

# Pain Catastrophizing for Patients with Temporomandibular Disorders

Jin-Ho Park, Hye-Kyoung Kim, Ki-Suk Kim, Mee-Eun Kim

Department of Oral Medicine, Dankook University College of Dentistry, Cheonan, Korea

Received February 25, 2015  
Revised March 6, 2015  
Accepted March 10, 2015

**Purpose:** Besides depression and anxiety, recently pain catastrophizing has been emphasized for an important psychological factor explaining pain response in various pain conditions including temporomandibular disorders (TMDs). The aims of this study were to evaluate pain catastrophizing of TMD patients and to investigate how the level of pain catastrophizing related with clinical variables and psychometric morbidity.

**Methods:** Inclusion criterion was all new TMD patients  $\geq 18$  years old attending the Department of Orofacial Pain and Oral Medicine of Dankook University Dental Hospital (Cheonan, Korea) over three-month period in 2014, who completed questionnaires. The questionnaires included the Brief Pain Inventory (BPI), Pain Catastrophizing Scale (PCS), and Symptom Check List-90-Revised (SCL-90-R). All of them were examined clinically and diagnosed.

**Results:** One hundred fifty five patients diagnosed as TMDs were participated in this study (mean age of  $38.7 \pm 15.2$  years, male:female=1:2.5). Mean PCS score of the patients was 17.3 with standard deviation of 12.6. By the median of the PCS score (i.e., 15), the subjects were categorized into the high ( $\geq 15$ ) and low catastrophizers ( $< 15$ ). Increased pain severity and interference and increased score of psychological features of SCL-90-R were found in the TMD patients with higher level of catastrophizing ( $p < 0.001$ ) and there was weak to moderate correlation between those factors ( $p < 0.05$ ). Difference in catastrophizing level was not found for other variables such as age, gender, duration of pain, education level and types of TMDs.

**Conclusions:** Conclusively, pain catastrophizing of TMD patients relates positively to pain severity and pain interference. In addition to depression and anxiety, pain catastrophizing is positively correlated with variable other psychological morbidity such as somatization, obsessive-compulsive, interpersonal sensitivity, paranoid ideation and psychoticism. Types of TMD diagnosis do not seem to affect catastrophizing level. The results of this study suggest that pain catastrophizing should be emphasized and assessed in the TMD patients.

**Key Words:** Catastrophization; Pain; Temporomandibular joint disorders

**Correspondence to:**

Mee-Eun Kim  
Department of Oral Medicine, Dankook  
University College of Dentistry, 119  
Dandae-ro, Dongnam-gu, Cheonan  
330-714, Korea  
Tel: +82-41-550-1913  
Fax: +82-505-434-7951  
E-mail: meunkim@dankook.ac.kr

## INTRODUCTION

It is widely accepted that psychological factors plays an important role in perpetuating and aggravating temporomandibular disorders (TMDs).<sup>1)</sup> Traditionally, depression and anxiety has been considered primary psychological factors.<sup>2)</sup> More recent studies have stressed out "catastrophizing" for one of the most important psychological factors explaining pain response.<sup>3-5)</sup>

The term, catastrophizing was adapted to describe a maladaptive cognitive style employed by patients with anxiety and depression disorders.<sup>6)</sup> According to their definitions, catastrophizing was the concept of an irrationally negative fore-cast of future event. Similarly, pain catastrophizing is defined as 'an exaggerated negative orientation towards actual or anticipated pain experiences' and reflects a tendency to misinterpret or exaggerate apparently threatening situations<sup>7)</sup> that can lead to increased sensitivity to pain, thus

enmeshing patients in a vicious circle that may also involve reduced bodily performance.<sup>8)</sup>

To assess an individual's propensity to catastrophize, several measures have been developed: Cognitive Errors Questionnaire (CEQ), Coping Strategies Questionnaire (CSQ), Pain Cognition List (PCL), and Pain Catastrophizing Scale (PCS). Among these, the CSQ and PCS are typically used with a variety of populations.<sup>9)</sup> The PCS assess three domains—rumination, magnification, helplessness—believed to comprise much of the pain catastrophizing construct, while the CSQ only evaluates the helplessness dimension. Hence, it can be said that the PCS considers a broader assessment of the catastrophizing construct than the CSQ.<sup>6)</sup>

Studies have been performed to assess the use of catastrophizing in a clinical context. A positive correlation between catastrophizing level and pain perception has been reported in studies involving healthy adults undergoing aversive diagnostic procedures, those with chronic pain conditions, those with whiplash injuries, and those undergoing dental procedures.<sup>8,10-13)</sup> Catastrophizing has also been suggested a predictive factor for postoperative pain.<sup>3,14)</sup> There also existed several studies concerning pain catastrophizing in the TMD population. Turner et al.<sup>15,16)</sup> showed that catastrophizing has been linked to self-reported clinical pain, activity interference, negative mood, greater clinical examination findings and increased health care utilization. In a prospective cohort study of TMDs by Velly et al.,<sup>4)</sup> catastrophizing and depression contributed to the progression of chronic TMD pain and disability.

Compared to other chronic pain conditions, less attention has been given to catastrophizing in TMD patients and particularly little attention has been paid to it in Korea. The aims of this study were to evaluate pain catastrophizing of TMD patients and to investigate how the level of pain catastrophizing related with various clinical variables and psychometric morbidity.

## MATERIALS AND METHODS

### 1. Subjects

Inclusion criterion was all new TMD patients attending the Department of Orofacial Pain and Oral Medicine of Dankook University Dental Hospital (Cheonan, Korea) over

three-month period in 2014, who completed the following questionnaires. Prior to the first consultation, all new patients in the waiting room were asked to fill in the Brief Pain Inventory (BPI), PCS, and Symptom Check List-90-Revised (SCL-90-R). Then all of them were examined clinically and diagnosed.

We exclude those who did not fully complete the questionnaires; <18 years old; with significant mental disorders; who were considered to have dental or psychological pain. Those who disagreed participating in the study were also excluded. In accordance to inclusion and exclusion criteria, total subjects were 155 with male:female ratio of 1:2.5 and their mean age of  $38.7 \pm 15.2$  years (range, 18 to 81 years).

### 2. Methods

Information collected retrospectively from clinical records of the eligible patients included scores of pain severity and interference from BPI and PCS scores, SCL-90-R, age, gender, education level, duration of symptoms and types of TMD diagnosis.

Pain catastrophizing level for the subjects in this study was measured by the PCS developed by Sullivan et al.<sup>7)</sup> in 1995. It has been developed for use in both clinical and nonclinical contexts. The items relate to the frequency of thoughts and feelings experienced when participants are in pain. It contains 13 items on a 5-point scale to assess three dimensions of catastrophizing—rumination, helplessness, and magnification. The PCS has been shown to have adequate internal consistency and construct validity.<sup>17)</sup> Catastrophizing is considered to have a continuous distribution in the population without a clear cut-off level to distinguish between high and low catastrophizers.<sup>3,18)</sup> We used the median PCS score to divide the subjects into a high and low catastrophizing groups as in Akhter et al.'s study<sup>19)</sup>: those who scored  $\geq 15$  were assigned to the high pain catastrophizing group and  $< 15$  to the low group.

Pain severity and pain interference for the subjects was evaluated by BPI, a simple, self-administered questionnaire.<sup>20)</sup> The BPI Pain severity is determined as the mean of the four BPI pain ratings: worst, least, average and current pain. The BPI Pain interference includes seven items to assess impact of pain on patient's general activity, mood, walking, work, relation with others, sleep, and enjoyment

of life, which were summed up and averaged. The question asking interference with walking ability was replaced by interference with chewing ability in this study because TMD is hardly considered to be related with walking ability. We also evaluated the subscales of pain interference, i.e., affection and activity related with catastrophizing level.

Psychological morbidity was assessed by SCL-90-R, a 90-item self-report questionnaire on a 5-point rating scale.<sup>21)</sup> SCL-90-R is widely used to screen global psychological distress in research with a variety of pain conditions with good internal consistency and test-retest reliability. The items include nine dimension measuring somatization (SOM), obsessive-compulsive (O-C), interpersonal sensitivity (I-S), anxiety (ANX), depression (DEP), hostility (HOS), phobic anxiety (PHOB), paranoid ideation (PAR), and psychoticism (PSY).

Duration of TMD symptoms such as pain and/or noise was categorized into acute and chronic; duration <6 months as acute, and ≥6 months as chronic. Mean duration of symptoms in this study was 13.2±28.9 months, ranging from 1 day to 180 months. TMD were categorized into internal derangement without pain (n=11), myalgia (n=69), arthralgia (n=47), and myalgia-arthralgia combined problem (n=28) as TMD is not a single entity but a heterogeneous disorder.

### 3. Statistical Analysis

We investigated relations of pain catastrophizing to demographic and clinical factors. The t-test was used to investigate influence of age, pain severity and interference by BPI and psychological morbidity by SCL-90-R on level of pain catastrophizing. The chi-square test was used any difference between high and low catastrophizers with regards to gender, chronicity, education and types of TMD diagnosis. Difference in PCS scores among TMD diagnosis groups were analyzed by one-way ANOVA. We calculated the Pearson's correlation coefficients for relations between pain catastrophizing and pain severity and interference and between pain catastrophizing and psychometric features. Statistical calculations were made by the PASW Statistics version 18.0 (IBM Co., Armonk, NY, USA) with the statistical significance set at the 0.05.

## RESULTS

Mean PCS score of 155 TMD patients in this study was 17.3 with standard deviation of 12.6. By the median of the PSC score of this study (i.e., 15), the subjects were categorized into high (≥15) and low catastrophizers (<15).

Table 1 shows the demographic and clinical variables of

**Table 1.** Comparison of demographic and clinical variables between high and low catastrophizers

Variable	Total	Low catastrophizers	High catastrophizers	p-value
Age (y)	38.7±15.2	36.4±16.0	41.0±14.2	0.059 <sup>a</sup>
Gender				0.379 <sup>b</sup>
Male	28.2	15.4	12.8	
Female	71.8	33.3	38.5	
Duration of symptom				0.565 <sup>b</sup>
Acute <sup>c</sup>	65.8	32.3	33.5	
Chronic <sup>c</sup>	34.2	16.8	17.4	
Pain intensity (BPI)	3.9±2.2	3.0±1.8	4.8±2.2	<0.001 <sup>a</sup>
Pain interference (BPI)	4.0±2.7	2.6±2.0	5.3±2.7	<0.001 <sup>a</sup>
Affection <sup>d</sup>	5.2±1.3	5.0±1.4	5.4±1.2	0.030 <sup>a</sup>
Activity <sup>d</sup>	4.0±2.8	2.6±2.0	5.2±2.8	<0.001 <sup>a</sup>
Education				0.452 <sup>b</sup>
Primary school	5.6	2.8	2.8	
Middle school	8.5	2.8	8	
High school	43.0	18.3	24.6	
College	43.0	23.2	19.7	

BPI, Brief Pain Inventory.

Values are presented as mean±standard deviation or %.

The catastrophizing groups were divided by the median Pain Catastrophizing Scale score, i.e., 15 (low, <15; high, ≥15).

<sup>a</sup>By t-test; <sup>b</sup>By chi-square test.

<sup>c</sup>Acute and chronic was defined based on the period of 6 months; acute (<6 months), chronic (≥6 months).

<sup>d</sup>Subscale of pain interference of BPI.

our subjects and their relation with the level of pain catastrophizing. There was no significant difference in age, gender, duration of symptoms and education between high and low pain catastrophizers. High catastrophizers were older than low catastrophizers but the difference did not reach the statistical significant level ( $p=0.059$ ; by t-test). On the contrary, the level of catastrophizing was clearly influenced by pain severity and pain interference of BPI questionnaire ( $p<0.001$ ; Table 1). High catastrophizers showed greater pain severity and pain interference. Interference in affection and activity of BPI was higher in high pain catastrophizers compared to low group, and the difference was greater in activity interference than in affection interference ( $p<0.001$ ; Table 1).

The level of catastrophizing was not different among different types of TMD including internal derangement without pain, myalgia, arthralgia and myalgia-arthralgia combined groups ( $p=0.494$ ; Table 2). Mean and standard deviation of the PCS scores for different TMD diagnosis groups were  $10.8\pm 7.1$  for internal derangement,  $19.1\pm 13.6$  for arthralgia,  $17.1\pm 12.3$  for myalgia and  $17.2\pm 12.6$  for combined group. The PCS score was the lowest in the subjects

with internal derangement compared to the other three groups but there was no significant difference among them ( $p=0.275$ ; by one-way ANOVA).

Table 3 shows the relation of pain catastrophizing scores to pain severity and interference. Moderate correlation was found between the total scores of PCS and pain severity and between the PCS scores and pain interference ( $p<0.001$ ; Table 3). The subscales such as magnification, rumination and helplessness also were moderately correlated with pain severity and pain interference, respectively ( $p<0.001$ ; Table 3).

Table 4 presents with difference in psychometric morbidity between high and low pain catastrophizers. Although their mean scores of the nine dimensions were within normal range, psychological features assessed by SCL-90-R were affected by level of pain catastrophizing (Table 4). Compared to low catastrophizers, high pain catastrophizers showed significantly higher scores in all dimensions of SCL-90-R including SOM, O-C, I-S, DEP, ANX, HOS, PHOB, PAR, and PSY ( $p<0.05$ ; Table 4). Pain catastrophizing was weakly to moderately associated with all psychological dimensions of SCL-90-R ( $p<0.001$ ; Table 5).

**Table 2.** Distribution of types of temporomandibular disorders related to the level of pain catastrophizing (n=155)

Diagnosis	Total (%)	Low catastrophizers (%)	High catastrophizers (%)
Internal derangement	7.1	5.2	1.9
Arthralgia	30.3	12.9	17.4
Myalgia	44.5	21.9	22.6
Combined <sup>a</sup>	18.1	9.0	9.1
Total	100	49.0	51.0

The catastrophizing groups were divided by the median Pain Catastrophizing Scale score, i.e., 15 (low, <15; high,  $\geq 15$ ).

<sup>a</sup>Myalgia-arthralgia combined.

$p=0.494$ , by chi-square test.

**Table 3.** Pearson's correlation analysis between pain intensity and interference and pain catastrophizing

Variable	Correlation coefficient	p-value
Pain severity of BPI	×PCS_total	0.492
	×PCS_magnification	0.365
	×PCS_rumination	0.443
	×PCS_helplessness	0.538
Pain interference of BPI	×PCS_total	0.575
	×PCS_magnification	0.495
	×PCS_rumination	0.544
	×PCS_helplessness	0.565

BPI, Brief Pain Inventory; PCS, Pain Catastrophizing Scale.

**Table 4.** Psychometric features by Symptom Check List-90-Revised and pain catastrophizing

Dimension	Total (n=155)	Low catastrophizers (n=76)	High catastrophizers (n=79)	p-value <sup>a</sup>
SOM	47.9±8.2	44.6±6.3	51.1±8.5	<0.001
O-C	44.8±9.2	41.0±6.8	48.4±9.7	<0.001
I-S	44.5±8.4	41.7±6.8	47.2±9.0	<0.001
DEP	44.3±9.3	41.1±7.3	47.3±10.0	<0.001
ANX	44.8±8.2	41.8±5.8	47.7±9.1	<0.001
HOS	46.0±8.4	43.3±6.3	48.6±9.3	<0.001
PHOB	45.5±9.1	43.2±6.2	47.7±10.8	0.002
PAR	43.6±6.9	41.2±5.2	45.8±7.6	<0.001
PSY	44.0±7.1	40.8±4.0	47.0±8.1	<0.001

SOM, somatization; O-C, obsessive-compulsive; I-S, interpersonal sensitivity; DEP, depression; ANX, anxiety; HOS, hostility; PHOB, phobic anxiety; PAR, paranoid ideation; PSY, psychoticism.

The catastrophizing groups were divided by the median Pain Catastrophizing Scale score, i.e., 15 (low, <15; high, ≥15).

<sup>a</sup>t-test between high and low catastrophizers.

**Table 5.** Pearson's correlation analysis between pain catastrophizing and psychometric morbidity by Symptom Check List-90-Revised

Variable	Correlation coefficient	p-value
PCS total × SOM	0.417	<0.001
× O-C	0.475	<0.001
× I-S	0.344	<0.001
× DEP	0.422	<0.001
× ANX	0.397	<0.001
× HOS	0.411	<0.001
× PHOB	0.365	<0.001
× PAR	0.384	<0.001
× PSY	0.449	<0.001

PCS, Pain Catastrophizing Scale; SOM, somatization; O-C, obsessive-compulsive; I-S, interpersonal sensitivity; DEP, depression; ANX, anxiety; HOS, hostility; PHOB, phobic anxiety; PAR, paranoid ideation; PSY, psychoticism.

## DISCUSSION

This study investigated relations between level of the pain catastrophizing and clinical and psychological variables for the subjects with TMDs. According to our results, increased pain severity and interference and increased psychological propensity were found in the TMD patients with the high level of catastrophizing and there were weak to moderate positive correlation between those variables. Difference in catastrophizing level was not found for other variables such as age, gender, duration of pain, education level and types of TMDs.

In this study, the catastrophizing level for 155 patients with TMDs using the PCS was the mean and standard deviation score of 17.3±12.6 (range, 0 to 52). Possible scores

of the PCS range from 0 to 52 with higher scores indicating greater catastrophizing.<sup>22)</sup> The questionnaire have been validated in patient and nonpatient samples, and the factor structure appears to be invariant across participant sex and patient/nonpatient status.<sup>7,17,23)</sup> In a study with sixty seven individuals with chronic back pain, the mean PCS score was 25.63±12.40, ranging from 1 to 51.<sup>24)</sup> One hundred twenty six healthy volunteers presented with the mean PCS score of 10.48±7.83 for women and 9.10±7.64 for men in the experiment on induced muscle injury by Parr et al.<sup>25)</sup> Quartana et al.<sup>22)</sup> reported the mean PCS score of 14.05±8.81 for 39 TMD patients and 8.91±6.77 for healthy controls. Mean PCS score of one hundred ninety eight Koreans with chronic non-cancer pain was 27.68±13.54.<sup>26)</sup> Taken these together, TMD patients appear to have relatively lower level of catastrophizing than that of the other chronic pain conditions and relatively higher level than that of healthy controls although catastrophizing level cannot be simply compared across the different samples because of possibility that there are influencing factors such as age, gender, ethnicity, etc.<sup>9)</sup>

This study showed that catastrophizing was positively correlated to pain severity, consistent with previous data obtained from variable types of pain conditions including TMD.<sup>18,24,27)</sup> Pain catastrophizing has been associated with a number of indices of pain sensitivity in the context of experimental pain testing paradigms, both among healthy, pain-free participants and individuals with various chronic pain conditions.<sup>6,18,27)</sup> Higher catastrophizing is associated with more tender points, enhanced responsiveness to



pain stimuli, reduced pain tolerance to cold pressor test.<sup>27)</sup> Moreover, pain catastrophizing is related prospectively to adverse pain-related outcomes.<sup>18)</sup> Prospective studies reported that baseline catastrophizing scores predicted enhanced pain at follow-up in patients with TMDs<sup>4)</sup> as well as in those with different musculoskeletal conditions such as arthritis, fibromyalgia and other rheumatic diseases.<sup>27)</sup>

In the study with patients with primary myofascial TMD diagnosis over six months and healthy controls, Quartana et al.<sup>22)</sup> reported a relationship between catastrophizing and salivary cortisol profile in the context to standardized pain testing, suggesting that pain catastrophizing might yield maladaptive neurophysiological responses to painful experience. In addition, relations between catastrophizing and cortisol responses to pain emerged patients and nonpatients alike, which indicate that pain catastrophizing may serve as a risk factor for the development of persistent pain as well as aggravate or maintain existing chronic pain via hypothalamus-pituitary-adrenocortical (HPA) pathway.<sup>6,22)</sup> Aberrant HPA axis integrity has been associated with worse postoperative pain severity.<sup>28,29)</sup>

Negative appraisals regarding pain and its consequences, such as catastrophic thinking, are considered a potential precursor for pain-related fear. Fear is characterized by escape and avoidance behaviors, the immediate consequences of which are functional disability in daily activities. Longstanding avoidance and physical inactivity has a detrimental effect on the musculoskeletal and cardiovascular systems, leading to the disuse syndrome, which can further worsen the pain problem.<sup>9)</sup> These behaviors may manifest as decreased amplitudes and/or velocities of movement,<sup>30,31)</sup> or as altered or disordered motor coordination<sup>5,30)</sup> that might involve a different motor-unit recruitment pattern.<sup>19)</sup> In terms of central mechanisms, pain catastrophizing correlates with pain-related activations within cerebral regions involved in motor response/planning, including thalamus, putamen and premotor cortex.<sup>29)</sup> This can be an explanation for positive correlation between catastrophizing and pain interference in our study and previous studies. High catastrophizers in this study showed greater pain interference compared to low catastrophizers and difference was more noticeable in activity interference rather than affection interference. Akhter et al.<sup>19)</sup> reported that the slower

velocity and greater variability of repetitive jaw movements in higher pain catastrophizing individuals in acute experimental pain, which may reflect altered motor coordination as an example of avoidance behavior for the jaw.

In this study, psychological morbidity assessed by SCL-90-R was affected by pain catastrophizing, although their mean scores of the nine psychological dimensions were still within normal range. High pain catastrophizers showed relatively higher scores in all dimensions of SCL-90-R including SOM, O-C, I-S, DEP, ANX, HOS, PHOB, PAR, and PSY ( $p < 0.05$ ; Table 4). Pain catastrophizing was weakly to moderately associated with variable negative psychological dimensions ( $p < 0.001$ ; Table 5). Catastrophizing is positively correlated with depression<sup>24)</sup> and shares elements in common with anxiety and its associated disorders and perhaps anger and hostility as well.<sup>6)</sup> It was reported that psychological factors such as anxiety, depression, somatization and catastrophizing are related to increased risk for, or persistence of, TMD pain.<sup>32-34)</sup> As mentioned earlier, pain catastrophizing is considered a precursor of pain-related fear. Intense, but irrational, fears are called "phobias." While fear motivates the individual to engage immediately in defensive behaviors, such as escape, anxiety is associated with preventive behaviors including hypervigilance, catastrophic worry and avoidance behaviors.<sup>9)</sup>

Some studies reported that women have higher PCS scores than men and younger people catastrophize more than older people.<sup>15,35,36)</sup> Richardson et al.<sup>24)</sup> reported the negative correlation between pain catastrophizing and education level. However, there was no any difference found for age, gender, duration of pain, education level and types of TMDs in this study. Although high catastrophizers (mean,  $36.4 \pm 16.0$  years) were relatively older than low group (mean,  $41.0 \pm 14.2$  years), the difference did not reach the statistical significance level ( $p = 0.059$ ; by t-test).

We also investigated any relation between types of TMDs and catastrophizing level because TMDs are heterogeneous disorders involving masticatory muscles and temporomandibular joints. Previous studies concerning catastrophizing in TMD patients did not categorize their specific types or included the subjects with myofascial pain or experimentally induced muscle pain.<sup>4,19,22,24,25)</sup> However, this study did not show the significant difference in distribution of TMD

types according to level of pain catastrophizing despite the lowest mean PCS scores in the patients for the internal derangement without pain. Considering the positive relation between catastrophizing and pain severity and the relatively small number of each TMD types in this study, a further study needs to be performed in a larger TMD samples.

Catastrophizing is impaired cognitive function by which an individual exaggerates or magnifies the perceived threat of pain sensations,<sup>37)</sup> thereby influencing the pain experience.<sup>18,28)</sup> It is also a potential predictor for adverse immediate and long-term pain-related outcomes including pain severity, disability and negative mood, eventually enmeshing the patients in a vicious cycle of fear-avoidance model.<sup>9)</sup> Moreover, catastrophizing may become a key target for multidisciplinary pain-management interventions.<sup>27)</sup> Therefore, catastrophizing should be emphasized and assessed in the patients with orofacial pain conditions including TMDs.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

## REFERENCES

1. Fillingim RB, Ohrbach R, Greenspan JD, et al. Psychological factors associated with development of TMD: the OPPERA prospective cohort study. *J Pain* 2013;14(12 Suppl):T75-T90.
2. Munafò MR, Stevenson J. Anxiety and surgical recovery. Reinterpreting the literature. *J Psychosom Res* 2001;51:589-596.
3. Khan RS, Ahmed K, Blakeway E, et al. Catastrophizing: a predictive factor for postoperative pain. *Am J Surg* 2011;201:122-131.
4. Velly AM, Look JO, Carlson C, et al. The effect of catastrophizing and depression on chronic pain: a prospective cohort study of temporomandibular muscle and joint pain disorders. *Pain* 2011;152:2377-2383.
5. Leeuw M, Goossens ME, Linton SJ, Crombez G, Boersma K, Vlaeyen JW. The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. *J Behav Med* 2007;30:77-94.
6. Quartana PJ, Campbell CM, Edwards RR. Pain catastrophizing: a critical review. *Expert Rev Neurother* 2009;9:745-758.
7. Sullivan MJ, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. *Psychological Assessment* 1995;7:524-532.
8. Monticone M, Baiardi P, Ferrari S, et al. Development of the Italian version of the Pain Catastrophizing Scale (PCS-I): cross-cultural adaptation, factor analysis, reliability, validity and sensitivity to change. *Qual Life Res* 2012;21:1045-1050.
9. Vlayen JWS, Steven SJM, Linton SJ, Boersma K, de Jong J. Pain-related fear: exposure-based treatment for chronic pain. Seattle: IASP Press; 2012. pp. 49-52.
10. Sullivan MJ, Neish NR. Catastrophizing, anxiety and pain during dental hygiene treatment. *Community Dent Oral Epidemiol* 1998;26:344-349.
11. Sullivan MJ, Stanish W, Waite H, Sullivan M, Tripp DA. Catastrophizing, pain, and disability in patients with soft-tissue injuries. *Pain* 1998;77:253-260.
12. Sullivan MJ, Tripp DA, Rogers WM, Stanish W. Catastrophizing and pain perception in sports participants. *J Appl Sport Psychol* 2000;12:151-167.
13. Keefe FJ, Lefebvre JC, Egert JR, Affleck G, Sullivan MJ, Caldwell DS. The relationship of gender to pain, pain behavior, and disability in osteoarthritis patients: the role of catastrophizing. *Pain* 2000;87:325-334.
14. Peters ML, Vlaeyen JW, van Drunen C. Do fibromyalgia patients display hypervigilance for innocuous somatosensory stimuli? Application of a body scanning reaction time paradigm. *Pain* 2000;86:283-292.
15. Turner JA, Dworkin SF, Mancl L, Huggins KH, Truelove EL. The roles of beliefs, catastrophizing, and coping in the functioning of patients with temporomandibular disorders. *Pain* 2001;92:41-51.
16. Turner JA, Brister H, Huggins K, Mancl L, Aaron LA, Truelove EL. Catastrophizing is associated with clinical examination findings, activity interference, and health care use among patients with temporomandibular disorders. *J Orofac Pain* 2005;19:291-300.
17. Osman A, Barrios FX, Kopper BA, Hauptmann W, Jones J, O'Neill E. Factor structure, reliability, and validity of the Pain Catastrophizing Scale. *J Behav Med* 1997;20:589-605.
18. Sullivan MJ, Thorn B, Haythornthwaite JA, et al. Theoretical perspectives on the relation between catastrophizing and pain. *Clin J Pain* 2001;17:52-64.
19. Akhter R, Benson J, Svensson P, Nicholas MK, Peck CC, Murray GM. Experimental jaw muscle pain increases pain scores and jaw movement variability in higher pain catastrophizers. *J Oral Facial Pain Headache* 2014;28:191-204.
20. Radbruch L, Loick G, Kiencke P, et al. Validation of the German version of the Brief Pain Inventory. *J Pain Symptom Manage* 1999;18:180-187.
21. Derogatis LR. SCL-90 (revised) manual. Baltimore: Clinical Psychometrics Research Unit; 1977.
22. Quartana PJ, Buenaver LF, Edwards RR, Klick B, Haythornthwaite JA, Smith MT. Pain catastrophizing and salivary cortisol responses to laboratory pain testing in temporomandibular disorder and healthy participants. *J Pain* 2010;11:186-194.
23. D'Eon JL, Harris CA, Ellis JA. Testing factorial validity and gender invariance of the pain catastrophizing scale. *J Behav Med* 2004;27:361-372.
24. Richardson EJ, Ness TJ, Doleys DM, Baños JH, Cianfrini L, Richards JS. Depressive symptoms and pain evaluations among persons with chronic pain: catastrophizing, but not pain acceptance, shows significant effects. *Pain* 2009;147:147-152.
25. Parr JJ, Borsa PA, Fillingim RB, et al. Pain-related fear and cata-

- strophizing predict pain intensity and disability independently using an induced muscle injury model. *J Pain* 2012;13:370-378.
26. Cho S, Kim HY, Lee JH. Validation of the Korean version of the Pain Catastrophizing Scale in patients with chronic non-cancer pain. *Qual Life Res* 2013;22:1767-1772.
  27. Edwards RR, Bingham CO 3rd, Bathon J, Haythornthwaite JA. Catastrophizing and pain in arthritis, fibromyalgia, and other rheumatic diseases. *Arthritis Rheum* 2006;55:325-332.
  28. Gracely RH, Geisser ME, Giesecke T, et al. Pain catastrophizing and neural responses to pain among persons with fibromyalgia. *Brain* 2004;127:835-843.
  29. Seminowicz DA, Davis KD. Cortical responses to pain in healthy individuals depends on pain catastrophizing. *Pain* 2006;120:297-306.
  30. Thomas JS, France CR, Lavender SA, Johnson MR. Effects of fear of movement on spine velocity and acceleration after recovery from low back pain. *Spine (Phila Pa 1976)* 2008;33:564-570.
  31. Geisser ME, Haig AJ, Wallbom AS, Wiggert EA. Pain-related fear, lumbar flexion, and dynamic EMG among persons with chronic musculoskeletal low back pain. *Clin J Pain* 2004;20:61-69.
  32. Ohrbach R, Dworkin SF. Five-year outcomes in TMD: relationship of changes in pain to changes in physical and psychological variables. *Pain* 1998;74:315-326.
  33. LeResche L, Mancl LA, Drangsholt MT, Huang G, Von Korff M. Predictors of onset of facial pain and temporomandibular disorders in early adolescence. *Pain* 2007;129:269-278.
  34. Velly AM, Look JO, Schiffman E, et al. The effect of fibromyalgia and widespread pain on the clinically significant temporomandibular muscle and joint pain disorders--a prospective 18-month cohort study. *J Pain* 2010;11:1155-1164.
  35. Jacobsen PB, Butler RW. Relation of cognitive coping and catastrophizing to acute pain and analgesic use following breast cancer surgery. *J Behav Med* 1996;19:17-29.
  36. Tripp DA, Stanish WD, Reardon G, Coady C, Sullivan MJ. Comparing postoperative pain experiences of the adolescent and adult athlete after anterior cruciate ligament surgery. *J Athl Train* 2003;38:154-157.
  37. Turner JA, Aaron LA. Pain-related catastrophizing: what is it? *Clin J Pain* 2001;17:65-71.