Review Article

The Psychological Effects of Musculoskeletal Trauma

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ABSTRACT

Musculoskeletal injuries comprise a large percentage of hospital admissions for adults and often contribute to persistent daily pain as an illness; opioid dependence; disability; and complaints of increased depression, anxiety, and symptoms of post-traumatic stress disorder. The prevalence of depression and post-traumatic stress disorder after orthopaedic trauma has been found to be considerably greater than the general adult cohort. Soon after sustaining a fracture, psychological factors can predict pain and disability many months after injury, even after controlling for injury severity. Thus, early in the care of orthopaedic trauma, there exists an opportunity to improve overall health by attending to psychological and social concerns, along with physical health. Recent literature has identified clinically actionable subgroups within the orthopaedic trauma cohort that are at psychological risk after an injury. Improving positive factors such as resilience, social support, and self-efficacy via validated interventions such as Cognitive-Behavioral Therapy, mindfulness training, and other types of mindset training has helped people return to their daily routine. Raising awareness of the psychological effects of trauma among the orthopaedic community could improve post-treatment planning, increase referrals to appropriate nonmedical professionals, and implement earlier effective interventions.

Most of the orthopaedic trauma literature in the past has focused on the technical and biological factors involved in the treatment of musculoskeletal injuries. In the past 20 years, the orthopaedic community has started to recognize the psychological effect that traumatic injuries have on the patient. Musculoskeletal injuries comprise a large percentage of hospital admissions for adults and often lead to chronic pain and long-term disability. Furthermore, it is quite common for patients who have sustained orthopaedic trauma to develop various symptoms of psychological distress. The psychological sequelae of trauma most consistently seen in the literature have been clinical depression, post-traumatic stress disorder (PTSD), and pain illnesses, along with the social complications of tobacco and alcohol abuse. Symptoms of PTSD, increased measures of anxiety, and...
depression in orthopaedic trauma patients have been reported in the literature to range between 15% to 51%, 5% to 35%, and 13% to 56%, respectively. These numbers likely underrepresent the true magnitude of post-traumatic psychological distress because it exists on a continuum of severity for all patients that sustain an injury. Even 1 to 3 years after trauma, patient reports exist of persistent mental health problems. Even with the elevated frequency of psychological disorders in this patient cohort, these conditions are often undertreated or even untreated in a large portion of patients. The Lower Extremity Assessment Project (LEAP) reported minimal treatment for psychological conditions. In patients who had sustained a severe lower-limb injury, nearly half were positive for a psychological condition 3 months later and 42% were positive at 2 years. Early in their treatment, only 12% stated that they used any mental health services and by 24 months, this number only increased to 22%. The situation is complicated by the large percentage of pre-existing psychological illness in the trauma cohort. Weinberg et al found that nearly 40% of patients had a pre-existing psychiatric disorder who had acquired a femoral or axial skeleton fracture at a level I trauma center. By the age of 50 years, 53.2% of women and 20.7% of men will have sustained some form of fracture. Soon after sustaining a fracture, psychological factors can predict pain and disability many months after injury, even after controlling for injury severity. This finding was replicated by Nota et al in the Netherlands, demonstrating the possibility of similar findings across cultures. Protective factors include resilience, self-efficacy, social support, and coping skills. These factors can be measured with validated tools early in the recovery process and may be modifiable with specific treatments. Within the acute phase of a musculoskeletal injury, there exists an opportunity to decrease future pain and disability by addressing these issues via proper psychological evaluations and validated interventions such as Cognitive-Behavioral Therapy (CBT), Relaxation Response Therapy (RRT), mindfulness training, and other coping skills to improve resilience and self-efficacy.

**Pain and Disability**

The data from the LEAP study revealed to the orthopaedic community many of the psychosocial consequences of trauma. Their study demonstrated that a biopsychosocial model addressing psychological issues such as PTSD, depression, and poor resilience is more effective than medical treatment alone in decreasing disability, improving surgical results, reducing healthcare costs, and preventing persistent pain disorders. Notable early predictors of chronic pain included having less than a high school or college education, low self-efficacy for return to usual major activities, and high levels of average alcohol consumption at baseline. Their data also underscored the consequence of early pain intensity on the development of chronic pain. High reported pain intensity, high levels of sleep and rest dysfunction, and elevated levels of depression and anxiety at 3 months postdischarge were strong predictors of chronic pain at 7 years. Chronic pain has been predicted by psychological disorders such as anxiety, PTSD, and catastrophic thinking, but not by patient descriptors such as age, sex, and occupation. The converse is true as well, with pain at discharge notably associated with PTSD 1 year later. This is worrisome because Archer et al showed that 59% of patients reported moderate-to-severe pain at the time of hospital discharge.

There clearly exists a close correlation between pain and psychological distress as indicated by various cognitive and emotional responses. Catastrophic thinking about pain is “the tendency to magnify pain, feel helpless when faced with pain, and ruminate on the pain experience,” and pain anxiety is “the cognitive and physiological anxiety when experiencing pain and avoidance of activities that cause pain.” Patients who catastrophize are most likely to have pain interfere with activities of daily living and interfere with rehabilitation. This is well demonstrated by Archer et al who reported that pain catastrophizing and depressive symptoms both increased pain levels and pain disturbance 1 year after lower extremity fracture surgery. Furthermore, depressive symptoms correlated to worse physical health at that time.

Pain catastrophizing can be measured using the Somatic Preoccupation and Coping (SPOC) questionnaire. This tool predicts the development of PPSP (persistent postsurgical pain) and functional outcomes after fracture surgery. Retrospectively using the FLOW (Fluid Lavage of Open Wounds) trial data, Busse et al found that the SPOC questionnaire had a strong association with pain interference at work, PPSP, and health-related quality of life 1 year after an open fracture repair. Similar findings were noted at around 2 years after surgery for traumatic tibial fractures, where almost half of the patients reported PPSP. The SPOC questionnaire seems to be the first validated instrument that
can be simply administered to detect fracture patients at elevated risk of poor outcomes because of psychological factors. Countering pain catastrophizing and pain anxiety with interventions aimed at improving coping skills and recovery expectations would be anticipated to improve outcomes.

Depression and Anxiety

The most common diagnostic criteria for depression include a “loss of interest or pleasure in daily activities, impaired function, and a behavior change from baseline.” The World Health Organization reports that depressive disorders are the foremost cause of disability in people aged 15 to 44 years. In one meta-analysis, the prevalence of depression after acute orthopaedic trauma was found to be 32.6%. This is notably higher than the estimates of depression in the adult cohort of the United States (6.7%). Likewise, anxiety disorders increase as high as 38% for trauma-related phobias. Although these numbers are alarming, it makes common sense that people would be distressed and uncertain after enduring skeletal trauma. Surgeons and clinicians should anticipate the psychological and emotional impact that trauma has on all patients, not just the percentage observed in the literature.

Vincent et al evaluated 101 orthopaedic trauma patients and found that at 12 weeks after being discharged from the hospital, “20.9% of patients had symptoms of moderate-to-severe depression and 35.3% of patients had symptoms of anxiety.” Moreover, the authors reported that patients with symptoms of depression at 12 weeks had increased unexpected adverse events requiring readmission. Furthermore, depression independently predicts greater postoperative complications. Using information from the LEAP study group, we know that its participants reported higher levels of depression, anxiety, and phobias, compared with age- and sex-matched norms. Again, early anxiety and depression was strongly correlated with poor functional outcomes and delayed return to work at 2 and 7 years after their injuries. In addition, both anxiety and depression was found to play a large role in why pain affects function. Not only does depression have long lasting effects on functional outcomes, the depression itself is long lasting. Among patients who were admitted to level I trauma centers for severe lower limb injury, over half screened positive for moderate-to-severe depression and over half of these patients were still depressed 2 years later. Thus, long-term monitoring for depression should be instituted after injury to identify any patients who may not have recovered emotionally from their trauma.

Unlike chronic pain, injury severity has had some predictive value for postinjury depression in teenagers. Han et al showed that patients with an Injury Severity Score (ISS) >16 had twice as much depression as patients with less severe injuries. Irrespective of location of injury or patient age, it seems that depressed people with severe injuries were less able to rehabilitate compared with people who were not depressed. Other qualitative characteristics of the injury also increased future risk of depression. Patients with open fractures had nearly 5 times greater risk of depression compared with patients with closed injuries. Rates of depression were higher at 6 and 12 months when an orthopaedic injury was accompanied by TBI. It is unclear because of conflicting results whether the trauma itself causes the depression or whether preexisting mental illness leads to an increased frequency of trauma. Patten et al suggest a bidirectional effect, which seems to be a plausible explanation for a complex scenario.

Post-Traumatic Stress Disorder

When faced with a life-threatening situation, it is instinctual to protect ourselves from harm. Post-traumatic stress disorder, or PTSD, is the exaggeration of this response where the distress from the situation persists and interferes with normal function even after the danger has passed. PTSD can be categorized into three groups: intrusions (flashbacks), avoidance (social withdrawal), and hyperarousal (anxiety). The prevalence of PTSD after acute orthopaedic trauma ranges from 20% to 51%. Starr et al found that half of patients after injury met the criteria for PTSD and indicated that the emotional issues they faced were more difficult to cope with than the physical problems. PTSD has been shown to be strong predictors of outcomes after orthopaedic trauma on all SF-36 mental health and physical domains, whereas injury severity has not. One explanation for these worse outcomes is the decreased ability of patients with PTSD to adequately do their rehabilitation. Patients with post-traumatic stress symptoms (PTSS) report markedly higher anxiety, catastrophizing, depression, kinesiophobia (ie, fear of reinjury or exacerbation of pain), pain severity, pain-related disability, and lower self-efficacy. PTSS and reinjury phobia may cause avolition, whereas persistent pain may cause anxiety and
negative thinking, both of which can hinder rehabilitation processes.22

Mounting evidence exists that has found further associations with PTSD, which will assist healthcare providers in predicting patients who may go on to develop PTSD. Data from a PTSD questionnaire mailed to patients from a Level I trauma center between 1 and 6 years after injury demonstrated that PTSS were not notably related to ISS, the time since the injury, household income, education level, or employment status at the time of injury. PTSD was notably associated with younger age, unemployment at the time of follow-up, the presence of chronic illnesses, use of a lawyer, blaming others for the injury, and having an unsettled compensation claim.28 In a prospective longitudinal observational study, Warren et al14 showed at 6 months a patient’s odds of having PTSS increased notably whether pain was >5 on the visual analog scale (VAS), whether they screened positive for depression, whether they scored below average on physical and mental function tests, and whether they had not yet returned to work.

As discussed earlier, research has found that pain is correlated with both PTSD and PTSS, although no causal relationship has been established. However, PTSD is present in around half of people with chronic pain after transportation or combat injuries.29 Studies also show that a higher VAS score was notably related to the occurrence of PTSD, in addition to lower limb fractures and having multiple fractures.26 Despite this prevalence, identification of symptoms and risk factors is not done routinely in most orthopaedic practices. In a study of patients enrolled from 8 level I trauma centers for evaluation of PTSD, only 22% of patients reported receiving psychological assistance of any kind to help ameliorate their PTSD.7 Increasing awareness among the orthopaedic community is necessary to begin referring these patients to the appropriate psychological providers. Unfortunately, such as depression, PTSD persists for an exceedingly long duration and may require long-term monitoring and treatment, even up to 14 years.22 Subsequently, early psychological intervention in orthopaedic trauma patients showing signs of PTSS might help minimize the long-lasting effects of PTSD. This highlights that aside from any signs of a formal psychological diagnosis that a patient might initially exhibit, anyone who has sustained a trauma is likely to have a notable psychological burden. Even if we cannot predict how well a given patient will react psychologically, we as surgeons need to be more proactive in asking more questions about our patients’ emotional adjustment and referring them to other specialists whenever appropriate. We should anticipate the emotional and cognitive reactions to trauma and be prepared to guide recovery.

Resilience and Coping Skills

The presence of resilience and various coping skills might help to explain why some individuals seem to deal with injuries more successfully than others. Resilience has been described as the “capacity to maintain healthy psychological function after exposure to a highly disruptive or traumatic event.”3 Resilience is characterized by several modifiable qualities such as optimism, self-efficacy and self-esteem, sense of control and coherence, and the ability to cope with stress in ways that facilitate integration back into the workplace and into their social network.

Resilience is a measurable cluster of adaptive skills and other resources that together help identify patients who might be in need of coping skills training for support. The most used validated resilience scale is the Connor Davidson Resilience Scale (CD-RISC), originally created during research with PTSD patients. The scale takes into account factors such as competence, trust, acceptance of change, control, and spiritual influences.30 Positive psychological factors such as resilience, social support, and self-efficacy have demonstrated protective effects on long-term outcomes, including pain and employment.12 Data from the LEAP study group showed that patients with higher scores for self-efficacy (a direct corollary of resilience) and social support at 3 months were more likely to return to work at 2 and 7 years.7 A systematic review and meta-analysis of resilience rehabilitation programs for trauma patients showed a statistically notable increase in the likelihood of ever returning to work and a decrease in missed days from work for people with musculoskeletal or orthopaedic injuries.31 The converse has been shown as well among orthopaedic patients, with longer duration of work disability predicted by low self-efficacy.32 Low self-efficacy was also associated with moderate-to-severe levels of pain at time of discharge for patients that had sustained orthopaedic trauma.15 Some studies have shown that the geriatric cohort possesses an overall higher level of resilience than the general cohort.33 This is likely because of earlier challenging life experiences which enhanced their resilience. A study of geriatric hip fracture patients found that low resilience was associated with poorer functional status at onset of rehabilitation, whereas high resilience was
associated with higher functional status on admission and at discharge. The results such as these suggest that screening for low resilience at the initial encounter may enable more vulnerable patients with lower rehabilitation potential to be identified and use interventions to increase their coping skills. This represents yet another opportunity for improving early functional outcome and preventing long-term disability after trauma.

**Interventions**

There exists various psychological interventions that have been shown to improve outcomes in the orthopaedic trauma cohort; regrettably, they are not yet routine care. Prevalent stigmas in the western medical world still impede the successful integration of these empirically supported psychologic practices. This is especially true for men, who comprise a greater proportion of the general orthopaedic trauma patient cohort at approximately a 3:1 ratio, and frequently sustain more severe injuries. Men are more likely to react to traumatic situations with anger and aggression. In addition, men have a greater likelihood to resist psychotherapeutic help and drop out of long-term therapies.

In a survey completed by 350 orthopaedic surgeons, Vranceanu et al reported that 90% of surgeons were “somewhat or very likely” to notice psychological problems in their patients. However, only 60% reported that they were “somewhat or very likely” to refer their patients for treatment. Barriers for referring patients cited in this study were a lack of time, the stigma associated with mental illness, and uncertainty of how to refer patients. To overcome these obstacles, teaching surgeons about available resources has been shown to improve confidence and competence in managing their patient’s psychological components. Internet-based interventions and telepsychology protocols were developed over the past years with very promising results that can address the time constraints of the surgeon, the absence of regional qualified psychologists, and the stigmatization by the patient. In the same study by Vranceanu et al, the surgeons’ outlook on psychological screening was “fairly neutral”; however, most surgeons depend on the patients’ medical chart (57%) or the patient interview (81%) to detect psychological illness. Only a quarter of surgeons used standardized questionnaires to screen for psychological illnesses. Because most orthopaedic surgeons are not trained with a background in psychology, using surveys may be a more reliable and efficient means of detecting psychological illness compared with a time-consuming interview. A host of validated screening tools exist that can be quickly administered during an acute inpatient stay, or in the office setting, including the Connor Resilience Scale, PTSD Checklist, Beck Depression Inventory, etc (see attached list). These forms do not need to be administered by a physician, and some are self-administered.

Various psychological treatments such as CBT, relaxation training, or mindfulness training strategies are validated treatments for PTSD, catastrophic thinking, pain anxiety, perceived disability, and depression. In addition, a Cochrane review validated the usefulness of trauma-focused CBT for adults suffering from PTSS. Vranceanu et al randomized patients who had sustained acute orthopaedic trauma to either receive CBT and RRT or the standard of care. A notable decrease in disability, pain with activity, and emotional distress was noted at 4 to 6 weeks after intervention, with 86% of the treatment group completing the full intervention. This demonstrates feasibility, efficacy, and a high patient compliance. A systematic review of 15 randomized controlled trials (RCT) found moderate evidence that perioperative psychotherapy (CBT and relaxation therapy) notably reduced PPSP and physical impairment. Combining CBT and RRT creates a comprehensive treatment protocol for patients with orthopaedic trauma, which is currently limited in orthopaedic practices.

Because it has been shown that early pain can lead to chronic pain and disability and PTSD, early prevention efforts should include optimal management of acute pain and distress. Several interventions have been found to be effective at preventing or attenuating the severity of PTSD after traumatic injury, including CBT and prolonged exposure. Even brief mindfulness training exercises can be beneficial. It was demonstrated in a RCT that a 60-second brief mindfulness exercise may improve depression, anger, anxiety, and pain. In one small RCT, psychotherapy was provided twice a week for 45 minutes to geriatric patients with a hip fracture who were admitted to the orthopaedic trauma service. Compared with the control group at the 1-month follow-up, the treatment groups’ anxiety and depression decreased by 16% and 66%, respectively. Pastoral care has also been shown to have positive benefits on inpatient orthopaedic trauma patients. Patients were interviewed and subsequent surveys showed that the helpful effects of pastoral care on PTSS, and “personal growth” occurred in all patients, regardless of their religious beliefs and the number of visits provided.
Future Research

It is reasonable to expect that anyone who undergoes surgery will face various adjustment issues postoperatively and fall on a continuum from minimal psychological impact to severe adjustment disorder. These include a range of emotional changes, preoccupation with the impact of the surgery, the physical demands of rehab, and potential pain-related issues. Although these might be normal reactions for most of our surgical patients, there will be patients who for various reasons might be at risk for more severe adjustment problems. To adequately provide effective targeted interventions specifically for trauma patients who are at risk of developing psychological problems that require therapeutic assistance, we must identify patients earlier in their traumatic experience based on known factors. In 2018, the Major Extremity Trauma Research Consortium (METRC) identified four clinically relevant groups of patients, ranging from “low risk and high protection to high risk and low protection.” Risk factors included pain, depression, PTSD, alcohol abuse, and tobacco use. Protective factors included resilience, “self-efficacy to return to work and to manage the financial consequences of the injury” and social support. Because the level of risk factors increased and the level of protective factors decreased, all outcome measures worsened, which included functional outcomes (as measured by the Short Musculoskeletal Function Assessment [SMFA]) and levels of depression and PTSD. The worst group with high risk and low protection encompassed 15% of the patient cohort. These patients had SMFA scores that exceeded disability screening thresholds even as early as 6 weeks after injury. At 1 year, greater than 90% of this high-risk cluster exceed SMFA disability thresholds, and around 75% were positive for depression and PTSD. This study is invaluable to the orthopaedic community because we have evidence that these patients can be identified early, can be risk stratified into groups that predict functional and psychological outcomes at 1 year, and would benefit from prompt referral to mental health professionals and pain management services to prevent worse long-term outcomes. The authors noted that the surveys used in the study can easily be administered in the clinical setting.

Future studies need to further elaborate on the effects of pre-existing psychological disorders, resilience levels, and previous/current use of antidepressant medications on outcomes after a traumatic injury. Large prospective studies should clarify how symptoms of depression, anxiety, and PTSD may be related to the location of the injury by evaluating various different orthopaedic injuries. Detection of fractures with high positive predictive values for these psychological illnesses would allow for the appropriate allocation of psychosocial care for those patients. Furthermore, additional research should look to delineate which cultures, age groups, and sexes may be less at risk for PTSD to appropriately allocate resources and interventions after traumatic injuries.

Undoubtedly, people who have sustained orthopaedic trauma develop a complex clinical profile that necessitates an intensive multimodal biopsychosocial approach to improve treatment outcome. A treatment program might consist of psychoeducational strategies about pain and trauma-related thoughts and attitudes, therapies such as CBT, RRT, mindfulness training, and patient-centered goal setting, along with functional rehabilitation and standard medication management. Patients at high risk may benefit from more frequent therapy sessions and longer duration of treatment. Elevated symptoms of depression, pain anxiety and avoidance, catastrophizing, and lower self-efficacy mediated the relationship between PTSD symptoms and pain-related disability. Therapy to increase resilience, reduce fear of pain, and improving confidence in doing everyday tasks despite expected pain, may lead to longer-term improvements in mood and outcomes. Brief educational interventions that incorporate pain coping skills and self-management techniques are likely practical and cost-effective approaches to decrease postoperative pain and increase self-efficacy in hospitalized trauma victims. Because many of the strategies to improve resilience are short term and use self-help manuals, little cost exists to the surgical team to promote these efforts. Other recommendations include routine inpatient screening for psychological illnesses to identify patients at high risk for developing unmanaged pain and better communication between surgeons and mental health providers to facilitate obtaining early mental health services. Future research comparing various psychological interventions—such as resilience training—administered by mental health professionals versus standard aftercare rehabilitation practices would be invaluable to enhance best practices after orthopaedic trauma.

Summary

Musculoskeletal trauma has profound psychological effects on patients and can lead to adverse outcomes such as chronic pain and disability. Certain high-risk
populations with low protective factors (e.g., resilience, social support, and self-efficacy) can be identified early in their traumatic experience and referred to the appropriate mental health professionals. We have an opportunity and obligation to help prevent the development of PTSD, depression, anxiety, and chronic pain by addressing these issues via psychological evaluations and validated interventions such as CBT, RRT, and mindfulness training.

Delivering comprehensive care to patients that addresses both the technical aspects of orthopaedic surgery along with the psychosocial dimensions of their health will improve outcomes and decrease overall morbidity (Figure 1).

A list of questionnaires is available at Supplemental Digital Content, http://links.lww.com/JAAOS/A607.

References

References printed in bold type are those published within the past 5 years.


