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Psychological distress mediates the effect of pain on function

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ABSTRACT

As part of a larger longitudinal study, the current analyses characterize the relationship among pain, psychological distress, and physical function after major lower extremity trauma. Structural equation modeling techniques were utilized to analyze data from a prospective 2-year observational study of 327 patients treated at 8 level I trauma centers. Data were gathered at 3, 6, 12, and 24 months after injury. In the models tested, higher levels of depressive and anxious distress at the preceding time point was related to lower levels of functioning at 6, 12, and 24 months, and higher levels of pain at the preceding time point were related to lower levels of functioning at 6 and 12 months, but not at 24 months. A reverse model in which lower levels of functioning led to higher levels of psychological distress or pain was tested and did not fit the data. The combination of depressive and anxious distress plays an increasingly important role in mediating the impact of pain on physical function as the recovery from lower extremity trauma progresses from early to later stages. Both pain and psychological distress contribute to reduced function during the first year after a serious injury; however, as recovery proceeds, the role of psychological distress in determining function increases.

1. Introduction

Functional limitations characterized by reduced physical activity and restricted participation in meaningful social roles are common after injury and the onset of chronic disease [29]. This is a major public health problem for which the etiology is poorly understood. The biopsychosocial model [27], which suggests that health and function are influenced by physical, psychological, and social factors, may be particularly relevant in understanding complex injuries and medical conditions.

Functional outcomes after severe lower extremity trauma are generally poor, with one large longitudinal study reporting only 50% of injured individuals returning to work within 2 years [12]. Psychosocial and socioeconomic factors, such as education, race, income, health insurance availability, and social support [51], are more closely associated with poorer function than biological factors such as the severity of the limb injury [13]. Patients commonly experience pain and psychological distress [36] after injury, both of which may contribute to functional limitations. Research regarding the early stages of other chronically painful conditions indicates that psychological distress is seen early in the course of illness [68], pain contributes to this distress [23], and distress may contribute to the persistence of pain [19]. The relationship among the extent to which pain and psychological distress can contribute to physical function is also complex. Pain [45] and psychological distress [25] prospectively predict level of physical function, but reduced physical function has also been reported to predict increased pain [18] and psychological distress [63]. Together, these data suggest a complex interrelatedness of pain, psychological distress, and physical function over time. In addition to the poor understanding we have regarding the directional nature of these relationships, it is not known whether the relationships vary as a function of the type of onset (eg, traumatic vs gradual), underlying pathophysiology (eg, immunologic vs musculoskeletal), or other population factors.

These previous studies reported either cross-sectional correlations or, in the case of longitudinal studies, focused on only 2 of the constellation of interrelated factors. Although these studies provide an important knowledge base, advanced statistical tools applied to longitudinal data permit better characterization of the

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temporal relationships between these interrelated sequelae common in many chronic conditions. Data on the longitudinal and structural relationships among pain, psychological distress, and physical function will provide key etiological information and serve as a guide for the development of effective therapies to improve function and quality of life.

As part of a larger study, the current analyses sought to characterize the relationship among pain, psychological distress (anxious distress and depressive distress), and physical function in a longitudinal sample after major lower extremity trauma. We hypothesized that: (1) higher levels of both pain and psychological distress would be related to lower levels of functioning at subsequent time periods; (2) lower levels of physical functioning would not lead to higher levels of psychological distress at subsequent time periods; and (3) psychological distress would mediate the impact of pain on subsequent levels of physical functioning.

2. Materials and methods

2.1. Study population and procedures

Subjects in the current analysis constitute a subgroup of patients from a larger study that assessed the outcomes of amputation or reconstruction after limb-threatening lower extremity trauma. This overall study group has been described in previous reports [13,49] and included patients 16 to 69 years old who were admitted to 8 level I trauma centers for treatment of high-energy trauma below the distal femur. The original study was collected during the period 1995–1999. High-energy trauma was defined to include Gustilo grade IIIB and IIIC fractures [32], selected grade IIIA fractures, dysvascular limbs, major soft tissue injuries, and severe foot and ankle injuries. Excluded were patients with a Glasgow Coma Scale score less than 15 at 21 days after hospitalization or discharge [65], spinal cord deficit, prior amputation, or third-degree burns. Also excluded were patients transferred to the trauma center more than 24 h after the injury, those who did not speak English or Spanish, those who had a documented preexisting psychiatric disorder, and those on active military duty. We enrolled a total of 601 patients. For the present analysis, 32 patients with bilateral injuries and 149 patients who underwent amputation were excluded. Complete data at all time points were available for 327 (78%) of the 420 remaining patients.

At baseline, demographic and background information on the patient and his or her health before the injury was collected, and the attending orthopaedic surgeon documented the nature and severity of the limb injury as well as the treatment received. Patients were recontacted at 3, 6, 12, and 24 months after the injury and returned for a follow-up assessment that included evaluation by a physical therapist to ascertain impairment, and an interview by a research nurse to assess the patient's report of pain, psychological distress, and functional outcome.

2.2. Characterizing patients and their injuries

All leg injuries were prospectively classified at the time of admission by means of standard classifications and limb salvage indices including the following: (1) type and extent of bony injury [31]; (2) the Limb Salvage Index [34] and the Predictive Salvage Index [56]; (3) the extent of skin, neurovascular, muscle, and tendon injury [56]; (4) plantar sensation [64]; and (5) overall tibia fracture assessment [39]. Associated injuries were classified by using the Abbreviated Injury Scale [3] and the Injury Severity Scale score [4]. Shock was defined as systolic blood pressure lower than 90 mm Hg before the initiation of resuscitation. Patient characteristics that have been related to outcome were also measured [49]. They include age, gender, and race/ethnicity; education; poverty status [30] and insurance status before injury; work status, occupation, and physical demands of the preinjury job [43]; and personality characteristics measured by the NEO Personality Inventory [17,24]. Social support was measured by a modified version of the Inventory of Socially Supportive Behaviors that assesses available support in terms of tangible assistance, directive guidance, and emotional support [7]. Respondents report the frequency with which they receive 40 specific supportive actions on a scale from 1 (not at all) to 5 (about everyday). Self-efficacy [5] that measures how confident patients are at the time of hospital discharge in their ability to resume their major life activity (10 point numerical rating scale where 1 = not at all confident and 10 = completely confident). Other factors hypothesized to influence recovery were self-rated preinjury health and the presence of preexisting chronic conditions; preinjury exercise, smoking, and drinking habits [52,59]; compensation received for the injury; and whether legal services were retained [33].

2.3. Measures

Functional outcome was measured by the Sickness Impact Profile (SIP) [10]. The SIP is a multidimensional measure of self-reported health status consisting of 136 statements about limitations in 12 categories of physical function: (1) ambulation, (2) mobility, (3) body care and movement, (4) social interaction, (5) alertness, (6) emotional behavior, (7) communication, (8) sleep and rest, (9) eating, (10) work, (11) home management, and (12) recreation. Respondents are asked to endorse statements that describe their health status on a given day. Scores are computed for the overall instrument for each of the 12 categories listed above and for 2 major dimensions of health (physical health summarizing limitations in the first 3 categories and psychosocial health summarizing limitations in the second 3 categories). Responses to the SIP have been well tested for reliability and validity [20], including assessment of postinjury outcome [41]. Overall SIP scores ranged from 0 to 100. A SIP score greater than 10 represents moderate disability and differences of 2 to 3 points reflect meaningful differences in function [10]. SIP scores range between 2 and 3 points for the general population [10,50].

Intensity of pain was measured by a visual analog scale [58]. Before the examination by the physical therapist, patients were asked to place a mark on a 10-cm line that best described their present level of pain. The line was anchored with the descriptors "no pain at all" on one end and "unbearable pain" on the other end. A continuous score was derived by measuring the distance of the mark (in millimeters) from the lower end of the scale (range 0–100).

Psychological distress was measured by the Brief Symptom Inventory (BSI) [22]. The BSI is a 53-item abbreviated version of the SCL-90-R (Symptom Checklist) [21]. The BSI was designed to assess the psychological symptom status of psychiatric and medical patients as well as individuals from the general population. For each item, the patients were asked to rate how much that problem distressed or bothered them during the past week on a 5-point Likert scale ranging from 0 (not at all) to 4 (always). Subscales are scored by summing the items within the scale and dividing by the number of endorsed items in that subscale [22]. To facilitate comparisons among the different subscales and between participants and other study populations, we used the standardized *T* scores that are provided in the BSI manual [22]. *T* scores have a mean of 50 and a standard deviation of 10. Four scales—anxiety, obsessive-compulsiveness, depression, and interpersonal sensitivity—were selected for measurement of distress. In our study sample, the Cronbach α coefficients for these scales was acceptable, ranging from 0.78 to 0.92 [53]. Test-retest reliability coeffi-