Patients profiles and outcomes of care in temporomandibular disorders

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CHAPTER 3

Correlation between oral health related quality of life and clinical dysfunction index in patients with temporomandibular joint osteoarthritis

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Abstract

Objectives: To evaluate the correlation between oral health related quality of life (OHRQoL) and the Helkimo clinical dysfunction index (HDI) in patients with temporomandibular joint osteoarthritis (TMJ OA).

Materials and methods: Clinical data and scores for the Chinese version of the 14-item Oral Health Impact Profile (OHIP-C14) were recorded and analyzed for 541 patients with TMJ OA. Each patient was assigned an HDI score of 1 to 25, which was used to classify severity into three categories. OHRQoL was assessed by using the OHIP-C14 score, which ranged from 0 to 56.

Results: Both HDI score and severity were significantly correlated with total OHIP-C14 sum score ($P < 0.001$ for both comparisons). The scores for all HDI domains except function impairment ($P = 0.205$) were significantly correlated with OHIP-C14 sum score. The scores for all seven OHIP-C14 domains were significantly correlated with HDI score and severity. Several correlations between OHIP-C14 domain scores and HDI domain scores were significant.

Conclusions: HDI score and severity were correlated with OHIP-C14 score in TMJ OA patients. As compared with function-related domains, pain-related HDI domains were more strongly inversely related to OHRQoL.

Introduction

The temporomandibular disorders (TMDs) are painful musculoskeletal disorders involving the masticatory muscles, temporomandibular joints (TMJ), and other orofacial anatomical structures [1]. TMDs are thought to be the second most common cause of chronic orofacial pain, after dental pain [2]. Previous studies indicate that at some stage of life 50 to 70% of the global population exhibits signs and symptoms of TMD, including pain, limited range of jaw movement, and TMJ noises [3,4]. In epidemiological samples, 3 to 7% of individuals report seeking treatment for TMDs [5]. TMJ osteoarthritis (TMJ OA) is an age-related degenerative joint disease that results in progressive destruction of articular tissues in the TMJ condyle and glenoid fossa [6]. TMJ OA is common and an important subtype of TMD [7]. A main cause of TMJ OA is overloading of the TMJ, including malocclusion and oral parafunctional habits [7,8], but most TMJ OA cases are not attributable to overloading, and the reasons for the destruction of articular tissues in such cases have yet to be determined [7].

Clinical TMD examination is essential for TMDs. There is an urgent need for a standardized classification that can be used to evaluate TMD signs and symptoms, measure and compare TMD severity in populations, and evaluate patient response to treatment [9]. Moreover, a tool that can assess etiological factors is necessary [9]. The Helkimo clinical dysfunction index (HDI), developed by Helkimo in 1974, is believed to be the first tool for assessing TMD severity and pain [10]. The HDI focuses on five basic signs and symptoms in the masticatory system: range of mandibular motion, TMJ function impairment, pain during mandibular movement, TMJ pain during palpation, and muscle tenderness during palpation[11]. The HDI is now widely used in dental practice to evaluate the severity of TMDs, including TMJ OA [12-14].

There is increasing interest in oral health related quality of life (OHRQoL) [15], a multifactorial construct that assesses the adverse effects of orofacial disease on normal oral-related functions [16]. A systematic review in 2010 [15] reported that the most widely used OHRQoL instrument was the Oral Health Impact Profile (OHIP), which has been translated and validated in several languages, including Chinese, German, and Swedish [17-19]. The OHIP can be administered in its original, 49-item, format or in a brief, 14-item, format. The Chinese version of the OHIP-14 (OHIP-C14) was reported

to have high reliability and validity and is widely used in dentistry in China [20]. Oral diseases such as caries and periodontitis can affect various aspects of life and quality of life [21]. Several studies reported that the adverse effects on OHRQoL are worse for TMDs [15,22] than for periodontal, dental, and neurological/vascular orofacial pain conditions [23,24].

Some studies reported positive correlations between the severity of TMD symptoms and OHRQoL [1,25]; however, other studies found no such correlation [26]. Therefore, we investigated whether the severity of signs and symptoms, as determined by the HDI, were correlated with OHRQoL in patients with TMJ OA. This is the first study to assess specific correlations with TMJ OA.

Material and methods

Study design

This study was approved by the Ethics Committee of the West China Hospital of Stomatology at Sichuan University (WCHSIRB-D-2013-092). We reviewed the clinical records and OHIP-C14 questionnaires of patients with TMJ OA who sought treatment at the Orofacial Pain Clinic of West China Hospital of Stomatology between January 2013 and January 2014. The inclusion criteria were age 18–70 years and a diagnosis of TMJ OA, which was based on the Research Diagnostic Criteria for TMDs (RDC/TMD axis I group IIIb), namely, presence of arthralgia and either crepitus in the joints or bony changes on cone-beam computed tomography, including flattening, erosion, or sclerosis of joint surfaces or osteophyte formation [27]. All patients provided written informed consent. Patients were excluded if they had no diagnosis of TMJ OA, had TMJ trauma, a history of TMJ surgery, condyle fracture, or polyarthritis, or if they had missing data for any variable.

Clinical data for the five HDI items (TMJ function impairment, muscle tenderness during palpation, TMJ pain during mandibular movement, range of mandibular motion, and TMJ pain during palpation) [10] were extracted from the medical records of all the included patients. All patients included were assigned a score of 0, 1, or 5 for each HDI item, based on the severity of the five clinical signs and symptoms above. Included patients were classified into four groups on the basis of their total score for the five HDI items: HDI 0 was defined as absence of TMD signs and symptoms (0 points), HDI 1 was defined as

mild TMD signs and symptoms (score range, 1-4 points), HDI 2 was defined as moderate TMD signs and symptoms (5-9 points), and HDI 3 was defined as acute/serious TMD signs and symptoms (10-25 points). All clinical examinations were performed by the same oral and maxillofacial expert, who has more than 40 years of clinical experience.

OHRQoL was measured with the OHIP-C14, which is reported to have superior validity and reliability in the Chinese population [20]. The OHIP-C14 was developed according to a conceptual model of oral health and contains seven OHRQoL domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. Responses on the OHIP-C14 were coded as follows: 0 = never, 1 = hardly ever, 2 = occasional, 3 = fairly often, and 4 = very often. The OHIP-C14 sum score ranges from 0 to 56 and was calculated by summing the response codes for the 14 items. Additionally, domain scores were calculated by summing the two response codes for each domain. Higher OHIP-C14 scores indicate worse OHRQoL

Statistical analysis

Statistical analyses were performed with SPSS 17.0 (SPSS Inc., Chicago, IL, USA). The sum and domain scores for the OHIP-C14 and HDI score are expressed as mean ± standard deviation (SD). The one-sample t-test was used to compare the mean OHIP-C14 sum score for the present patients with the Chinese norm (11.89). Differences in OHIP-C14 sum score and domain scores in relation to HDI severity and scores for HDI domains were analyzed by one-way ANOVA. The Spearman rank correlation test was used to assess correlations of HDI score and severity with OHIP-C14 sum score; OHIP-C14 domain scores with HDI score and severity; HDI domain scores with OHIP-C14 sum score; and HDI domain scores with OHIP-C14 domain scores. A P value of <0.05 was considered to indicate statistical significance.

Results

A total of 541 patients (134 men and 407 women) who satisfied the inclusion criteria were included in the present study. Mean age was 38.59 ± 15.52 years (women: 38.82 ± 15.49; men: 37.87 ± 15.68). The sum score for the OHIP-C14 was 16.10 ± 11.17, which was significantly higher than the Chinese norm for the OHIP-C14 (11.98) ($P < 0.001$). The mean OHIP-C14 domain scores are shown in **Table 1**. Zero (0%) patients

were classified as HDI 0, 68 (12.6%) as HDI 1, 179 (33.1%) as HDI 2, and 294 (54.3%) as HDI 3. The mean HDI score for the 541 patients was 11.28 ± 5.05. HDI score distributions and severity are shown in **Table 2**. The OHIP-C14 sum score significantly increased as HDI severity increased from 1 to 3 (P < 0.001). In addition, OHIP-C14 domain scores significantly increased as HDI severity increased from 1 to 3 (**Table 3**).

Table 1 Mean scores and standard deviations for OHIP-C14 domains (N=541)

Domains	Mean score	Standard deviation
Function limitation	1.28	1.78
Physical pain	3.89	2.28
Psychological discomfort	2.51	2.28
Physical disability	2.64	2.28
Psychological disability	2.36	2.08
Social disability	1.65	1.88
Handicap	1.77	1.96
Sum score	16.10	11.17

OHIP-C14: Chinese version of the 14-item Oral Health Impact Profile.

Table 4 shows mean OHIP-C14 sum score and domain scores in relation to HDI domain scores. An increase from 1 to 5 in the score for TMJ function impairment on the HDI was associated with a significant increase in the OHIP-C14 score for physical pain (P = 0.008). An increase in the score for muscle tenderness during palpation on the HDI was significantly associated with increases in the OHIP-C14 sum score and scores for all OHIP-C14 domains. In addition, an increase in the score for TMJ pain during palpation on the HDI was significantly associated with increases in OHIP-C14 sum score and all the OHIP-C14 domain scores except functional limitation (P = 0.232). Additionally, an increase in the score for pain during mandibular movement on the HDI was significantly associated with increases in the OHIP-C14 sum score and scores for physical pain (P < 0.001), physical disability (P < 0.001), and social disability (P < 0.001) but not with other OHIP-C14 domains. Furthermore, an increase in the score for range of mandibular motion on the HDI was significantly associated with the OHIP-C14 sum score and OHIP-C14 scores for physical pain (P < 0.001), physical disability (P < 0.001), and psychological disability (P = 0.035) but not with other OHIP-C14 domains.

HDI score was significantly associated with the OHIP-C14 sum score (P < 0.001; correlation coefficient, r, = 0.399), and HDI severity was significantly associated with the OHIP-C14 sum score (P < 0.001; r = 0.459). The scores for all HDI domains except TMJ function impairment (P = 0.205, r = -0.055) were significantly associated with the OHIP-C14 sum score (**Table 5**). The scores for all seven OHIP-C14 domains were significantly associated with HDI score and severity (**Table 6**). As shown in **Table 7**, there were correlations between some scores for OHIP-C14 domains and HDI domains.

Table 2 Distribution of patients in relation to HDI scores and severity (N=541)

HDI severity	HDI scores	Number of patients
HDI 0	0	0
HDI 1	1	0
	2	4
	3	41
	4	23
Total		68
HDI 2	5	0
	6	7
	7	38
	8	99
	9	35
Total		179
HDI 3	10	0
	11	16
	12	64
	13	53
	15	2
	16	65
	17	52
	20	14
	21	26
	25	2
Total		294

HDI: Helkimo clinical dysfunction index

Table 3 Mean (SD) OHIP-C14 sum and domain scores in relation to HDI severity (N=541)

	HDI severity			
OHIP scores	1	2	3	P value
OHIP sum score	6.68 (6.44)	13.08 (9.39)	20.24 (11.15)	<0.001
Functional limitation	0.65 (1.36)	1.07 (1.70)	1.56 (1.86)	<0.001
Physical pain	1.88 (1.98)	3.16 (2.01)	4.82 (2.02)	<0.001
Psychological discomfort	1.01 (1.41)	2.14 (2.01)	3.10 (2.39)	<0.001
Physical disability	1.12 (1.47)	1.95 (2.01)	3.43 (2.28)	<0.001
Psychological disability	1.06 (1.60)	2.01 (1.85)	2.90 (2.14)	<0.001
Social disability	0.40 (0.85)	1.26 (1.63)	2.19 (2.00)	<0.001
Handicap	0.56 (1.31)	1.49 (1.72)	2.23 (2.09)	<0.001

SD: standard deviation; **OHIP-C14:** Chinese version of the 14-item Oral Health Impact Profile; **HDI:** Helkimo clinical dysfunction index.

Discussion

About 15% of the global population has OA [28], and TMJ OA is the most common form of arthritis in the TMJ [29]. Clinical studies indicate that TMJ OA affects 8 to 16% of the global population and is more prevalent in women [30]. The most common clinical symptom of TMJ OA is pain [29], specifically, a dull ache that may be sharp during movement [30]. TMJ OA pain is more common during the early stages of the disease, because of the presence of synovitis [30]. Crepitus is often present during oral functions such as chewing. Other clinical signs of TMJ OA are joint tenderness, radiographic bony changes of the condyles and glenoid fossa, and narrowing of joint spaces [29].

Table 5 Correlations of OHIP-C14 sum score with HDI domains (N=541)

	OHIP-C14 sum score	
HDI domains	*P* value	r
TMJ function impairment	0.205	-0.055
Muscle tenderness during palpation	<0.001	0.235
TMJ pain during palpation	<0.001	0.200
Pain during mandibular movement	<0.001	0.198
Range of mandibular motion	<0.001	0.152

r: correlation coefficient; **OHIP-C14:** Chinese version of the 14-item Oral Health Impact Profile; **HDI:** Helkimo clinical dysfunction index.

Table 4 Mean (SD) OHIP-C14 sum and domain scores in relation to HDI domain scores (N=541)

			Domains of OHIP-C14							
HDI Domains	Score for HDI domains	Number of patients	OHIP sum score	Functional limitation	Physical pain	Psychological discomfort	Physical disability	Psychological disability	Social disability	Handicap
TMJ function impairment	0	0	0	0	0	0	0	0	0	0
	1	264	14.71 (10.36)	1.16 (1.64)	3.39 (2.33)	2.25 (2.06)	2.42 (2.12)	2.15 (1.88)	1.57 (1.64)	1.77 (1.79)
	5	277	17.20 (10.86)	1.38 (1.86)	4.36 (2.11)	2.64 (2.30)	2.83 (2.33)	2.55 (2.10)	1.70 (1.98)	1.74 (2.01)
	P value		0.078	0.188	0.008	0.090	0.074	0.096	0.524	0.815
Muscle tenderness during palpation	0	312	13.97 (10.32)	1.06 (1.71)	3.49 (2.29)	2.17 (2.08)	2.46 (2.18)	2.04 (1.94)	1.33 (1.69)	1.42 (1.85)
	1	208	18.32 (11.24)	1.58 (1.87)	4.33 (2.12)	2.88 (2.39)	2.77 (2.31)	2.70 (2.12)	1.97 (1.94)	2.10 (1.94)
	5	21	25.71 (13.71)	1.57 (1.43)	5.43 (2.11)	4.10 (2.76)	3.95 (2.94)	3.81 (2.64)	3.19 (2.60)	3.67 (2.27)
	P value		< 0.001	0.004	< 0.001	<0.001	0.008	< 0.001	< 0.001	< 0.001
TMJ pain during palpation	0	0	0	0	0	0	0	0	0	0
	1	401	14.83 (10.82)	1.23 (1.78)	3.64 (2.23)	2.35 (2.18)	2.42 (2.22)	2.17 (1.99)	1.45 (1.77)	1.57 (1.87)
	5	140	19.74 (11.42)	1.44 (1.78)	4.60 (2.08)	2.98 (2.50)	3.25 (2.35)	2.92 (2.24)	2.21 (2.07)	2.34 (2.03)
	P value		<0.001	0.232	<0.001	0.005	<0.001	<0.001	<0.001	<0.001
Pain during mandibular movement	0	109	12.68 (9.19)	1.09 (1.73)	2.76 (2.30)	2.17 (2.05)	1.96 (1.99)	2.02 (1.92)	1.16 (1.42)	1.52 (1.72)
	1	82	13.74 (11.22)	1.16 (1.67)	3.17 (2.10)	2.29 (2.35)	1.95 (2.15)	2.22 (2.19)	1.37 (1.84)	1.59 (2.00)
	5	350	17.71 (11.41)	1.37 (1.82)	4.41 (2.14)	2.67 (2.32)	3.01 (2.32)	2.50 (2.10)	1.87 (1.97)	1.89 (2.02)
	P value		<0.001	0.291	<0.001	0.079	< 0.001	0.084	0.001	0.160
Range of mandibular motion	0	70	14.49 (11.17)	1.23 (1.73)	3.51 (2.21)	2.27 (2.24)	2.14 (2.14)	2.10 (2.09)	1.39 (1.84)	1.84 (2.21)
	1	287	14.98 (10.85)	1.23 (1.81)	3.61 (2.27)	2.41 (2.24)	2.34 (2.21)	2.22 (2.04)	1.56 (1.85)	1.59 (1.85)
	5	184	18.46 (11.35)	1.38 (1.76)	4.46 (2.21)	2.77 (2.33)	3.28 (2.32)	2.68 (2.12)	1.88 (1.91)	2.01 (2.02)
	P value		0.002	0.648	<0.001	0.151	<0.001	0.035	0.092	0.074

SD: standard deviation; **OHIP-C14:** Chinese version of the 14-item Oral Health Impact Profile; **HDI:** Helkimo clinical dysfunction index.

Table 6 Correlations of HDI score and severity with OHIP-C14 domain scores (N=541)

	HDI score		HDI severity	
OHIP-C14 domains	P value	r	P value	r
Functional limitation	<0.001	0.179	<0.001	0.203
Physical pain	<0.001	0.396	<0.001	0.463
Psychological discomfort	<0.001	0.260	<0.001	0.305
Physical disability	<0.001	0.340	<0.001	0.402
Psychological disability	<0.001	0.288	<0.001	0.308
Social disability	<0.001	0.315	<0.001	0.355
Handicap	<0.001	0.283	<0.001	0.297

r: correlation coefficient; **HDI:** Helkimo clinical dysfunction index; **OHIP-C14:** Chinese version of the 14-item Oral Health Impact Profile.

We found that TMD severity, as determined by the HDI, was correlated with OHRQoL in TMJ OA patients. That is, a higher HDI score and greater severity was associated with worse OHRQoL, which is consistent with the findings of several previous studies [31]. Pain is thought to be the most important factor in diminished OHRQoL. The initial nociceptive stimulus can be modulated and weakened via several mechanisms in the body before the stimulus is converted to pain in the central nervous system (CNS). The pain sensation is caused by an imbalance between the amount of stimulus and the effectiveness of modulation mechanisms. Furthermore, the pain sensation can be maintained and exacerbated when the nociceptive stimulus is of high magnitude or repetitive, which can cause peripheral and CNS changes. Chronic orofacial pain can be caused by peripheral input as well as CNS changes. Patients with chronic pain usually have various psychosocial and behavioral comorbid disorders, including psychological stress, depression, and sleep disorders [2], which can compromise OHRQoL. In addition, patients with diverse chronic pains can have abnormal reactions, including pain-related belief, catastrophizing, and compromised coping strategies. Pain-related catastrophizing is defined as excessive attention to pain, exaggeration of the pain-related threat, and helplessness regarding pain control, all of which may adversely affect OHRQoL. These reactions are strongly associated with pain intensity and OHRQoL impairment [2]. TMJ OA is pain-related, and TMJ OA patients usually have chronic pain in the TMJ and muscle areas [7]. This may explain why the OHRQoL scores for the present TMJ OA patients were

Table 7 Correlations of OHIP-C14 domain scores with HDI domain scores (N=541)

	HDI domains				
OHIP-C14 domains	TMJ function impairment	Muscle tenderness during palpation	TMJ pain during palpation	Pain during mandibular movement	Range of mandibular motion
	P value (r)	*P* value (r)	*P* value (r)	*P* value (r)	*P* value (r)
Function limitation	0.482 (-0.030)	<0.001 (0.173)	0.090 (0.073)	0.113 (0.068)	0.322 (0.043)
Physical pain	<0.001 (0.209)	<0.001 (0.217)	<0.001 (0.178)	<0.001 (0.307)	<0.001 (0.158)
Psychological discomfort	0.545 (0.026)	<0.001 (0.175)	0.013 (0.107)	0.029 (0.094)	0.050 (0.083)
Physical disability	0.073 (-0.077)	0.033 (0.092)	<0.001 (0.160)	<0.001 (0.219)	<0.001 (0.201)
Psychological disability	0.735 (0.015)	<0.001 (0.182)	<0.001 (0.151)	0.022 (0.098)	0.010 (0.111)
Social disability	0.247 (-0.050)	<0.001 (0.204)	<0.001 (0.172)	<0.001 (0.156)	0.012 (0.108)
Handicap	0.552 (-0.026)	<0.001 (0.240)	<0.001 (0.189)	0.070 (0.078)	0.077 (0.076)

r: correlation coefficient, **OHIP-C14:** Chinese version of the 14-item Oral Health Impact Profile; **HDI:** Helkimo clinical dysfunction index.

associated with pain severity on the HDI, including muscle tenderness during palpation, TMJ pain during palpation, and pain during mandibular movement.

In our analysis of dysfunction in HDI domains, range of mandibular motion was correlated with OHRQoL. Limited mandibular mobility is a key symptom and clinical sign of TMD. Limited mandibular function—including mouth opening, lateral movement, and mandible protrusion—can interfere with chewing and speaking and thus has adverse effects on social behaviors, including group activities, and can increase patient discomfort [1]. This is reflected by an increase in OHIP score. The domain of TMJ function impairment was not correlated with OHRQoL score, which is consistent with a previous study [32]. TMJ function impairment includes clicks, locking, and luxation of the TMJ. However, previous studies found that joint sounds do adversely affect OHRQoL because frequent clicks during chewing in public places may limit social activities [1,33]. This discrepancy between past and present findings may be attributable to the fact all the present patients had TMJ OA rather than other types of TMD. Chronic pain and limited mouth opening are the main complaints for TMJ OA patients, and TMJ click may thus be a less important symptom.

HDI score and severity were associated with all OHIP-C14 domains. As shown in **Table 3**, the scores for OHIP-C14 domains significantly increased in relation HDI severity, which indicates that patients with more severe signs and symptoms of TMJ OA tended to have lower OHRQoL. HDI encompasses orofacial pain and dysfunction due to TMJ. Pain can have various adverse effects on a person's physical condition [26]. Therefore, it is understandable that changes in orofacial pain are related to changes in the OHRQoL domains of physical pain and physical disability, as was reported in a previous study [26]. Interestingly, changes in HDI score and severity were correlated in the present study with changes in the domain of social disability, which includes irritability and difficulty performing usual tasks. This finding is consistent with an empirical model of oral health in which pain is thought to be correlated with physical and psychological measures, social disability, and social handicap [34].

Psychological and psychosocial factors are very important in understanding TMDs [35]. Depression, psychological stress, somatization, and anxiety can change individuals' thresholds for pain sensation by altering nociceptive impulses from the CNS and release of neurotransmitters [36]. In addition, psychological disorders can increase the

frequency, intensity, and duration of oral parafunctional habits (e.g., sleep bruxism and diurnal clenching), thereby resulting in hyperactivity of masticatory muscles, TMJ overloading, and joint or muscle changes accompanied by pain and functional limitations, which increase TMD severity [37]. Persistent pain can also cause psychological problems. Several studies of the correlations between depression, anxiety, stress, and pain found that individuals with muscular pain may have more psychological disorders and worse sleep quality and use more anti-anxiolytics [1,36,38], thus reducing OHRQoL. This explains why HDI score and severity were correlated with the domains of psychological discomfort and psychological disability in the present study.

An interesting finding of the present study is that the OHIP-C14 domain of functional limitation was correlated with HDI score and severity. This domain focuses on pronunciation difficulty and change in taste sensation. There is no evidence that TMJ pain and dysfunction adversely affect the pronunciation of TMJ OA patients. Moreover, taste sensation is thought to be modulated in the brain regions that process nociceptive signals [39]; there is therefore an inherent interaction between these two sensory systems. Persons with TMD pain are more likely to have taste disturbances than those without TMD pain [39]. A graded interaction was demonstrated between perceived taste and TMD pain: pain was positively correlated with the frequency of taste complaints [39]. That finding explains why HDI score and severity were correlated with the domain of function limitation in the present study.

Moreover, pain-related HDI domains (muscle tenderness during palpation, TMJ pain during palpation, and pain during mandibular movement) were correlated with pain-related and psychological OHIP-C14 domains (physical pain and psychological discomfort/disability). Higher scores for pain-related HDI domains were significantly associated with higher scores for pain-related and psychological OHIP-C14 domains, as shown in **Table 4** and **Table 7**. It is important to note that the domain of muscle tenderness was significantly correlated with all OHIP-C14 domains, that is, higher scores for muscle tenderness were significantly associated with higher scores for all OHIP-C14 domains, which indicates that muscle pain has a clear adverse impact on OHRQoL. TMD patients with muscular pain were found to have greater OHRQoL impairment as compared with patients with other types of TMD [25,40,41], which was confirmed in the present study. In addition, function-related HDI domains (TMJ func-

tion impairment and range of mandibular motion) were not correlated with several domains from OHIP-C14, and the r values for function-related domains tended to be lower than those for pain-related domains, which indicates that pain has a greater adverse effect than dysfunction on OHRQoL in patients with TMJ OA. This is consistent with the findings of several other studies [25,40,41].

This study has some limitations. First, the present inclusion criteria differed from those of previous studies, which could result in bias. Second, although the HDI instrument used in this study is widely used in dentistry to assess TMD severity and provides a numerical score for TMD severity, it is based completely on objective examinations by dentists and thus may not reflect the true severity of patient signs or symptoms, as compared with other scales that depend on patients' subjective assessment of symptoms. This might complicate interpretation of the present results and reduce the clinical applicability of our findings. Third, a new OHIP called the OHIP-TMDs was introduced in 2011 [42]. This instrument was developed for TMD patients and has only 22 items. It includes more items relevant to TMD and may be an appropriate biopsychosocial, patient-centered outcome measure for assessment of OHRQoL in TMD patients.

Conclusion

In summary, TMJ OA had an adverse effect on patient OHRQoL. HDI score and severity were correlated with OHRQoL sum score in TMJ OA patients. Scores for all HDI domains except TMJ function impairment were correlated with OHRQoL. Scores for all seven OHIP-C14 domains were correlated with HDI scores, and scores for all OHIP-C14 domains except function limitation were correlated with HDI severity. Pain-related HDI domains had a greater adverse effect than function-related domains on OHRQoL in patients with TMJ OA.

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