge, the average scores on the SF-12 PCS and MCS were 35.6 (SD = 10.6) and 45.1 (SD = 11.2), respectively. The average score on the PHQ-9 was 11.2 (SD = 6.6) and on the PCL-C was 33.3 (SD = 16.2). Fifty-six percent of patients reported clinically significant depressive symptoms (PHQ-9 ≥ 10) and 22% scored greater than or equal to 44 on the PCL-C, indicating the presence of PTSD. Out of those with PTSD, 86% displayed depression comorbidity.

Pearson correlation coefficients between pain at hospital discharge and physical and mental health at 1 year were found to be -0.13 and -0.16, respectively (corrected $p > 0.05$) (Table 3). Bivariate linear regression analyses demonstrated no statistically significant relationship between pain at hospital discharge and physical health (β -0.62; 95% CI, -1.4 to 0.20) and mental health (β -0.77; 95% CI, -1.6 to 0.09). Statistically significant correlations were found between pain at hospital discharge and depressive ($r = 0.74$; $p < 0.0001$) and PTSD symptoms ($r = 0.33$; $p < 0.001$) at 1 year. Bivariate associations between pain and the presence of depression and PTSD were significant with odds ratios of 3.3 (95% CI, 2.2 to 4.9) and 1.5 (95% CI, 1.2 to 2.0), respectively.

Multivariable linear regression analyses found that pain at hospital discharge was not statistically associated with physical health ($\beta = -0.78$; $p = 0.06$) or mental health ($\beta = -0.80$; $p = 0.07$) at 1 year follow-up (Table 4). Pain intensity was statistically associated with depression (OR = 3.3; $p < 0.001$) and PTSD (OR = 1.4; $p = 0.03$). In addition, increased age was associated with decreased physical health ($\beta = -0.13$; $p = 0.03$), while having greater than a high school education was associated with increased physical health ($\beta = 5.5$; $p = 0.003$) and mental health ($\beta = 5.2$; $p = 0.003$). Greater than a high school education was protective of PTSD (OR = 0.28; $p = 0.02$) and PTSD symptoms at hospital discharge (OR = 1.1; $p = 0.003$) was statistically associated with the presence of PTSD at 1 year follow-up.

Discussion

This study examined whether pain at hospital discharge was significantly associated with general health and depression and PTSD at 1 year following traumatic orthopaedic injury. Results did not support our hypothesis that pain intensity would impact long-term general physical and mental health. However, early postoperative pain was associated with the presence of depression and PTSD at 1 year after controlling for demographic and injury characteristics as well as psychological symptoms at hospital discharge. Results suggest that efforts to improve pain assessment and management in the hospital setting may have a positive impact on long-term depressive and PTSD symptoms.

The hypothesis that pain at hospital discharge would have a relationship with general physical and mental health at 1-year was not supported. These results were unexpected, given that cross-sectional studies in trauma survivors have found an association between pain and general health outcomes at 12 months following injury.[22-24] Moreover, work by the LEAP study group and others have demonstrated a predictive relationship between acute post injury pain and long-term physical disability.[7,25] Our non-significant findings may be due to a difference in outcome measures. Previous longitudinal work utilized the Sickness Impact Profile and the World Health Organization Disability Assessment Schedule, while the current study focused on general health as measured by the SF-12. Another explanation may be that negative mood or emotional factors play a larger role in general health outcomes. Pain and psychological distress are inter-related and negative emotions tend to be elevated during the early post injury period.[1,26-29] Wegener et al.[7] found that higher levels of negative mood had a stable longitudinal relationship with lower levels of function in patients treated for high-energy trauma, and that the influence of pain on function appeared to be through the negative affect that accompanies the pain experience.

As hypothesized, we found increased levels of early postoperative pain to be independently associated with clinically significant depression at 1 year. Our finding is consistent with work by Wegener et al.[9] who found that pain intensity at 3 months predicted depressive symptoms during the first year post trauma. O'Donnell and colleagues[26] also reported a significant relationship between pain severity during hospitalization and psychiatric symptoms at 12 month follow-up. Our data support studies that demonstrate a pain-depression relationship longitudinally, with the severity of pain symptoms determining the risk of developing psychological distress.[30-33]

Increased pain intensity at hospital discharge was also associated with the presence of clinically significant PTSD. This finding is not surprising since PTSD is frequently associated with depression[34] and 86% of our patients with PTSD at 1 year displayed comorbid depression. Results are also consistent with previous studies that suggest uncontrolled pain may result in the exacerbation of posttraumatic stress symptoms and the development of PTSD, with pain serving as a reminder of the traumatic experience.[35-38] The cognitive, affective, and behavioral components of pain and pain perception, such as anxiety sensitivity, catastrophizing, and avoidant coping, may also influence the development and maintenance of PTSD.[39] Soberg et al.[37] found a statistically significant relationship between increased pain intensity at 2 weeks after hospital discharge and posttraumatic stress symptoms at 2 years in patients with multiple trauma. Peritraumatic pain within 48 hours of traumatic injury has also been reported to be a risk factor for PTSD at 4 and 8 months following hospital admission.[38]

It is important to note that the link between pain and psychological distress, especially depression, is well-established and comorbidity is common.[30,31] Co-occurrence rates of 30% to 50% for pain and depression have been reported in primary care patients[31] and population estimates of comorbid pain and PTSD are 7% to 8%.[40] Archer et al.[1] reported moderate to severe pain and clinically significant depressive and PTSD symptoms in 39% and 18% of patients at hospital discharge with traumatic orthopaedic injury, respectively. Overall, long-term outcomes in trauma survivors have the potential to be greatly improved by jointly assessing pain and psychological distress during hospitalization and the early postoperative recovery period. The assessment of pain and depression is particularly encouraged since robust evidence has found that pain and depression respond to similar treatments and often exacerbate one another.[30-33,41] Pain appears to predict depression with the same strength as depression predicts the onset of persistent pain.[31]

Findings from this study have significant implications for the care of patients following traumatic orthopaedic injury. Pain is complex and multidimensional and a single-item that measures pain intensity alone may be insufficient to distinguish trauma patients in need of more aggressive pain treatment.[43] A systematic review of patients following traumatic injury recommends the use of comprehensive and validated measures for pain that follow the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) guidelines.[36] IMMPACT identifies domains of pain that include intensity as well as quality (affective and sensory), temporal aspects, and physical and emotional functioning.[43] Potential pain assessment strategies include a composite measure of pain intensity, interference and affect, and joint assessment of pain and emotional functioning (i.e., symptoms of depression and anxiety).[9,30,33,42,44] Discharge planning could incorporate computer adaptive testing using PROMIS or NIH Toolbox instruments for pain and emotional distress, which is in line with models of early pain and psychological intervention service delivery.[45] Furthermore, studies have started the use of repeated measures to assess a patient's pain trajectory (i.e., rate of pain resolution).[33,42,44]

The results of this study are underscored by growing literature highlighting the need for interventions in the early postacute phases of recovery to address pain and patients' psychosocial needs following traumatic injury.[7,26,36,46] Studies suggest that stepped and collaborative care models may be effective for improving long-term outcomes.[26,45,47] Other suggestions include the use of self-management and brief cognitive-behavioral programs in the hospital setting that have been shown effective for chronic pain.[1,46,48] Clinicians and researchers may also consider in-hospital treatments which seek to decrease pain and foster the development and strength of positive affect. These hospital interventions may include, but are not limited to mindfulness-based strategies and Acceptance and Commitment Therapy (ACT).[49,50]

There are several limitations to consider when interpreting the results of this study. First, the follow-up rate for the 1 year assessment was 62%. The comparison of baseline demographic and injury characteristics between patients with and without complete data showed that these groups were similar. However, caution should be exercised when generalizing results of this study to other trauma populations and settings outside of urban academic medical centers. A second limitation is that patient-reported measures were used to assess depressive and PTSD symptoms instead of an interview with a mental health professional. We used well-accepted instruments that are reliable and valid; however, perceived psychological distress can innately influence and contribute to observed variances. Another limitation is the lack of data on the management of pain in the hospital setting. We are unable to ascertain whether the prevalence of moderate to severe pain was due to an inability to control the neurophysiological or affective aspects of pain, which limits conclusions regarding the type and frequency of pain management interventions.

Despite these limitations, the current results provide support for the independent association between increased pain at hospital discharge and depression and PTSD at 1 year following traumatic orthopaedic injury. Findings highlight the importance of early screening for uncontrolled postoperative pain to identify patients at high risk for poor outcomes and who could benefit from more aggressive pain management. Results suggest early interventions are needed to address pain severity in patients with orthopaedic trauma.

Acknowledgments

Sources of Support: This publication was supported with funds from the Orthopaedic Trauma Association and by CTSA award No. UL1TR000445 from the National Center for Advancing Translational Sciences. Its contents are solely the responsibility of the authors and do not necessarily represent official views of the National Center for Advancing Translational Sciences or the National Institutes of Health.

References

1. Archer KR, Castillo RC, Wegener ST, et al. Pain and satisfaction in hospitalized trauma patients: the importance of self-efficacy and psychological distress. J Trauma Acute Care Surg. 2012; 72(4): 1068–1077. [PubMed: 22491629]

2. Williamson OD, Gabbe BJ, Cameron PA, et al. Predictors of moderate or severe pain 6 months after orthopaedic injury: A prospective cohort study. J Orthop Trauma. 2009; 23:139–144. [PubMed: 19169107]
3. Castillo RC, MacKenzie EJ, Wegener ST, et al. Prevalence of chronic pain seven years following limb threatening lower extremity trauma. Pain. 2006; 124:321–329. [PubMed: 16781066]
4. Urquhart DM, Williamson OD, Gabbe BJ, et al. Outcomes of patients with orthopaedic trauma admitted to level 1 trauma centres. Aust N Z J Surg. 2006; 76:600–610.
5. Clay FJ, Newstead SV, Watson WJ, et al. Bio-psychosocial determinants of persistent pain 6 months after non-life threatening acute orthopaedic trauma. J Pain. 2010; 11:420–430. [PubMed: 20439055]
6. Rivara FP, Mackenzie EJ, Jurkovich GJ, et al. Prevalence of pain in patients 1 year after major trauma. Arch Surg. 2008; 143(3):282–287. [PubMed: 18347276]
7. Wegener ST, Castillo RC, Haythornthwaite J, et al. Psychological distress mediates the effect of pain on function. Pain. 2011; 152(6):1349–1357. [PubMed: 21396777]
8. MacKenzie EJ, Bosse MJ, Kellam JF, et al. Early predictors of long-term work disability after major limb trauma. J Trauma. 2006; 61:688–694. [PubMed: 16967009]
9. Castillo RC, Wegener ST, Heins SE, et al. Longitudinal Relationships between Anxiety, Depression, and Pain: Results from a Two Year Cohort Study of Lower Extremity Trauma Patients. Pain. 2013; 154:2860–2866. [PubMed: 23994104]
10. Cleeland CS, Ryan KM. Pain assessment: global use of the Brief Pain Inventory. Ann Acad Med Singapore. 1994; 23:129–138. [PubMed: 8080219]
11. Mendoza TR, Chen C, Brugger A, et al. The utility and validity of the modified Brief Pain Inventory in a multiple-dose postoperative analgesic trial. Clin J Pain. 2004; 20:357–362. [PubMed: 15322443]
12. Zalon ML. Comparison of pain measures in surgical patients. J Nurs Meas. 1999; 7:135–152. [PubMed: 10710858]
13. Ware JE, Kosinski M, Keller SD. A 12 Item Short Form Health Survey: Construction of scales and preliminary tests of reliability and validity. Med Care. 1996; 34:220–233. [PubMed: 8628042]
14. Jenkinson C, Layte R, Jenkinson D, et al. A shorter form health survey: can the SF-12 replicate results from the SF-36 in longitudinal studies? J Public Health Med. 1997; 19:179–186. [PubMed: 9243433]
15. Luo X, Lynn GM, Kakouras I, et al. Reliability, validity, and responsiveness of the Short Form 12-Item Survey (SF-12) in patients with back pain. Spine. 2003; 28:1739–1745. [PubMed: 12897502]
16. Spitzer RL, Williams JBW, Kroenke K. Utility of a new procedure for diagnosis mental disorders in primary care: The PRIME-MD 1000 Study. JAMA. 1994; 272:1749–1756. [PubMed: 7966923]
17. Weathers, F.; Litz, B.; Huska, J., et al. PTSD checklist—civilian version. Boston: Nation Center for PTSD. Behavioral Sciences Division; 1994.
18. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: Validity of a brief depression severity measure. J Gen Intern Med. 2001; 16(9):606–613. [PubMed: 11556941]
19. Spitzer RL, Kroenke K, Williams JB. Validation and utility of a self-report version of PRIME-MD: The PHQ primary care study. primary care evaluation of mental disorders. patient health questionnaire. JAMA. 1999; 282(18):1737–1744. [PubMed: 10568646]
20. Wilkins KC, Lang AJ, Norman SB. Synthesis of the psychometric properties of the PTSD checklist (PCL) military, civilian, and specific versions. Depress Anxiety. 2011; 28(7):596–606. [PubMed: 21681864]
21. Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric properties of the PTSD checklist (PCL). Behav Res Ther. 1996; 34:669–673. [PubMed: 8870294]
22. Mock C, MacKenzie EJ, Jurkovicj G, et al. Determinants of disability after lower extremity fracture. J Trauma. 2000; 49:1002–1011. [PubMed: 11130480]
23. Michaels AJ, Michaels CE, Smith JS. Outcome from injury: general health, work status, and satisfaction 12 months after trauma. J Trauma. 2000; 48:841–850. [PubMed: 10823527]
24. Ponsford J, Hill B, Karamitsios M. Factors influencing outcome after orthopaedic trauma. J Trauma. 2008; 64:1001–1009. [PubMed: 18404068]

25. Ponzer S, Bergman B, Brismar B, et al. A study of patient-related characteristics and outcome after moderate injury. Injury. 1996; 27:549–555. [PubMed: 8994559]
26. O'Donnell ML, Verker T, Homes AC, et al. Disability after injury: the cumulative burden of physical and mental health. J Clin Psychiatry. 2013; 74:e137–e143. [PubMed: 23473359]
27. McCarthy ML, MacKenzie EJ, Edwin D. Psychological distress associated with severe lower-limb injury. JBJS. 2003; 85A:1689–1697.
28. Wood R, Maclean L, Pallister I. Psychological factors contributing to perceptions pain intensity after acute orthopaedic injury. Injury Int J Care Injured. 2011; 42:1214–1218.
29. Hinrichs-Rocker A, Schulz K, Järvinen I, et al. Psychosocial predictors and correlates for chronic post-surgical pain (CPSP) - a systematic review. Eur J Pain. 2009; 13:719–730. [PubMed: 18952472]
30. Kroenke K, Wu J, Bair MJ, et al. Reciprocal relationship between pain and depression: a 12-month longitudinal analysis in primary care. J Pain. 2011; 12:964–973. [PubMed: 21680251]
31. Bair MJ, Robinson RL, Katon W. Depression and pain comorbidity: a literature review. Arch Intern Med. 2003; 163:2433–2445. [PubMed: 14609780]
32. Gureje O, Simon GE, Von Korff M. A cross-national study of the course of persistent pain in primary care. Pain. 2001; 92:195–200. [PubMed: 11323140]
33. Arola H, Nicholls E, Mallen C. Self-reported pain interference and symptoms of anxiety and depression in community-dwelling older adults: can a temporal relationship be determined? Eur J Pain. 2010; 14:966–971. [PubMed: 20381389]
34. Poundja J, Fikretoglu D, Brunet A. The co-occurrence of posttraumatic stress disorder symptoms and pain: is depression a mediator? J Traumatic Stress. 2006; 19:747–751.
35. Schreiber S, Galai-Gat T. Uncontrolled pain following physical injury as the core-trauma in post-traumatic stress disorder. Pain. 1993; 54:107–110. [PubMed: 8378097]
36. Rosenbloom BN, Khan S, McCartney C, et al. Systematic review of persistent pain and psychological outcomes following traumatic musculoskeletal injury. J Pain Research. 2013; 6:39–51. [PubMed: 23357964]
37. Soberg HL, Bautz-Holter E, Roise O, et al. Mental health and posttraumatic stress symptoms 2 years after severe multiple trauma: self-reported disability and psychosocial functioning. Arch Phys Med rehabil. 2010; 91:481–488. [PubMed: 20298843]
38. Norman SB, Stein MB, Dimsdale JE, et al. Pain in the aftermath of trauma is a risk factor for post-traumatic stress disorder. Psychol Med. 2008; 38:533–542. [PubMed: 17825121]
39. Sharp TJ, Harvey AG. Chronic pain and posttraumatic stress disorder: mutual maintenance. Clin Psychol Review. 2001; 21:857–877.
40. Von Korff M, Krane P, Lane M, et al. Chronic spinal pain and physical-mental comorbidity in the United States: results from the national comorbidity survey replication. Pain. 2005; 113:331–339. [PubMed: 15661441]
41. Dersh J, Polatin PB, Gatchel RJ. Chronic pain and psychopathology: research findings and theoretical considerations. Psychom Med. 2002; 64:773–786.
42. Clay FJ, Watson WL, Newstead SV, et al. A systematic review of early prognostic factors for persistent pain following acute orthopedic trauma. Pain Res Manage. 2012; 17:35–44.
43. Dworkin RH, Turk DC, Farrar JT. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. Pain. 2005; 113:9–19. [PubMed: 15621359]
44. Chapman CR, Donaldson GW, Davis JJ, et al. Improving individual measurement of postoperative pain: the pain trajectory. J Pain. 2011; 12:257–262. [PubMed: 21237721]
45. O'Donnell MJ, Bryant RA, Creamer M, et al. Mental health following traumatic injury: toward a health system model of early psychological intervention. Clin Psychol Review. 2008; 28:387–406.
46. MacKenzie EJ, Bosse MJ. Factors influencing outcome following limb-threatening lower limb trauma: lessons learned from the lower extremity assessment project (LEAP). J Am Acad Orthop Surg. 2006; 14:S205–S210. [PubMed: 17003200]
47. Zatzick D, Roy-Byrne P, Russo J, et al. A randomized effectiveness trial of stepped collaborative care for acutely injured trauma survivors. Arch Gen Psychiatry. 2004; 61:498–506. [PubMed: 15123495]

48. Wong E, Chan S, Chair S. Effectiveness of an educational intervention on levels of pain, anxiety, and self-efficacy for patients with musculoskeletal trauma. J Advanced Nursing. 2010; 66:1120–1131.
49. Hamilton NA, Kitzman H, Guyotte S. Enhancing health and emotion: Mindfulness as a missing link between cognitive therapy and positive psychology. J Cogn Psychother. 2006; 20:123–134.
50. Hayes SC, Bissett RT, Korn Z, et al. The impact of acceptance versus control rationales on pain tolerance. The Psychol Rec. 1999; 49(1):33–47.

Table 1

Baseline demographic and clinical characteristics of study population by response status at 1 year

Characteristic	Total (N=213)	Responders (N=133)	Non-Responders (N=80)	p-value
Age, Mean (SD)	43.9 (15.7)	45.6 (14.9)	41.4 (16.5)	0.05
Sex, N (%)				0.16
Female	93 (44%)	63 (47%)	30 (37%)	
Male	120 (56%)	70 (53%)	50 (63%)	
Race, N (%)				0.19
White	198 (93%)	126 (95%)	72 (90%)	
Black	15 (7%)	7 (5%)	8 (10%)	
Education, N (%)				0.79
≤ High School	112 (53%)	69 (52%)	43 (54%)	
> High School	101 (47%)	64 (48%)	37 (46%)	
Marital Status, N (%)				0.27
Married	109 (51%)	72 (54%)	37 (46%)	
Single	104 (49%)	61 (46%)	43 (54%)	
Preinjury Employment, N (%)				0.71
No	103 (48%)	63 (47%)	40 (50%)	
Yes	110 (52%)	70 (53%)	40 (50%)	
Insurance, N (%)				0.96
Private	119 (56%)	74 (56%)	45 (56%)	
Public	44 (21%)	27 (20%)	17 (21%)	
None	50 (23%)	32 (24%)	18 (23%)	
Comorbid Conditions, N (%)				0.84
None	101 (47%)	61 (46%)	40 (50%)	
1	54 (26%)	35 (26%)	19 (24%)	
> 1	58 (27%)	37 (28%)	21 (26%)	
Preinjury Psychological Condition, N (%)				0.23
No	159 (75%)	103 (77%)	56 (70%)	
Yes	54 (25%)	30 (23%)	24 (30%)	
BMI Category, N (%)				0.45
Normal Weight	59 (28%)	40 (30%)	19 (24%)	
Overweight	75 (35%)	43 (32%)	32 (40%)	
Obese	79 (37%)	50 (38%)	29 (36%)	
Multiple Injuries, N (%)				0.61
No	161 (76%)	99 (74%)	62 (78%)	
Yes	52 (24%)	34 (26%)	18 (22%)	
Surgery Type, N (%)				0.57
Acute Trauma	132 (62%)	79 (59%)	53 (66%)	
Revision Surgery	65 (31%)	44 (33%)	21 (26%)	
Infection	16 (7%)	10 (8%)	6 (8%)	

Characteristic	Total (N=213)	Responders (N=133)	Non-Responders (N=80)	p-value
Mechanism of Injury, N (%)				0.17
Motor vehicle	124 (58%)	72 (54%)	52 (65%)	
Fall/Falling Object	70 (33%)	50 (38%)	20 (25%)	
Blunt/Penetrating	19 (9%)	11 (8%)	8 (10%)	
ISS, Mean (SD)	11.0 (7.7)	11.1 (7.8)	10.8 (7.7)	0.82
Hospital LOS, Mean (SD)	4.8 (4.0)	4.8 (4.5)	4.9 (3.3)	0.81

BMI = body mass index; ISS = injury severity score; LOS = length of stay

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Pearson correlation coefficients for pain, depression, and PTSD at hospital discharge

	Pain: Hospital Discharge	Depression: Hospital Discharge
Depression: Hospital Discharge	0.61*	-
PTSD: Hospital Discharge	0.46*	0.70*

PTSD = post-traumatic stress disorder;

*Corrected $p < 0.05$.

Table 3

Pearson correlation coefficients for pain, physical and mental health, depression, and PTSD at 1 year

	Physical Health: 1 Year	Mental Health: 1 Year	Depression: 1 Year	PTSD: 1 Year
Pain: Hospital Discharge	-0.13	-0.16	0.74*	0.33*
Depression: Hospital Discharge	-0.16	-0.23	0.52*	0.43*
PTSD: Hospital Discharge	-0.16	-0.23	0.41*	0.46*

PTSD = post-traumatic stress disorder;

* Corrected $p < 0.05$.

Table 4

Results from multivariable regression analyses for physical and mental health and depression and PTSD at 1 year (N = 133)

Risk factor	Physical Health β (95% CI)	Mental Health β (95% CI)	Depression OR (95% CI)	PTSD OR (95% CI)
Pain at Hospital Discharge	-0.78 (-1.6, 0.02)	-0.80 (-1.7, 0.06)	3.3 (2.1, 5.3)*	1.4 (1.0, 1.78)*
Age in years	-0.13 (-0.26, -0.01)*	-0.05 (-0.18, 0.08)	0.99 (0.95, 1.0)	1.0 (0.97, 1.1)
> High School vs. ≤ High School (ref)	5.5 (2.0, 9.1)*	5.2 (1.4, 9.0)*	1.0 (0.35, 2.9)	.28 (0.10, .78)*
Injury Severity Score	0.01 (-0.22, 0.24)	-0.17 (-0.42, 0.07)	1.1 (0.99, 1.2)	.99 (0.94, 1.1)
Depression at Hospital Discharge	-	-	1.0 (0.90, 1.2)	-
PTSD at Hospital Discharge	-	-	-	1.1 (1.0, 1.1)*

PTSD = post-traumatic stress disorder;

* $p < 0.05$