SCIENTIFIC RESEARCH REPORT

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Association of malocclusion, self-reported bruxism and chewing-side preference with oral health-related quality of life in patients with temporomandibular joint osteoarthritis

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Objectives: The aim of this study was to evaluate the association of oral health-related quality of life (OHRQoL) with malocclusion and self-reported bruxism and chewing-side preference (CSP) in patients with temporomandibular joint osteoarthritis (TMJ-OA). **Methods:** This study involved 511 patients diagnosed with TMJ-OA. Each participant completed the Chinese version of the 14-item Oral Health Impact Profile (OHIP-C14) questionnaire and received a clinical examination concerning malocclusion (posterior crossbite, overbite, overjet and anterior open bite). Also patients' self-reported awake bruxism (AB), sleep bruxism (SB) and CSP based on the Oral Behavior Checklist (OBC) were recorded. The associations of OHIP-C14 with malocclusion and self-reported bruxism and CSP were assessed using multiple linear regression analysis. **Results:** Posterior crossbite, overbite, overjet and anterior open bite were not significantly associated with either the total OHIP-C14 score or the scores of each domain of OHIP-C14. AB was significantly associated with both the total OHIP-C14 score and the scores of each domain with the largest standardised coefficients. CSP was significantly associated with both the total OHIP-C14 score and the scores of the psychological and social domains. SB was significantly associated with the scores of both the function limitation and psychological disability domains. **Conclusions:** Malocclusion is not significantly associated with OHRQoL in patients with TMJ-OA. Self-reported AB is highly associated with OHRQoL in patients with TMJ-OA, while self-reported SB and CSP are both moderately associated with OHRQoL in patients with TMJ-OA.

Key words: *Temporomandibular joint disorders, osteoarthritis, malocclusion, bruxism, quality of life*

INTRODUCTION

Temporomandibular disorders (TMDs) are a heterogeneous group of conditions related to the temporomandibular joint (TMJ) and/or the jaw muscles[1]. TMJ osteoarthritis (OA) is the major subtype of TMD and joint pain is the major symptom[2,3]. Other clinical signs of TMJ-OA include joint tenderness, crepitus, radiographic bony changes and joint space narrowing[3]. In past decades, dental occlusion was thought to have a dominant effect on the onset as well as the management of TMDs[4]. Some analytical studies show that occlusal factors act as risk indicators for the development of TMDs[5] and may decide the patterns of load distributions on the TMJ, thus impacting resistance of the musculoskeletal system[4]. However, recent evidence does not support a role for malocclusion in the aetiology of TMDs[5]. Particularly, studies with multidimensional disease models suggest that dental occlusion characteristics are very weakly correlated with muscular pains and TMJ pains[5]. Thus, the role of malocclusion in the development of TMDs is controversial. As for TMJ-OA, it was reported that malocclusion, including crossbite, deep overbite and abnormal overjet, was associated with morphological changes in the TMJ, which is a major radiographic sign for the diagnosis of TMJ-OA[6]. TMJ-OA resulting from functional overloading can cause joint tissue collapse and condylar resorption, resulting in morphological changes of TMJs and then a decrease in ramus height[7]. This may lead to progressive mandibular retrusion with anterior open bite[7]. Furthermore, based on previous literature, researchers have used several techniques to disrupt dental occlusion in mice and rat models and found that malocclusion can induce degradation of condylar cartilage and development of TMJ-OA[8–10]. That is, malocclusion is thought to be associated with TMJ-OA and the association is bidirectional. Sleep bruxism (SB), awake bruxism (AB) and chewing-side preference (CSP) are also regarded as potential major causative factors in TMJ-OA and are thought to underlie the onset of TMDs because they may aggravate muscular tension and TMJ overload. However, whether there is a significant association of bruxism and CSP with signs and symptoms of TMDs remains controversial.

Oral health-related quality of life (OHRQoL) in patients with TMJ-OA has been shown to be significantly impaired[11]. Also, patients with severe malocclusion may report a variety of oral health-related impacts that reduce their QoL in several aspects[12]. However, a recent review suggests that a great deal of controversy still exists concerning the influence of malocclusion on QoL[13]. Bruxism and CSP also reduce OHRQoL because they may cause muscular and joint pains around TMJ areas and these habits may be associated with psychological factors[14]. A better understanding of the effects of malocclusion, bruxism and CSP on OHRQoL is needed from a patient's perspective, which will facilitate the planning and evaluation of public health interventions and contribute to appropriate allocation of resources. However, the impacts of malocclusion, bruxism and CSP on OHRQoL in patients with TMJ-OA are very poorly studied. Therefore, the aim of this study was to assess the association of OHRQoL with malocclusion, self-reported bruxism and CSP (e.g. SB, AB and CSP) in patients with TMJ-OA.

METHODS

The study protocol was approved by the Ethics Committee of the West China Hospital of Stomatology at Sichuan University (WCHSIRB-D-2013-092). The study was conducted in full accordance with the World Medical Association Declaration of Helsinki. This cross-sectional evaluation involved 515 adults who sought treatment at the Orofacial Pain Clinic, West China Hospital of Stomatology, Sichuan University, between 7 January 2013 and 17 January 2014. The inclusion criteria were patients 18–70 years of age who were diagnosed with TMJ-OA according to the Research Diagnostic Criteria for TMDs (RDC/TMD axis I group IIIb)[15] and who provided written informed consent. The exclusion criteria included other subtypes of TMDs based on RDC/TMD (but with normal TMJ structure); TMJ trauma; history of TMJ-related surgery, condyle fracture or polyarthritis; and missing data.

Data were collected through both face-to-face interviews and clinical examinations. OHRQoL in the past 1 month was evaluated using the Chinese version of the 14-item short-form Oral Health Impact Profile (OHIP-C14) questionnaire[16]. The OHIP-C14 includes seven domains: functional limitation; physical pain; psychological discomfort; physical disability; psychological disability; social disability; and handicap. A higher OHIP-C14 score indicates worse OHRQoL and vice versa.

During the interviews, patients also answered three questions about self-reported bruxism and CSP from the Oral Behavior Checklist (OBC)[17]: How often do you clench or grind teeth when asleep, based on any information you may have? (SB)How often do you clench or grind teeth together during waking hours? (AB)How often do you chew food on one side only? (CSP).The responses were coded 'no' if the answer was 'none of the time'; otherwise, the responses were coded 'yes'.

In the clinical assessments, the occlusal features of each patient were accurately recorded based on previous literature[4,18]. Posterior crossbite was defined as present when the buccal cusp of any of the maxillary premolars or molars totally occluded lingually to the buccal cusps of the antagonist mandibular tooth/teeth, otherwise the absence of posterior crossbite was recorded.Anterior open bite was recorded as present when no overlap was seen between the maxillary and mandibular incisors (edge-to-edge bite was included in this type), otherwise absence of anterior open bite was recorded.Overbite was defined as the vertical distance of the maxillary central incisors overlapping the crown of the mandibular central incisors.Overjet was defined as the horizontal distance between the labial surface of the anterior upper maxillary and the anterior mandibular central incisor, which is parallel to the occlusal plane. All clinical assessments were carried out by a single oral and maxillofacial expert with more than 40 years of clinical experience.To assess intra-examiner reliability, 30 people who were not part of this study were randomly selected and re-examined at a 2-week interval after their first examination. The kappa value was 0.968.

Statistical analysis

Statistical analysis was conducted using SPSS 21.0 (IBM, New York, NY, USA). Summary scores and domain scores obtained from the OHIP-C14 were expressed as mean $\pm$ standard deviation (SD). Differences in total scores and in domain scores, depending on the presence or absence of malocclusion (posterior crossbite and anterior open bite) and self-reported bruxism (SB and AB) and CSP, were evaluated using independent-sample *t*-tests. Also, multiple linear regression was used to evaluate whether malocclusion or self-reported bruxism and CSP were associated with OHRQoL. In the multiple linear regression, the backward selection method was used to determine the variable(s) most associated with the total score or domain score of OHIP-C14. In the backward selection method, the corresponding variable(s) with a significance level of $P < 0.10$ would be included in the final model. In the multiple linear regression, an unstandardised regression coefficient was used to evaluate how many OHIP-C14 scores were increased/decreased when an independent variable was changed from absent to present (categorical variables) or changed by one unit (continuous variables), while the other independent variables were constant. A standardised regression coefficient was used to compare the importance of independent variables in the model, in which a higher value indicates higher importance. R^2 was used to assess the amount of variability in the dependent variable that can be accounted for by the independent variables in the model. All results except backward selection were considered significant at $P < 0.05$.

RESULTS

A total of 515 patients (131 men and 384 women) who met the inclusion criteria were included in this study. The mean age was 38.38 ± 15.10 years (women: 38.50 ± 15.10 years; and men: 38.02 ± 15.14 years). The sociodemographic profile, malocclusion and self-reported bruxism and CSP observed here are presented in *Table 1*. In the case of malocclusion, the prevalences of posterior crossbite and anterior open bite were 6.2% and 8.0%, respectively. Also, the prevalences of self-reported SB, AB and CSP were 18.1%, 21.0% and 70.3%, respectively. The mean values of overbite and overjet were 2.98 ± 1.35 and 2.84 ± 1.41 mm, respectively.

The mean sum score of the OHIP-C14 was 16.09 ± 11.42 (*Table 2*). The mean and SD values of domain scores of the OHIP-C14 are presented in *Table 2*. The scores and statistical significance of each domain of OHIP-C14, based on posterior crossbite, anterior open bite and self-reported bruxism and CSP, are presented in *Table 3*. The total OHIP-C14 score was significantly higher in patients with TMJ-OA in the presence of self-reported SB ($P = 0.012$) and self-reported AB ($P < 0.001$). However, the total scores of OHIP-C14 were not significantly different between patients with TMJ-OA in the presence and absence of posterior crossbite ($P = 0.771$), anterior open bite ($P = 0.613$) or CSP ($P = 0.124$).

Table 1 Sociodemographic characteristics, malocclusion and self-reported bruxism and chewing-side preference ($n = 515$)

Variables	Values
Sociodemographic characteristics	
Sex	
Female	384 (74.6)
Male	131 (25.4)
Age (years)	38.38 ± 15.10
Female	38.50 ± 15.10
Male	38.02 ± 15.14
Malocclusion	
Posterior crossbite	
Yes	32 (6.2)
No	483 (93.8)
Anterior open bite	
Yes	41 (8.0)
No	474 (92.0)
Overbite (mm)	2.98 ± 1.35
Overjet, (mm)	2.84 ± 1.41
Self-reported bruxism and chewing-side preference	
Sleep bruxism	
Yes	93 (18.1)
No	422 (81.9)
Awake clenching	
Yes	108 (21.0)
No	407 (79.0)
Chewing-side preference	
Yes	362 (70.3)
No	153 (29.7)

Values are given as *n* (%) or mean ± standard deviation.

Table 2 Scores obtained for each domain of the Chinese version of the 14-item Oral Health Impact Profile (OHIP-C14) questionnaire ($n = 515$)

Domains	Mean score	Standard deviation
Functional limitation	1.28	1.80
Physical pain	3.83	2.32
Psychological discomfort	2.54	2.29
Physical disability	2.62	2.30
Psychological disability	2.38	2.09
Social disability	1.67	1.91
Handicap	1.77	1.98
Total score	16.09	11.42

As shown in *Table 4*, in multivariate linear regression model 1, which includes all the independent variables, both AB and CSP are significantly associated with the total OHIP-C14 score ($P < 0.001$; $P = 0.047$). After backward selection, only AB and CSP are included in model 2. When CSP was constant, the total OHIP-C14 score in patients with the presence of AB increased by 5.99 compared with the absence of AB. When AB was constant, the OHIP-C14 score in patients with CSP increased by 2.04 compared with patients who did not have CSP. The standardised coefficients of AB were larger than those of CSP in both models, indicating that AB plays a more important role than CSP in the total OHIP-C14 score.

Table 3 Total scores and domain scores obtained using the Chinese version of the 14-item Oral Health Impact Profile (OHIP-C14) questionnaire, based on posterior crossbite, anterior open bite or self-reported chewing-side preference (n = 515)

Variables	Number of patients	Functional limitation	Physical pain	Psychological discomfort	Physical disability	Psychological disability	Social disability	Handicap	Total
Posterior crossbite									
Yes	32	1.16 ± 1.69	3.91 ± 2.40	2.38 ± 2.09	2.94 ± 2.61	2.59 ± 1.78	1.75 ± 2.20	1.94 ± 2.17	16.66 ± 11.00
No	483	1.29 ± 1.80	3.83 ± 2.32	2.55 ± 2.31	2.60 ± 2.28	2.36 ± 2.11	1.66 ± 1.90	1.76 ± 1.96	16.05 ± 11.46
P value		0.684	0.850	0.678	0.425	0.548	0.798	0.615	0.771
Anterior open bite									
Yes	41	1.61 ± 1.82	3.83 ± 2.57	2.56 ± 2.44	2.34 ± 2.54	2.61 ± 2.32	1.85 ± 2.03	2.15 ± 2.28	16.95 ± 12.78
No	474	1.25 ± 1.79	3.83 ± 2.30	2.54 ± 2.28	2.65 ± 2.28	2.36 ± 2.07	1.65 ± 1.90	1.73 ± 1.95	16.01 ± 11.31
P value		0.223	0.996	0.946	0.414	0.461	0.513	0.200	0.613
SB									
Yes	93	1.74 ± 2.14	4.10 ± 2.38	2.98 ± 2.42	3.11 ± 2.53	2.91 ± 2.19	1.90 ± 2.17	2.03 ± 2.22	18.77 ± 10.96
No	422	1.18 ± 1.70	3.77 ± 2.31	2.44 ± 2.25	2.52 ± 2.24	2.26 ± 2.05	1.61 ± 1.85	1.71 ± 1.92	15.49 ± 10.96
P value		0.006*	0.223	0.052	0.025*	0.153	0.187	0.025*	0.012*
AB									
Yes	108	1.75 ± 2.01	4.42 ± 2.15	3.57 ± 2.44	3.34 ± 2.28	3.24 ± 2.12	2.32 ± 2.15	2.29 ± 2.13	20.94 ± 12.31
No	407	1.16 ± 1.72	3.68 ± 2.34	2.26 ± 2.17	2.43 ± 2.27	2.15 ± 2.02	1.49 ± 1.81*	1.63 ± 1.91	14.80 ± 10.83
P value		0.002*	0.002*	0.082	0.064	0.053	<0.001*	0.159	<0.001*
CSP									
Yes	362	1.34 ± 1.84	3.90 ± 2.28	2.71 ± 2.37	2.67 ± 2.27	2.51 ± 2.08	1.79 ± 1.97	1.87 ± 2.04	16.79 ± 11.73
No	153	1.14 ± 1.69	3.68 ± 2.41	2.13 ± 2.03	2.52 ± 2.37	2.06 ± 2.09	1.37 ± 1.73	1.52 ± 1.79	14.41 ± 10.51
P value		0.236	0.337	0.009*	0.493	0.078	0.076	0.088	0.124

Values are given as mean ± standard deviation.
AB, awake bruxism; CSP, chewing-side preference; SB, sleep bruxism.
*Significant difference between the presence and absence of the independent variable ($P < 0.05$).

Table 4 Multivariate linear regression analyses for prediction of total scores of the Chinese version of the 14-item Oral Health Impact Profile (OHIP-C14) (*n* = 515)

Variables	Model 1			Model 2		
	Unstandardised coefficients B (standard error)	Standardised coefficients Beta	*P* value	Unstandardised coefficients B (standard error)	Standardised coefficients Beta	*P* value
Posterior crossbite	1.48 (2.10)	0.031	0.482			
Overbite	−0.24 (0.43)	−0.028	0.577			
Overjet	−0.06 (0.38)	−0.007	0.878			
Anterior open bite	−0.06 (2.00)	−0.002	0.975			
SB	1.97 (1.32)	0.066	0.138			
AB	5.53 (1.25)	0.197	<0.001*	5.99 (1.21)	0.214	<0.001*
CSP	2.17 (1.09)	0.087	0.047*	2.04 (1.08)	0.082	0.058
Constant	13.84 (1.82)		<0.001*	13.39 (0.92)		<0.001*
R^2	0.061			0.055		

*$P < 0.05$.
AB, awake bruxism; CSP, chewing-side preference; SB, sleep bruxism.
Model 1 was based on all the independent variables; Model 2 was based on backward selection.

As shown in *Table 5*, self-reported AB was significantly associated with all the domains of OHIP-C14. The standardised coefficients of AB were the largest in each domain, indicating that AB has a dominant effect on all domain scores of OHIP-C14 compared with the other variables in the study. Self-reported SB was significantly associated with domains of both functional limitation and psychological disability in OHIP-C14. Self-reported CSP was significantly associated with domains of psychological discomfort, psychological disability, social disability and handicap in OHIP-C14.

Table 5 Multivariate linear regression based on the backward selection method for prediction of domain scores of the Chinese version of the 14-item Oral Health Impact Profile (OHIP-C14) (*n* = 515)

Variables	Unstandardised coefficients B (standard error)	Standardised coefficients Beta	*P* value	R^2
Dependent variable: OHIP-functional limitation				
AB	0.49 (0.20)	0.112	0.013	0.026
SB	0.44 (0.21)	0.093	0.038	
Dependent variables: OHIP-physical pain				
AB	0.74 (0.25)	0.130	0.003	0.017
Dependent variables: OHIP-psychological discomfort				
AB	1.28 (0.24)	0.227	<0.001	0.065
CSP	0.51 (0.22)	0.101	0.018	
Dependent variables: OHIP-physical disability				
AB	0.91 (0.25)	0.161	<0.001	0.026
Dependent variables: OHIP-psychological disability				
AB	0.97 (0.23)	0.189	<0.001	0.058
SB	0.42 (0.24)	0.077	0.082	
CSP	0.41 (0.20)	0.090	0.038	
Dependent variables: OHIP-social disability				
AB	0.81 (0.20)	0.172	<0.001	0.039
CSP	0.37 (0.18)	0.089	0.041	
Dependent variables: OHIP-handicap				
AB	0.64 (0.21)	0.131	0.003	0.024
CSP	0.32 (0.19)	0.074	0.090	

AB, awake bruxism; CSP, chewing-side preference; SB, sleep bruxism.

DISCUSSION

In the present study, malocclusion was not significantly associated with either the total score or any domain score of the OHIP-C14. Based on previous literature, involving both human research and animal research, TMJ-OA tended to be associated with malocclusion and the association was bidirectional[6–10]. However, there was no literature focusing on the relationship between malocclusion and OHRQoL in patients with TMJ-OA. In the OHIP-14, physical dimensions included worsening taste, inaccurate pronunciation, pain in mouth and discomfort eating. No evidence has proved that malocclusion affected patients' taste and pronunciation. Also, it was reported that malocclusion may be associated with the development and exacerbation of TMJ-OA mainly based on morphological changes of TMJ condylar cartilage in human or animal models[6,8–10], but no evidence in humans indicates that malocclusion is associated with pain in the mouth or orofacial regions. Besides, on one hand, if the malocclusion was present before TMJ-OA occurred, it means that the malocclusion was more likely to have been present for a long time and patients may already be used to the malocclusion in daily life and are not likely to report feel discomfort in eating in the preceding 1 month. On the other hand, if the malocclusion of the patients occurred secondary to TMJ-OA, patients may have anterior open bite, which is called acquired open bite associated with TMJ-OA[7,19]. However, acquired open bite associated with TMJ-OA is not very common and TMJ-OA can only cause relatively minor open bite changes with slow progression[7]. Therefore, anterior open bite is not likely to make patients uncomfortable eating. Therefore, it is reasonable to think that malocclusion is not associated with the physical dimensions of the OHIP-C14.

However, dentition is regarded as one of the important factors affecting overall facial appearance because people mainly focus on dental arrangement, alignment and appearance[20]. Patients with severe malocclusion tend to feel useless, shameful and inferior, which may impair the psychological and social dimension of OHRQoL[21,22]. However, this is inconsistent with our results. The reason may be that the patients included in previous studies needed orthodontic treatment, indicating that the relatively severe malocclusion and malocclusion problem they had may have already deteriorated their facial appearance. However, the majority of our patients did not have a severe malocclusion. Slight malocclusion may have a very minimal effect on the psychological and social aspects of OHRQoL in patients with TMJ-OA. This may explain why, in the present study, malocclusion is not significantly associated with psychological and social dimensions of OHIP-C14 in patients with TMJ-OA.

Self-reported AB was strongly associated with OHRQoL and with all the domains of OHIP-C14 in our study. Compared with other variables included in the study, self-reported AB had a dominant effect on the OHRQoL of patients with TMJ-OA. In a large-scale study involving 50- and 60-year-old Swedish subjects, AB was proved to be correlated with craniofacial pain[23]. Also, two previous studies demonstrated that patients with myofascial pain associated with TMD were more likely to exhibit clenching and experience higher levels of stress and tension compared with those without TMD-associated myofascial pain[24,25]. It was also shown that participants who clenched for up to 20 minutes per day for up to 8 days reported significantly more pain at the end of the laboratory experiment[26]. Moreover, experimental tooth-grinding for 30 minutes caused obvious muscular pain in the TMJ for several days in nine healthy subjects[27]. AB can cause facial pain because of eccentric muscle contractions[28]. Eccentric contractions can cause inflammatory changes in the muscles that trigger some mechanisms with peripheral sensitisation of the primary afferent nerve fibers[29]. This may explain why AB is strongly associated with the domain of physical pain in OHIP-C14. However, it is interesting that SB was not related to the domain of physical pain in the present study. This is consistent with the previous finding that AB is more likely to cause TMJ pain and functional limitation than SB because an individual's average awake period is twice as long as their average sleeping period in a day[30].

Furthermore, both SB and AB can cause TMJ overloading. This can lead to proteoglycan degradation, synovium alteration, inflammation and synovial fluid changes, which may impair lubrication and nutrition of chondrocytes, eventually leading to cartilage degradation[31]. This, in turn, may cause or exacerbate TMJ-OA, resulting in functional limitation and physical disability. Furthermore, excessive mechanical stresses on the TMJ may cause the generation of free radicals via various mechanisms. Accumulation of free radicals in the joint leads to degradation of the cartilage matrix and elaboration of the inflammatory response, ultimately affecting the biomechanical properties of articular tissues[32,33]. That is why both AB and SB were associated with the functional limitation domains of OHIP-C14, and AB was associated with physical disability. However, in the present study, SB was not associated with physical disability in the regression analyses, but patients with and without self-reported SB had significantly different physical disability scores (*Table 3*). This indicates that SB may also be related to physical disability, but at a relatively low level, and is consistent with a previous study which proves that AB is more likely to cause TMJ clicking, locking, jaw muscle pain and difficulty in yawning than SB, and therefore AB may further aggravate physical disability[30].

Moreover, self-reported AB and SB were also associated with psychological and social handicap domains in OHIP-C14. As previously reported, subjects with SB and AB have both been shown to have difficulty concentrating and to interrupt others more than twice as frequently as controls[34]. For instance, the prevalence of thought disorders, conduct disorders and antisocial disorders were all shown to be significantly higher in patients with bruxism than in those without bruxism[35]. Moreover, other characteristics, including neuroticism, perfectionism, aggressiveness, higher sensitivity to stress and maladaptive coping strategies, are all seemingly related to an increased risk of bruxism development[36]. Tooth clenching can be exacerbated by anxiety and is related to lack of stress-coping ability[37]. These findings are consistent with our results that AB and SB are both related to psychological and social domains of OHIP-C14.

In the present study, self-reported CSP was associated with the total score of OHIP-C14 as well as with the psychological and social domains of OHIP-C14. As reported previously, patients with unilateral TMJ pain had significantly increased frequency of CSP[38]. The occurrence of TMJ pain on the non-chewing side might be caused by increased loading of this joint as a consequence of chewing on the other side only. The balancing joint is more severely loaded during mastication than the working joint[38] and exclusive unilateral mastication can alter the structure of the condylar cartilage and exacerbate the symptoms and signs of TMJ-OA[39]. It is well known that patients with TMD pain have some reactions, including pain-related believing, catastrophising and coping strategies[39]. These reactions are strongly associated with pain intensity, psychosocial adjustment, physical functioning and impairment of

QoL[40]. This may explain why self-reported CSP, AB and SB were all associated with the psychological and social domains of the OHIP-C14 in the present study.

For clinical practice, our study may provide some clues that if patients with TMJ-OA have self-reported AB, SB or CSP, they are more likely to have lower OHRQoL than those without self-reported AB, SB or CSP. So, in this situation, clinicians should pay more attention to the psychosocial well-being of these patients and may adopt extra psychological or social support for the patients. Besides, clinicians should further assess patients' bruxism or CSP using instrumentation such as polysomnography to confirm the diagnosis. If it is confirmed, clinicians should adopt specific treatments for bruxism or CSP, such as physiotherapy or splint, or psychological treatment, in order to improve the patients' OHRQoL.

It should be noted that several limitations need to be considered when interpreting the data in this study. First, because of the cross-sectional design, we only could assess the associations of OHRQoL with malocclusion and self-reported bruxism and CSP, not causality. Second, the self-reported bruxism and CSP were only assessed based on patients' subjective judgment instead of clinical examinations. The behavioural definitions of SB, AB and CSP may differ among patients, which may cause bias. SB, AB and CSP can be examined unequivocally only by the use of polysomnogram recordings of clinical measurements, which is regarded as the reference standard approach for the measurement of bruxism[41,42]. However, polysomnography has seldom been used in the literature reporting bruxism epidemiology[43] because it is limited by high cost and the small number of adequately equipped laboratories[31]. In the present study, strong positive correlations between self-reported and clinically measured SB ($r = 0.626–0.932$) and AB ($r = 0.363–0.811$) were found[31]. Thus, even though self-reporting SB in the present study was subjective, it is reliable and so far the most feasible method to collect data for large-sample studies. This is also why self-reported measures were used in the majority of studies to assess bruxism and CSP. Third, the malocclusion and self-reported bruxism and CSP could explain the relatively low variance of OHRQoL in patients with TMJ-OA (1.7–6.2%), suggesting that other factors should be considered in the future to find more reliable predictors.

CONCLUSIONS

Malocclusion, including posterior crossbite, overbite, overjet and anterior open bite, is not significantly associated with the OHRQoL of patients with TMJ-OA. Self-reported AB is highly associated with overall OHRQoL, including all the domains of OHIP-C14 in patients with TMJ-OA. Self-reported CSP is also significantly associated with OHRQoL in patients with TMJ-OA, but mainly in the psychological and social domains of OHIP-C14. Self-reported SB is significantly associated with the functional limitation and psychological disability domains in OHIP-C14 in patients with TMJ-OA.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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