The Psychosocial and Affective Burden of Posttraumatic Neuropathy Following Injuries to the Trigeminal Nerve

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Aims: *To explore the impact of trigeminal nerve injuries on quality of life, including the effect of pain on psychological and affective function.* ***Methods:*** *An observational, cross-sectional survey design was employed. Fifty-six patients with inferior alveolar nerve injury (IANI) and 33 patients with lingual nerve injury (LNI) completed standardized self-report measures of pain intensity, pain catastrophizing, self-efficacy to cope with pain, and mood, in addition to generic and oral health-related quality of life (HRQoL) indicators. The impact of pain severity on these aspects of psychosocial function was examined. Summary statistics were calculated for all measures and compared with norms or values of other relevant studies, when available, using* t *tests. The impact of pain severity on these aspects of psychosocial function was examined using analysis of variance and hierarchical multivariate regression models.* ***Results:*** *The majority of patients reported pain associated with their nerve injury (86%). Nerve injury had a significant impact on all investigated domains, and this was closely linked with reported pain levels. Patients with severe pain showed particularly elevated levels of depression and pain catastrophizing, as well as substantially reduced HRQoL and coping efficacy levels. Pain intensity level was a significant predictor in all models except anxiety, uniquely contributing between 17% and 26% of variance to the prediction of pain catastrophizing, depression, coping efficacy, and generic and oral HRQoL.* ***Conclusion:*** *Traumatic injury to the trigeminal nerve is associated with a substantial patient burden, particularly in patients who experience severe neuropathic pain as part of their condition. These findings highlight the need to identify, develop, and evaluate more effective treatments for neuropathic pain in trigeminal nerve injury that will not only provide clinically meaningful reductions in pain but also improve patients' quality of life.* J OROFAC PAIN 2013;27:293–303. doi: 10.11607/jop.1056

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Injuries to the third division of the trigeminal nerve remain a common and complex clinical problem of significant research interest.[1,2] Problematic trigeminal nerve injury (TNI) appears to be predominantly caused by iatrogenic damage during oral surgical procedures, including placement of dental implants, endodontic therapy, orthognathic surgery, local anesthetic injections, and dentoalveolar surgery, particularly involving the removal of mandibular third molars.[3] It is estimated that approximately 0.5% of operations to remove mandibular third molars lead to a permanent sensory disorder involving the inferior alveolar nerve or the lingual nerve,[4,5] and these patients make up more than half of tertiary referrals to TNI clinics.[1,2]

Permanent neurosensory damage due to TNI is clinically reflected in a loss of function (anesthesia, hypoesthesia) and, similar to other posttraumatic nerve injuries, often accompanied by neuropathic pain (NeP; defined as pain arising as a direct consequence of a lesion or disease affecting the somatosensory system; for review, see Treede et al[6]). For instance, Robinson recently observed that more than 40% of the patients referred to a TNI clinic in the UK over a 12-month period had the unpleasant painful sensations of dysesthesia.[2] Another recent UK study reported that approximately 70% of TNI patients presented with NeP coincident with anesthesia and/or paresthesia.[1] NeP arising from TNI is typically characterized by unremitting throbbing or burning in the affected area and can endure for many years after injury, with only modest improvement over time.[7,8]

The recognized impact of NeP on patient functioning and quality of life[9–11] suggests that patients with inferior alveolar nerve injury (IANI) or lingual nerve injury (LNI) are likely to experience significant life changes related to the injury. A number of recent studies have reported reduced quality of life, impaired psychosocial functioning, and elevated levels of anxiety and depression in patients suffering from orofacial pain with a neuropathic component, such as patients diagnosed with trigeminal neuralgia and idiopathic continuous orofacial NeP.[9,12,13] In these patients, impairment of function and reduced quality of life appears to be closely linked with pain levels, as indicated by poorer health status and greater pain interference with functioning with increasing NeP severity.[9,13]

Although much attention has been directed towards biomedical aspects of diagnosis and management of TNI, particularly quantitative sensory testing,[14,15] literature dedicated to measuring the psychosocial impact is relatively scarce. It is known that patients with TNI often complain that their neuropathic symptoms interfere significantly with daily function, such as speaking, eating, drinking, kissing, facial expression, make-up application, and shaving.[1] These interferences disrupt social interactions and may ultimately lead to psychological problems.[7,8] But studies reporting disability and functional limitations due to TNI have generally relied on basic interviews or assessments using rudimentary, nonstandardized questionnaires intended to identify gross psychosocial difficulties.[7,8,16] A comprehensive psychosocial assessment that addresses health-related quality of life (HRQoL) in conjunction with cognitions (eg, beliefs, expectations of symptoms and coping efficacy, interpretation of the meaning and implications of symptoms) and mood (eg, anxiety and depression) is needed to better characterize the patient burden of TNI. The purpose of the present investigation was to systematically measure the impact of NeP on patient-reported functioning and well-being in patients with TNI.

Materials and Methods

Design

This was a cross-sectional clinical study assessing the perceived disability of patients referred to a specialist center subsequent to iatrogenic TNI. It used questionnaires designed to evaluate functionality, health, and psychosocial aspects related to their injury.

Participants

Eighty-nine patients who were referred to the Dental Institute in King's College Hospital, London, with a TNI as a result of dental treatment agreed to participate in the study. At the time of the study, approximately 300 TNI patients had been consulted and/or were receiving care for their injury at the specialist centre. Patients were included in the study if they presented to the clinic with reported sensory changes due to iatrogenic IANI or LNI. Patients were excluded from the study if they had a concomitant illness unrelated to their TNI, including chronic orofacial pain caused by other conditions. Participants were either given a set of questionnaires intended to measure pain-related psychological and psychosocial function (described below) to complete at their clinic appointment (n = 16) or had questionnaires posted to them after their consultation (n = 73). Clinicians on the research team provided clinical information related to etiology and duration of injury and prescribed medications for TNI. Ethical approval for the study was provided by the London–London Bridge Local NHS Research Ethics Committee (REC number 08/H0808/105).

Measures and Instruments

Participants were asked to complete several measures of functioning, in the form of standardized self-report instruments, as outlined below.

Pain-Intensity Measures

Pain severity was assessed using the 11-point numerical rating scales (NRS) dedicated to the evaluation of a patient's reported current pain level and its strongest and average levels during the past month from the PainDETECT tool.[17] Pain severity cut-off points were 1–3 for mild pain, 4–6 for moderate pain, and 7–10 for severe pain.[9,18]

Assessment of Psychosocial, Affective, and Health Function

The Hospital Anxiety and Depression Scale (HADS), designed for use in people with physical illness, was used to measure symptoms of anxiety and depression.[19] This self-rated questionnaire consists of two 7-item scales: one for anxiety (HADS-A) and one for depression (HADS-D), both with a scoring range of 0–21. Scores between 7 and 10 indicate borderline anxiety and/or depression, with higher scores representing higher levels of symptoms of anxiety and/or depression. The HADS has been shown to have good psychometric properties in a variety of medical populations with respect to factor structure, subscale intercorrelation, homogeneity, and internal consistency.[20]

Catastrophizing about pain was assessed using the Pain Catastrophizing Scale (PCS).[21] This is a 13-item self-completion measure, sampling the tendency to attend to pain stimuli, to overestimate their threat value, and to underestimate the ability to handle that threat. Each statement is rated on a scale ranging from 0 (not at all) to 4 (all the time), and total scores range from 0 to 52. Internal consistency is high[21] and the test-retest reliability is satisfactory.[22]

The Pain Self-Efficacy Questionnaire (PSEQ) was used to measure pain self-efficacy beliefs.[23] This 10-item self-report questionnaire measures both the strength and generality of a patient's beliefs about his/her ability to accomplish activities in 10 different areas despite the pain, with higher scores indicating stronger self-efficacy beliefs. Each statement (eg, I can enjoy things despite the pain) is followed by a scale ranging from 0 (not at all confident) to 6 (completely confident), with total scores ranging from 0 to 60 (completely confident for all activities). The PSEQ has been shown to have good test-retest reliability and internal consistency.[24]

Oral health–related quality of life (OHRQoL) was evaluated by means of the short-form Oral Health Impact Profile (OHIP-14), a 14-item questionnaire designed to measure an individual's perception of the social impact of oral disorders on well-being and to assess discomfort, disability, and dysfunction attributable to oral conditions.[25] For each item, participants were asked to indicate on a scale (0, never; 1, hardly ever; 2, occasionally; 3, fairly often; and 4, very often) how frequently they had experienced the impact in the last 3 months. OHRQoL impairment was characterized by the overall severity score, which is the simple sum of all 14 item responses and the prevalence of "fairly often" or "very often" responses across items. The OHIP-14 also distinguishes seven domains of oral health by using two items for each domain that range from functional limitation to handicap. Coded responses to each question were multiplied by item weights derived from Slade[25] and the products added to produce subscale scores. OHIP-14 was selected for this study as it has been shown to have good reliability, validity, and precision.[25,26]

Patients also completed the EQ-5D-5L survey, a standardized measure of health status developed by the EuroQol Group to provide a simple, generic measure of overall functioning and well-being for clinical and economic appraisal.[27,28] Respondents are asked to report their levels of difficulty or problems on a five-point ordinal scale (0, no problems; 1, slight problems; 2, moderate problems; 3, severe problems; 4, extreme problems) in five dimensions: mobility, self care, usual activities, pain/discomfort, and anxiety/depression. Patients' health states are described by the profile of levels across areas, with health-state valuations calculated for each profile based on precalculated scoring coefficients. In this study, information relating to EQ-5D-5L health states were converted into a single index value by using the crosswalk link function based on the available dataset and could range from –0.59 (extreme problems in all five areas) to 1.00 (no problems in any of the five areas).[29] Additionally, patients also completed the EQ visual analog scale (VAS), by which patients rated their health on a 20-cm vertical VAS with endpoints labeled "the best health you can imagine" and "the worst health you can imagine."

Statistical Analysis

Summary statistics for the TNI sample were calculated in the form of means and standard deviations for continuous variables and frequency distributions for categorical variables. The distributional properties of all continuous outcome variables were examined. Where skewness and/or kurtosis values indicated a substantial departure from normal distribution (acceptable range of normality is between –1 and +1[30]), box-plots were used to display data distributions, and Box-Cox transformation procedures[31] were used to achieve adequate normality in regression analyses. Where norms or values from other relevant studies on employed measures were available, *t* test comparisons were made with (normally distributed) TNI patients' scores. To evaluate the association between pain severity (categorized as none, mild, moderate, or severe) and psychosocial/

Table 1 Demographic Characteristics and Injury Etiology of Trigeminal Nerve Injury (TNI) Patients

Demographic/Clinical variable	All TNI (n = 89)	IANI (n = 56)	LNI (n = 33)
Sex, female/male	61/28	40/16	21/12
Age, mean ± SD	44.3 ± 13.6	47.0 ± 13.6	39.6 ± 12.3
Months since injury, median (range)	10 (1–216)	10 (1–215)	8 (1–83)
≥ 6 months since injury, n (%)	55 (61.8)	36 (64.3)	19 (57.6)
Etiology of injury, n (%)			
Third molar surgery	46 (51.7)	19 (33.9)	27 (81.8)
Implant placement under LA	12 (13.5)	12 (21.4)	
Extraction of mandibular tooth/teeth (apart from third molar surgery)	11 (12.4)	9 (16.1)	2 (6.1)
Chemical injury from the LA	7 (7.9)	5 (8.9)	2 (6.1)
Restorative (eg, endodontic) treatment	3 (3.4)	3 (5.4)	
Other	5 (5.6)	4 (7.1)	1 (3.0)
Trauma (nonsurgical; eg, assault)	2 (2.2)	2 (3.6)	
Pathological excision	1 (1.1)	1 (1.8)	
Apicectomy	1 (1.1)	1 (1.8)	
Unknown	1 (1.1)		1 (3.0)

IANI = inferior alveolar nerve injury; LNI = lingual nerve injury; LA = local anesthetic.

functional outcome measures, Kruskal-Wallis one-way analysis of variance (ANOVA) models were employed. Hierarchical linear regression analyses were used to establish the contribution of pain severity to each outcome measure in addition to sociodemographic and injury-related variables. For each regression model, the normal distribution of the residuals, assumption of homoscedasticity, and absence of multicollinearity were tested. All statistical analyses were completed with the Statistical Package for the Social Sciences, Release 19.0 (SPSS, IBM). *P* values < .05 were considered to reflect statistical significance.

Results

Sample Characteristics

Eighty-nine participants completed the questionnaires, 56 patients with IANI and 33 patients with LNI. The demographic characteristics and etiology of nerve injury for the patient sample are displayed in Table 1. Notably, IANI patients tended to be older than their LNI counterparts ($t[87] = 2.58$, $P = .012$). A little more than half of all patients' nerve injuries were sustained during third molar surgery, although this was more likely for LNI patients than IANI patients ($\chi^2[1] = 19.07$, $P < .001$) whose injuries arose from a wider range of procedures.

A minority of patients (19; 21.3%) were receiving one or more prescription medications at the time of the study; 6 were taking two or more different medication classes. Of those receiving medications, 9 were taking antiepileptic medications (pregabalin, gabapentin, carbamazepine, or oxcarbazepine), 8 were taking antidepressants (tricyclic antidepressants or selective serotonin reuptake inhibitors), 6 were receiving topical local anesthetics (lidocaine, benzocaine), 2 were taking paracetamol, 1 was using opioid medication (tramadol), 1 was taking a tranquilizer (benzodiazepine), and another was on a course of cortisone. Seven patients (7.9%) had previously undergone surgery intended to resolve their nerve injury, while 21 (23.6%) had received or were receiving (at the time of the study) cognitive-behavioral therapy.

Questionnaire Responses

Study measures were administered to all TNI participants, except for the OHIP-14, which was included in questionnaires to 70 participants only. A small number of the questionnaire results (typically < 10% for each measure) were excluded from analyses because of the patients' failure to complete the questionnaire or a high number of missing items (ie, > 10%; in the few cases where omissions constituted less than 10% of all items, the mean questionnaire score was imputed for each missing item).

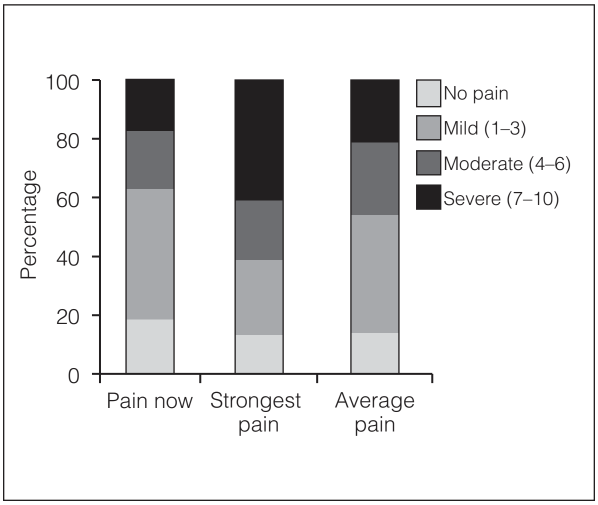

Fig 1 Reported pain intensity (percentage reporting in each severity cut-off point) in trigeminal nerve injury patients (from PainDETECT numerical rating scales: pain now, n = 55; strongest pain during the past 4 weeks, n = 54; and average strength of pain during the past 4 weeks, n = 54).

Table 2 Scores for Psychosocial and Affective Function and Health-Related Quality of Life (HRQoL) in Trigeminal Nerve Injury (TNI) Patients

Questionnaire	n*	Mean ± SD
Psychosocial/Affective		
PCS (0–52)	85	18.0 ± 13.7
PSEQ (0–60)	80	48.2 ± 14.15
HADS Depression (0–21)	84	5.6 ± 4.4
HADS Anxiety (0–21)	86	8.0 ± 4.8
HRQoL measures		
OHIP Severity (0–56)	67	23.2 ± 14.1
OHIP Extent (0–14)	67	4.3 ± 4.1
EQ Health (–0.59–1.00)	87	0.68 ± 0.22
EQ VAS (0–100)	86	73.7 ± 19.8

*The n values for each questionnaire are variable due to the exclusion of a small number of patients' questionnaire results from analyses because of failure to complete the questionnaire or a high (ie, > 10%) number of missing items.
PCS = Pain Catastrophizing Scale; PSEQ = Pain Self-Efficacy Questionnaire; HADS = Hospital Anxiety and Depression Scale; OHIP = Oral Health Impact Profile-14; EQ Health = EQ-5D-5L health-state evaluation; EQ VAS = current overall health rating.

Pain Intensity

The frequency distributions of pain-severity scores for TNI patients indicate that pain severity varied widely across patients (Fig 1). There were no differences in the distribution of pain intensity according to injury type (IANI versus LNI patients) for any of the three pain scales (for all comparisons, $\chi^2 < 0.88$, $P > .830$). Nor was pain severity related to sex, age, duration of nerve injury, whether or not patients were receiving medication for pain, or if patients had undergone surgery for nerve injury (for all univariate comparisons on pain-intensity scales, $P > .05$). Given the absence of IANI versus LNI group differences on pain measures, data for all subsequent analyses were collapsed over injury type.

Psychosocial, Affective, and Health Function

The psychosocial, affective, and HRQoL data for the TNI sample are shown in Table 2. Many TNI patients exhibited self-reported pain catastrophizing, and the group mean was significantly greater than that of a large nonclinical community sample reported in a PCS validation study (n = 215, 13.9 ± 10.1, $P = .005$).[32] Self-efficacy for coping with pain was, generally speaking, high in the patient sample, with the mean score approaching 50 (out of a maximum self-efficacy score of 60). Nineteen patients (23.8%) scored the maximum PSEQ score of 60, while only 8 (10.0%) scored 30 or less. The TNI patients also exhibited mild-to-moderate levels of general anxiety and depression. Almost 30% (29.8%) of TNI patients scored equal to or more than the recommended HADS-D cut-off score for the presence of depressive disorder (ie, 8),[19,20] while 15.5% reported symptom levels that were moderate or severe (> 10).[19] This proportion was considerably higher for anxiety, for which more than half (51.2%) reported clinically significant anxiety levels and more than a third (33.7%) reported moderate-to-severe levels.

Nerve injury had a significant impact on patients' OHRQoL. Mean OHIP-14 severity was well above average for the UK dentate population (5.1 [95% confidence interval, CI, 4.8–5.3], $P < .001$),[33] with almost 6 out of 10 patients (58.2%) scoring more than the upper 90th percentile value (severity score of 17). The mean severity scores were also much greater than those in a sample of 100 patients reported 1 week after (successful) third molar surgery (8.6 ± 7.2, $P < .001$).[34] There was a high prevalence of frequently occurring OHIP-14 items, with patients reporting on average 4 items as occurring "fairly often" or "very often." The overall percentage of patients reporting one or more items "fairly often" or "very often" was 77.6%. The distribution of scores for the seven dimensions of the OHIP-14 are presented in Fig 2. In addition to physical pain, dimensions relating to psychological discomfort

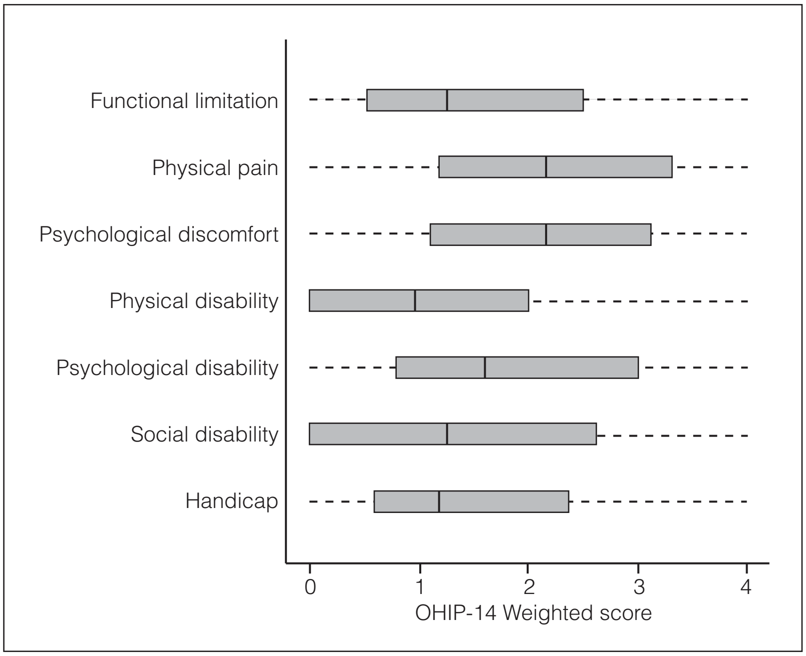

Fig 2 Boxplot showing distribution of OHIP-14 dimension scores (weighted range: 0–4) for trigeminal nerve injury patients (n = 70). Boxes contain medians, interquartile ranges (the middle 50% of values on dimensions), and the extreme values.

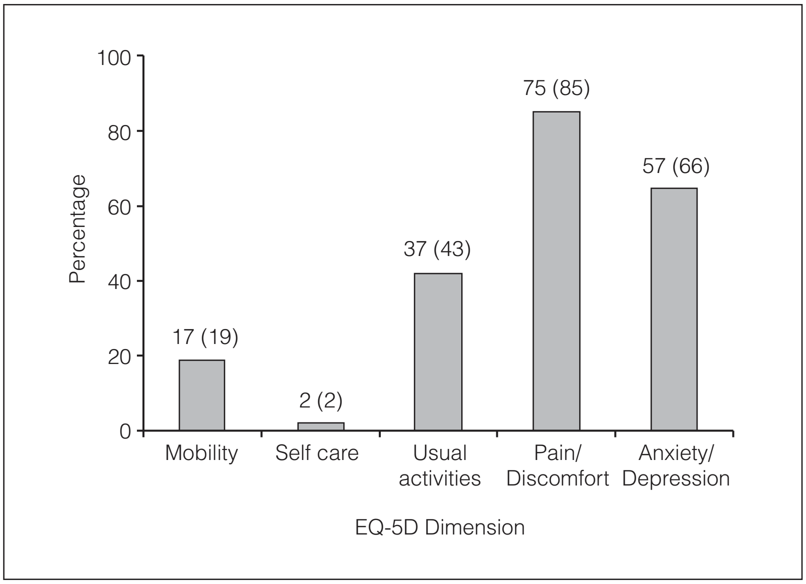

Fig 3 EQ-5D-5L profile (percentage reporting problems in each dimension) of trigeminal nerve injury patients (n = 88; for both Usual activities and Anxiety/Depression dimensions, n = 87). Note: Data labels represent n values and corresponding percentage.

(self-conscious, tense) and psychological disability (difficulty to relax, embarrassment) were the most problematic for patients.

The burden of nerve injury on overall health, as gauged by the EQ-5D-5L, was less pronounced, although the mean health-state evaluation score (0.68) was less than EQ-5D-5L norms observed in age-matched healthy UK populations (which across 10-year age cohorts from 25 to 64 years range from 0.93 to 0.80).[35] The EQ-5D-5L profile of TNI patients (percentage reporting problems in each dimension; Fig 3) indicates that iatrogenic nerve injury had little impact on patients' self-care and mobility. This was in stark contrast to pain/discomfort and mood disturbances, for which problems were common.

Figure 4 displays the median observed scores and interquartile ranges on functional measures for each level of average pain intensity. Kruskal-Wallis ANOVAs revealed highly significant associations between average pain intensity and all measures, except for the HADS-A. In general, patients with severe pain intensity expressed the greatest degree of impairment on psychosocial function and HRQoL

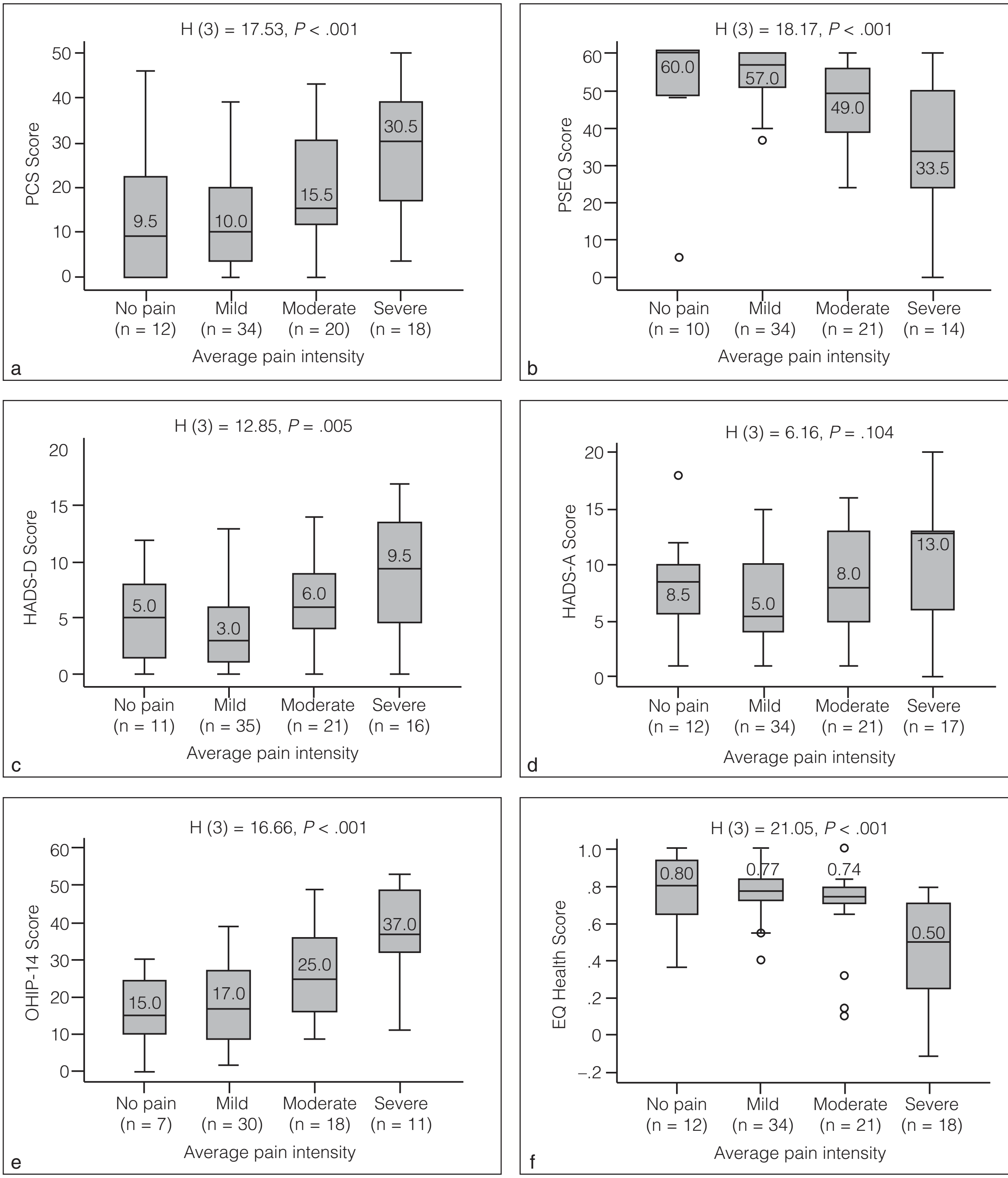

Fig 4 Boxplots showing distributions of psychosocial, affective, and health function scores according to reported average strength of pain during the past 4 weeks. Boxes contain median scores, interquartile ranges (the middle 50% of values by category of pain intensity), extreme values, and outliers (open circles). The *P* values shown are from Kruskal-Wallis one-way ANOVAs examining the effect of pain intensity on each measure. The H statistic of the Kruskal-Wallis one-way ANOVA is the resulting chi-square value (3 degrees of freedom). PCS = Pain Catastrophizing Scale; PSEQ = Pain Self-Efficacy Questionnaire; HADS-D = Hospital Anxiety and Depression Scale–Depression; HADS-A = Hospital Anxiety and Depression Scale–Anxiety; OHIP-14 = Oral Health Impact Profile-14; EQ Health = EQ-5D-5L health-state evaluation.

measures, while those with moderate pain showed greater impairment relative to those with mild pain, who as a group were functionally similar to those TNI patients reporting no pain.

Table 3 Hierarchical Multivariate Regression Analysis to Identify Contribution of Patient Characteristics and Pain Severity (Reported Average Strength of Pain During the Past 4 Weeks) on Each Outcome Measure

	PCS	PSEQ	HADS-D	HADS-A	OHIP-14	EQ Health
Step 1[a] (Stand β)						
Sex	–0.15	0.11	0.02	–0.01	0.10	0.05
Age	0.05	–0.10	–0.04	–0.13	–0.06	–0.03
Injury type	–0.01	–0.10	0.01	–0.03	0.19	0.11
Injury duration	0.09	–0.11	0.07	0.09	–0.01	–0.12
Step 1 model (ΔR^2)	0.04	0.04	0.01	0.02	0.09	0.05
Step 2[b] (Stand β)						
Moderate pain	0.27*	–0.29*	0.23*	0.15	0.27*	–0.15
Severe pain	0.45**	–0.51**	0.43**	0.28*	0.53**	–0.51**
Step 2 model						
ΔR^2	0.20**	0.25**	0.17**	0.07	0.26**	0.23**
R^2	0.24	0.29	0.19	0.07	0.35	0.28

PCS = Pain Catastrophizing Scale, n = 84; PSEQ = Pain Self-Efficacy Questionnaire, n = 79; HADS-D = Hospital Anxiety and Depression Scale–Depression, n = 83; HADS-A = Hospital Anxiety and Depression Scale–Anxiety, n = 84; OHIP-14 = Oral Health Impact Profile-14, n = 66; EQ Health = EQ-5D-5L health-state evaluation, n = 85; Stand β = standardized beta coefficient; all standardized beta coefficients are from the final regression equation; $\Delta R^2 = R^2$ change; *$P < .05$, **$P < .001$.
[a]Sex: Female = 0, Male = 1; Injury type: Inferior alveolar nerve injury = 0, Lingual nerve injury = 1; Injury duration: ≤ 12 months = 0; > 12 months = 1.
[b]Patients were classified into three pain severity groups: None/Mild, Moderate, and Severe; None/Mild was the reference category (ie, 0).

A series of hierarchical linear regression analyses were conducted to assess the relative contribution of pain severity to each psychosocial outcome measure in addition to potentially relevant sociodemographic and injury-related factors. Age, sex, type of injury (IANI versus LNI), and duration of injury (≤ 12 months versus > 12 months) were entered in the first step of the analysis. Pain severity (none/mild, moderate, severe) was entered in the second step. To reduce the number of ordinal categories, the patients with no pain and mild pain were collapsed into a single group (this followed from the similarity between the two), which was the reference category. The normality assumption of the residual distribution of each model was tested with the Shapiro-Wilk test and not rejected ($P > .10$ for all models). Plots of regression-standardized residuals predicted values showed that the assumption of homoscedasticity was not violated. There were no problems with multicollinearity of independent variables, with all variance inflation factors across all models < 1.15. The results of the hierarchical multivariate regression analysis are shown in Table 3. Together, sociodemographic variables and type and duration of nerve injury contributed less than 10% of variance to the prediction of each outcome measure (range 1% to 9%), with no significant individual predictors. In contrast, pain severity contributed between 17% and 25% of variance to the prediction of each measure of psychological function, save the Anxiety subscale of the HADS (7%), and 26% and 23% of the variance to the prediction of oral and generic quality of life measures, respectively. Examination of the β weights for the final regression equation revealed that severe levels of reported pain contributed significant unique variance to the prediction of all outcome measures, while moderate pain was a significant predictor of pain catastrophizing, self-efficacy, depression, and OHRQoL.

Discussion

This is the first study to measure systematically both HRQoL and psychological function in patients suffering from NeP secondary to TNI by using standardized, self-report measures that are well established in the assessment of (related) dimensions of the experience of chronic pain. As a whole, the study has demonstrated a substantial patient burden resulting from the NeP associated with iatrogenic TNI.

Consistent with previous reports, the overwhelming majority of patients with TNI in this study suffered from painful altered sensations.[1,36] To the extent that pain scores ≥ 4 on an 11-point NRS are indicative of considerable daily suffering,[18] the results suggest that many nerve injury patients in the present study experienced substantial pain for significant periods. Thus, the results confirm what has been documented about the severity of the pain experience in peripheral nerve injury[18,37,38] and add to the literature concerning the prevalence and intensity of NeP in patients with permanent trigeminal sensory dysfunction.[1,2]

Critically, however, the findings here indicate that TNI also results in psychological effects rarely seen in dental pain patients. A previous study, which followed up 145 patients with IANI or LNI at least 3 years after the injury was sustained, found that 37% of patients reported having suffered from depression.[7] In the present study, almost two-thirds of patients indicated some level of mood disturbance on the EQ-5D-5L, while 16% of patients had moderate or severe symptom levels of depression on the HADS-D. This figure more than doubled for anxiety symptom levels, suggesting mood disorders are prevalent in TNI patients. The observed levels of anxiety and depression are in line with those shown in other populations with chronic orofacial pain[39] and other peripheral NeP conditions such as diabetic peripheral neuropathy and posttraumatic peripheral NeP.[37,38] Pain catastrophizing levels, although variable across the sample, were indicative of exaggerated negative orientation towards pain in many patients. Group means of catastrophic thinking were similar to those reported in samples of pain outpatients, individuals with NeP, and those with orofacial pain conditions.[12,21,32] Notably, Gustin and colleagues[12] also recently observed a high level of pain-related catastrophizing in a small group of patients suffering from trigeminal NeP, of which many had a diagnosis of trigeminal neuralgia.

HRQoL was also reduced in the present sample of TNI patients. This was most obvious on the OHIP-14, which revealed marked oral dysfunction, comparable in magnitude to that of burning mouth syndrome[40] and temporomandibular disorder (TMD).[41] Interestingly, however, the mean EQ-5D health-state valuation (0.68) tended to be higher than that reported in other neuropathic conditions, such as failed back surgery syndrome (0.15), and postherpetic neuralgia and diabetic neuropathy (0.61).[42,43] This suggests that although overall functioning and well-being are reduced in TNI relative to healthy populations, the impact may be less than conditions involving bodily NeP, perhaps as a consequence of the latter's potentially devastating effect on mobility and self-care, aspects of HRQoL that were relatively intact in the present sample. Additionally, the fact that many patients scored highly on the PSEQ suggests that these patients are confident in coping with their NeP, thus minimizing the impact on overall quality of life.

Although LNI is often associated with (more) severe disability than IANI, as indicated by the high proportion of lawsuits in such cases[44] and a greater proportion likely to be offered remedial nerve surgery,[2] the type of injury had little impact on disability in the present study. Rather, the presence and increasing severity of pain in TNI patients were closely linked with decreased function and increased mood disturbance. These findings draw parallels with those in studies of other NeP conditions and orofacial pain.[9,38,43] For example, Segù et al[45] demonstrated that the scores of all OHIP subscales increased with the amount of pain in TMD patients. The strongest correlations reported by these authors occurred within the domains of functional limitation, psychological discomfort, and physical and psychological disability. In patients with trigeminal neuralgia, Tolle et al[9] observed poorer (generic) health status and greater pain interference in functioning with increasing NeP severity.

Previous studies have emphasized the psychosocial disability that accompanies TNI, and many important social functions such as eating, speaking, and kissing are affected.[1,7,8,36] The findings of the present study lend support to this hypothesis and extend them by providing a quantitative basis for assessing psychosocial impact, including comparison with other syndromes. The substantial burden of illness observed here suggests a need to identify, develop, and evaluate more effective treatments for NeP in TNI that will not only provide clinically meaningful reductions in pain but also improve patients' functioning across a broad range of QoL domains. Of particular importance is addressing the psychosocial care requirements of those patients with severe pain who show particularly elevated levels of depression, anxiety, and pain catastrophizing, as well as substantially reduced efficacy levels to cope with pain and HRQoL. Cognitive-behavioral therapy approaches alone or within the context of an interdisciplinary pain-rehabilitation program has the greatest empirical evidence for success in the management of patients with chronic pain conditions,[46] and, as such, are likely to be useful complements to medication management and rehabilitation in patients suffering from NeP associated with TNI.

Study Limitations

This study has some limitations. First, the cross-sectional design does not allow the specification of how any psychological (dys)function contributes to the perpetuation of pain and disability in TNI patients. Previous studies of patients with chronic pain conditions, including TMD patients, have demonstrated that depression, pain catastrophizing, and pain vigilance and awareness all contribute uniquely to the prediction of reported pain intensity and disability.[47,48] In the present study each functional outcome was examined alone and at a single time point. Future studies examining the progression of patients'

NeP and associated disability at various points after injury, with consideration for adjustment of psychometric factors to each other, may better elucidate the relationships between various psychosocial and affective factors and the nature of their association with pain intensity and disability.[49] Second, across a range of surgical procedures, chronic postoperative pain is more likely to occur amongst patients with preoperative pain, pain anxiety, high catastrophizing, and/or depression, suggesting a predisposition towards the development of chronic pain in patients with psychological vulnerability.[49,50] In the absence of preoperative assessments (and given the sheer volume of dental procedures associated with TNI, assessments are not likely to be pragmatic), it remains difficult to rule out the effects of any pre-existing pain or psychological distress on patients' present functioning. Finally, patients in this study were seeking further care for their nerve injury (including advice, reassurance, and/or possible medical/surgical interventions). The Dental Institute in King's College Hospital is one of the largest centers in the UK for handling a (relatively) large number of TNI referrals; so in terms of the TNI population whose symptoms are severe enough to warrant specialist referral, the sample is likely to be highly representative. However, psychometric data were not available from patients who may have been eligible for the study but did not participate in the clinic's research. Further, those with permanent injury to the trigeminal nerve who do not seek treatment may have less pain and/or a different psychosocial experience. Hence the data here are not necessarily reflective of the TNI population as a whole.

Conclusions

This study demonstrated that peripheral neuropathy resulting from TNI is associated with a substantial psychosocial and affective burden. This burden is pronounced in a subset of patients who suffer from high levels of NeP and suggests a need for improved management strategies in patients with TNI.

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