Article

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The Influence of Pain and Resiliency on Foot and Ankle Surgery Outcomes

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Abstract

Background: Resilience is the ability to recover after stressful events and has been shown to correlate with surgical outcomes. However, there has been minimal research on the impact of patient resiliency on foot and ankle surgical outcomes. This study aims to determine the predictive value of preoperative resiliency scores on surgical outcomes and investigate how this compares with the predictive value of pain scores.

Methods: We conducted a retrospective review of adult patients who completed a preoperative Brief Resilience Scale (BRS) and underwent surgery between November 2019 and November 2020 with a fellowship-trained foot and ankle surgeon (N=184). Data included demographics, comorbidities, surgical details, complication and reoperation rates, pre- and postoperative opioid and benzodiazepine use, and additional patient-reported outcome measures (ie, visual analog scale [VAS], Pain Catastrophizing Scale [PCS], Pain Disability Index [PDI], Foot and Ankle Outcome Score [FAOS] pain subscale). Mean follow-up duration was 4.49 (range, 1.10-14.17) months.

Results: BRS weakly correlated with decreased postoperative benzodiazepine use (*P*=.007). PCS magnification (*P*=.050) and helplessness (*P*=.047) subscales weakly correlated with increased follow-up duration. PDI total score and most subscores significantly correlated with an increase in at least 1 of the following: follow-up duration, or postoperative opioid or benzodiazepine use. Neither the VAS nor FAOS pain subscore correlated with any outcome. PDI total score was the strongest predictor of postoperative opioid (β=0.334) and benzodiazepine (β=0.315) use. Preoperative opioid users had significantly higher PDI total score (user=39.3, nonuser=24.9; *P*=.012) and subscores (ie, social activity, sexual behavior, self-care, life-support activities).

Conclusion: BRS is an unreliable tool for predicting outcomes in foot and ankle surgery, as it only weakly correlated with decreased benzodiazepine use. Rather, given the PDI's strong associations with postoperative measures in this study, physicians should consider the value of preoperative PDI completion when predicting how foot and ankle surgery recipients will fare postoperatively.

Level of Evidence: Level III, retrospective cohort study.

Keywords: opioid, pain, resilience, Pain Disability Index, Brief Resilience Scale

Introduction

There is a growing body of evidence that psychiatric comorbidities influence surgical outcomes across multiple surgical fields, including orthopaedic subspecialities.[8,9,13,17,22,26,27,31,33] Depression and anxiety have been shown to correlate with both objective and subjective outcomes after orthopaedic procedures,[4,5,9,11,25,31,33] but subclinical psychological variables such as emotional and attitudinal factors have also correlated with outcomes.[16,19,21,26] These include preoperative expectations, feelings of self-efficacy, and overall optimism.[26]

This connection between psychology and surgical outcomes is predictable, particularly for subjective and functional outcomes that directly relate to pain, as pain relief has been shown in numerous studies to relate to both

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clinical and subclinical psychological variables. The correlation between depression and chronic pain has been well borne out in the literature,[2,32] as has the effect of anxiety and pain catastrophizing on postoperative analgesia usage.[15]

One less studied area of psychological influences on surgical outcomes is the idea of resilience, or the ability to recover from an identifiable stressor. The Brief Resilience Scale (BRS), created by Smith et al,[28] was designed to focus on measuring one's innate resilience, as opposed to personal qualities that infer resilience, which was the focus of previous scales.[34] Measured on a 5-point Likert scale, the BRS directly asks the respondent in 6 questions to rate their ability to cope with stressors and difficult events. However, the Connor-Davidson Resilience Scale (CD-RISC), which is another popular resiliency scale, asks respondents to rate themselves on a much broader range of characteristics such as persistence, confidence, and determination that are assumed to relate to resilience.[10] Only a few studies in the orthopaedic literature have investigated the potential correlation between preoperative resiliency scores and postoperative outcomes, with mixed results.[6,12,30] No study to date has investigated resilience specifically in the foot and ankle patient population.

The main purpose of this prospective study is to determine the potential predictive value of preoperative resiliency scores on surgical outcome measures, including postoperative narcotic usage. As a secondary analysis, this study investigates the predictive value of more commonly used preoperative pain scores to compare with the results of the resiliency scores. We hypothesize that preoperative resiliency correlates with surgical outcomes in the foot and ankle patient population.

Materials and Methods

After obtaining approval from the Institutional Review Board, an initial retrospective review was conducted on patients who had completed a preoperative BRS and undergone foot or ankle surgery between November 2019 and November 2020 with a fellowship-trained foot and ankle orthopaedic surgeon or podiatric surgeon (N=208). After excluding pediatric patients, podiatric patients, and those with less than 1 month of follow-up, the final cohort consisted of 184 patients. The 3 most common surgeries were implant removal (n=17), Brostrom procedure (n=12), and flexor or extensor tenolysis (n=10). All surgeries are outlined in Table 1. The average follow-up duration for the final cohort was 4.5 (range, 1.1-14.2) months, average age was 54.7 (range, 19-84) years, and average body mass index was 30.3 (range, 18.9-49.8). Additionally, the cohort was primarily White (83.7%) and female (58.7%). Of note, 21.7% of the cohort used opioids within 3 months prior to surgery.

Table 1. Distribution of Surgical Procedures Included in the Cohort.[a]

CPT Code	Description	n
20680	Removal of implant	17
27698	Brostrom	12
27680	Flexor/extensor tenolysis	10
20902	Calcaneal allograft	9
28750	1st metatarsophalangeal arthrodesis	9
28270	Capsulotomy metatarsophalangeal	7
28289	Cheilectomy	7
27659	Peroneal repair	6
28080	Morton's neuroma excision	6
28285	Correction of hammertoe	6
27654	Secondary Achilles repair	5
27685	Lengthening or shortening of tendon/TAL	5
27691	Deep ligament transfer	5
28725	Subtalar arthrodesis	5
28060	Plantar fascia partial excision/Tenex	4
28090	Ganglion cyst excision	4
28615	ORIF Lisfranc	4
29898	Ankle scope extensive	4
28120	Calcaneal/talar exostectomy	3
28122	Midfoot exostectomy	3
28299	Double bunion osteotomy	3
28740	Interphalangeal joint arthrodesis	3
38220	Bone marrow aspirate concentrate	3
20240	Open superficial bone biopsy	2
20694	Removal of external fixation	2

Abbreviations: *CPT*, *Combined Procedural Terminology*; ORIF, open reduction internal fixation; TAL, tendon Achilles lengthening.
[a]The 3 most common surgeries were implant removal (n=17), Brostrom procedure (n=12), and flexor/extensor tenolysis (n=10).

Data Collection

Variables collected included patient demographics, medical comorbidities, surgical indications and details, complication and reoperation rates, and pre- and postoperative opioid and benzodiazepine use. Opioid and benzodiazepine use was assessed using the South Carolina Reporting & Identification Prescription Tracking System (SCRIPTS) database. Of note, the primary surgeon did not prescribe the benzodiazepines, but given their inclusion in the SCRIPTS database and their correlation with psychiatric comorbidities, it was decided to include this variable in the analysis.

In addition to the BRS, other preoperative patient-reported outcome measures (PROMs) that were assessed included the visual analog scale (VAS), Pain Catastrophizing Scale (PCS), Pain Disability Index (PDI), and Foot and Ankle Outcome Score (FAOS) pain subscale. All PROMs were collected in clinic via survey. The VAS is reported as a pain score on a continuum. The PCS is composed of 3 subscales—rumination, magnification, and helplessness—that respectively address intrusive negative thoughts of pain,

Table 2. Significant Associations Between Baseline PROMs and Postoperative Outcomes.[a]

	Opioid Use		Benzodiazepine Use		Follow-up Duration	
Relationship	*r* Value	*P* Value	*r* Value	*P* Value	*r* Value	*P* Value
BRS	–0.004	.957	–0.198	.007*	–0.013	.865
VAS	+0.090	.320	+0.109	.230	+0.129	.155
PCS total	+0.058	.649	+0.136	.281	+0.243	.051
PCS rumination	+0.087	.484	+0.140	.260	+0.240	.050
PCS magnification	+0.034	.788	+0.072	.565	+0.242	.050*
PCS helplessness	+0.026	.835	+0.137	.272	+0.246	.047*
PDI Total	+0.402	.006*	+0.366	.013*	+0.264	.079
PDI family/home responsibilities	+0.319	.027*	+0.330	.022*	+0.245	.094
PDI Recreation	+0.262	.069	+0.258	.074	+0.343	.016*
PDI social activity	+0.293	.041*	+0.308	.031*	+0.262	.069
PDI occupation	+0.230	.124	+0.246	.099	+0.214	.154
PDI sexual behavior	+0.293	.043*	+0.037	.802	+0.069	.639
PDI self-care	+0.449	.002*	+0.458	.001*	+0.181	.224
PDI life-support activities	+0.554	<.001*	+0.557	<.001*	+0.183	.212
FAOS pain	+0.032	.852	–0.041	.807	+0.010	.953

Abbreviations: BRS, Brief Resilience Scale; FAOS, Foot and Ankle Outcome Score; PCS, Pain Catastrophizing Scale; PDI, Pain Disability Index; PROMs, patient-reported outcome scores; VAS, visual analog scale.

[a]This table presents correlations between PROMs (ie, BRS, VAS, PCS, PDI, FAOS pain) and postoperative outcome measures (ie, postoperative opioid use, postoperative benzodiazepine use, follow-up duration). The BRS was significantly associated with decreased postoperative benzodiazepine use, and PCS magnification and helplessness subscores were significantly associated with increased follow-up duration. However, these significant correlations were not as strong as the positive associations the PDI total score and subscores had with the postoperative outcome measures.

*$P < .050$.

expectations of negative outcomes, and inability to cope with pain. The PDI measures the degree to which pain affects the following aspects of one's life: family and home responsibilities, recreation, social activity, occupation, sexual behavior, self-care, and life-support activities. Finally, the FAOS pain subscale accounts for the frequency and severity of pain.

Data Analysis

IBM SPSS Statistics for Macintosh, version 25.0, was used for the processing of all statistical data (Armonk, NY). Analyses included bivariate regression, multivariate logistic regression, and 2-tailed Student *t*-test. An alpha less than .05 defined significance. Post hoc test of the correlation between PDI total score and postoperative opioid use indicated our study was well powered ($P = .82$).

Results

The BRS significantly, although weakly, correlated with decreased postoperative benzodiazepine use ($r = -0.198$, $P=.007$) but did not correlate with any other measured outcome. The PCS subscores of magnification ($r=0.242$, $P=.050$) and helplessness ($r=0.246$, $P=.047$) significantly, although weakly, correlated with increased follow-up duration, but the PCS total score did not correlate with any measured outcome. The PDI total score and all subscores except the occupation subscore significantly correlated with increased follow-up duration, increased postoperative opioid use, and increased postoperative benzodiazepine use. It is important to note that PCS and PDI correlations were limited in sample size, as compared to the BRS correlation. These correlations are outlined in Table 2. Neither the VAS nor FAOS pain subscore correlated with any outcome.

Although not significant and underpowered, multivariate logistic regression of 39 patients showed the PDI total score to be the strongest predictor of postoperative opioid ($\beta=0.334$, $P=.112$, $P=.564$) and benzodiazepine ($\beta=0.315$, $P=.128$, $P=.644$) use among BRS, VAS, and PCS total scores. The VAS score was the second strongest predictor of postoperative opioid use ($\beta=0.104$, $P=.618$), and the BRS score was the second strongest predictor of postoperative benzodiazepine use ($\beta=0.204$, $P=.204$) (Table 3).

Preoperative opioid users had significantly higher PDI total score (user=39.3, nonuser=24.9; $P=.012$) and subscores (ie, social activity, sexual behavior, self-care, life-support activities), and postoperative opioid (user=58.2 morphine milligram equivalent [MME], nonuser=6.0 MME; $P=.001$) and benzodiazepine (user=1.4 LME, nonuser=0.2 MME; $P=.046$) use than those who were not prescribed opioids within 3 months before surgery. Results of this 2-tailed Student *t* test can be found in Table 4.

Table 3. Predictive Value of PROMs on Postoperative Opioid and Benzodiazepine Use.[a]

	Opioid Use (R^2=0.178)			Benzodiazepine Use (R^2=0.203)		
	β Value	*t* Value	*P* Value	β Value	*t* Value	*P* Value
BRS	–0.084	–0.527	.602	0.204	1.295	.204
VAS	0.104	0.503	.618	0.126	0.618	.541
PCS total	–0.035	–0.194	.847	0.091	0.512	.612
PDI total	0.334	1.630	.112	0.315	1.560	.128

Abbreviations: BRS, Brief Resilience Scale; PCS, Pain Catastrophizing Scale; PDI, Pain Disability Index; PROMs, patient-reported outcome scores; VAS, visual analog scale.
[a]Among BRS, VAS, PCS total, and PDI total scores, multivariate logistic regression showed the PDI total score to be the strongest predictor of postoperative opioid and benzodiazepine usage. The PCS total score was the worst predictor of these outcome measures.

Table 4. Significant Pre- and Postoperative Differences by Preoperative Opioid Use.[a]

	Preoperative Opioid Use	*No* Preoperative Opioid Use	*P* Value
Preoperative			
PDI total	39.25 ± 18.19	24.89 ± 15.44	.012
PDI social activity	5.86 ± 2.60	3.94 ± 3.05	.044
PDI sexual behavior	5.07 ± 4.10	2.12 ± 2.17	.021
PDI self-care	4.85 ± 2.97	2.41 ± 2.08	.003
PDI life-support activities	3.86 ± 3.21	1.77 + 1.71	.034
Postoperative			
Opioid use, MME	58.24 ± 88.04	5.97 ± 9.23	.001
Benzodiazepine use, LME	1.42 ± 3.81	0.17 ± 0.79	.046

Abbreviations: LME, lorazepam milligram equivalent; MME, morphine milligram equivalent; PDI, pain disability index.
[a]Preoperative opioid users had significantly higher PDI total score and PDI social activity, sexual behavior, self-care, and life-support activities subscores than those who were not prescribed opioids within 3 months prior to surgery. Postoperatively, opioid and benzodiazepine usage were significantly higher for preoperative opioid users.

Discussion

Psychological influences on surgical outcomes have been studied extensively. First, psychiatric diagnoses, particularly depression and anxiety, have been shown to correlate with subjective and objective outcome measures across multiple orthopaedic subspecialties, including the foot and ankle patient population.[8,9,13,17,22,27,31,33] This is also true for psychological factors, such as expectations, self-efficacy, patient-perceived control over recovery, and general optimism.[26,32]

Resiliency, defined as the innate ability to recover from stressful events, would intuitively correlate with surgical outcomes, but is a less studied patient factor. The BRS is a validated, 6-question survey that quantifies resilience and has been used in previous studies investigating psychosocial effects on surgical outcomes.[28] Although this study only found 1 significant correlation between the BRS and measured outcomes, orthopaedic literature has found mixed results for the predictive value of the BRS on postoperative outcomes.[6,20,23,30] Tokish et al[30] found the BRS to significantly correlate with higher Single Assessment Numeric Evaluation and Penn scores in 70 patients undergoing total shoulder arthroplasty, and Magaldi et al[20] found the BRS to significantly correlate with higher Patient-Reported Outcome Measurement Information System (PROMIS) Mental and Physical scores in 242 patients undergoing total knee arthroplasty. Chavez et al,[6] however, found no correlation between the BRS and the Knee Injury and Osteoarthritis Outcome Score or Single Assessment Numeric Evaluation scores in 175 patients undergoing arthroscopic partial meniscectomy and/or chondroplasty. Furthermore, in the Magaldi et al[20] study, while resilience correlated with PROMIS scores, it did not correlate with the postoperative Knee Injury and Osteoarthritis Outcome Score scores. These inconsistent findings suggest that larger cohorts are required to investigate the predictive value of the BRS and resilience, in general.

The PDI is a 7-question survey that quantifies the impact chronic pain has on various aspects of a patient's life. It was originally developed as a tool for management of chronic pain and has been shown to be a valid and reliable measure for perceived disability related to pain.[7,29] To date, no studies have investigated the predictive value of the PDI on postoperative outcomes in orthopaedic patients. Given its strong correlation with pain, perceived disability, and pain catastrophizing, it was included in this study, and was found to strongly correlate with pre- and postoperative opioid usage. Previous studies have corroborated this correlation in chronic and neuropathic pain patients, with higher PDI scores in opioid users vs nonusers.[1,3] In the study by Bostick et al,[3] this was true even when controlling for disease severity. Further, patients with continued postoperative narcotic use have been shown to have worse results of surgical reconstruction, highlighting the importance of identifying these patients preoperatively.

Finally, this study did not find any correlations between the PCS and postoperative outcome measures, as previous studies have. However, in this study, the subscales of magnification and helplessness were found to correlate with increased postoperative follow-up, although the total PCS did not. Contrarily, higher preoperative PCS scores have been shown to predict worse subjective outcomes and pain scores after total knee arthroplasty, even when controlling for comorbid anxiety.[18,24] This was also found to be true in musculoskeletal trauma patients with extended periods of opioid use postoperatively.[14] Therefore, because of the paucity of foot and ankle research investigating the predictive value of the PCS, despite its strong correlation to postoperative outcomes in other subsets of orthopaedic patients, further research is warranted.

Limitations

There were inherent limitations to this study. First, various foot and ankle procedures of the hindfoot, midfoot, and forefoot were included to provide a sufficient sample size, thus introducing variability that was difficult to control for. Additionally, this study was subject to the biases associated with survey administration, such as response and order bias. Third, opioid and benzodiazepine usage were obtained through the SCRIPTS database, which is a state database tracking narcotic prescription fulfillment that does not record the number of pills consumed. Fourth, as a retrospective study, it was limited by subjective collection bias. Finally, 4.49 months is a relatively short mean follow-up period, so further research should be done with a longer follow-up period.

Conclusion

In conclusion, resiliency, as measured by the BRS, did not correlate with postoperative outcomes, whereas the PDI was correlated with postoperative narcotic and benzodiazepine usage. However, the intake paperwork provided to and completed by patients can easily become burdensome, and any portions that can be omitted, should be. This study shows the BRS is not a powerful predictive tool and, therefore, does not need to be provided to foot and ankle patients. The PDI, however, could potentially represent an easily administered tool to predict postoperative narcotic usage. Further research investigating these measures specifically in the foot and ankle patient population is needed to better assess their validity.

Ethical Approval

Ethical approval for this study was obtained from the Medical University of South Carolina's Institutional Review Board (Pro00103183).

Declaration of Conflicting Interests

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