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Clinical correlates of oral impacts on daily performances

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Abstract: *Objectives:* The aim of this study was to investigate the associations between oral health measures and oral health-related quality of life as captured by OIDP (oral impacts on daily performances). *Methods:* The study was performed in three dental clinics in Sweden and included 204 patients, 43.8% men and 56.2% women (aged 20–86 years), consecutively recruited in connection with their routine dental examination. The patients were interviewed using the OIDP followed by a clinical examination. Four bite-wing radiographs were taken in two of the clinics ($n = 154$). A self-administered questionnaire provided information about socio-economic data. *Results:* Subjects ≥60 years had significantly more missing teeth, lesser maximal jaw opening, higher number of sites with alveolar bone loss and proportionally more filled teeth than younger individuals. Impacts related to the oral health that affected their daily life were reported in 39.7%. Multivariate logistic regressions analysis showed that missing teeth (≥10) and a limited jaw opening (<40 mm) were significantly associated with having one or more impact as measured with the OIDP [odds ratio (OR) 6.50, 95% CI 1.48–28.43 and OR 2.87, 95% CI 1.03–7.96, respectively]. *Conclusions:* Individuals with diminished functional oral health status (missing teeth and limited jaw opening) had significantly more often one or more oral impacts on daily life than those with fewer than 10 missing teeth and a jaw opening ≥40 mm. The OIDP instrument may be valuable for use in routine dental check-ups in patients with related problems to determine possible oral impacts on daily life.

Key words: dental status; OIDP; oral health; oral impacts; quality of life

Introduction

Pain and discomfort in the oral cavity may interfere with difficulties in daily performances such as ability to eat, speak and socialize, and consequently affect general well-being and quality of life (1). Oral health status, e.g. number of teeth, decayed teeth and periodontal pocket depth, is traditionally registered by dental hygienists or dentists. However, the ability to capture the oral health experienced by the individual him/herself, considering functional and psychosocial aspects and thus the significance of quality of life, is limited by using only clinical measures (2). Oral health-related quality of life (OHRQoL) instruments to measure the impact on an individual's everyday life have therefore been developed and evaluated (3). These instruments are theory-based and intended for use as a complement to clinical measures (4).

The oral impacts on daily performances (OIDP) is a short OHRQoL instrument developed to measure oral impacts on physical, psychological and social aspects of an individual's daily life (5). The OIDP has been reported to be reliable and valid in different ages, populations and countries (6–8). Recently, OIDP was adapted and validated in Swedish and was shown to have good psychometric properties (9).

A high frequency of oral health-related problems has previously been reported to influence the quality of life among adults (10, 11). Associations have been shown between OHRQoL as measured by a variety of self-reported instruments and clinical indicators such as number of missing and decayed teeth (12–14), denture wearing (15), halitosis (16), hypersensitive teeth (17) and endodontic treatment need (14). The knowledge about the relationships between OIDP and clinical oral health measures is, however, limited. Among dentate older people, associations between the number of missing teeth and occluding pairs of teeth (18, 19), and between anterior tooth spaces (18) and OIDP have been reported. Furthermore, a positive relation between increased number of missing teeth and OIDP has also been found among adults (20). Investigations of the relations between the OIDP and clinical oral health measures among adult individuals of varying ages are needed because most of the studies mentioned above targeted elderly people.

The aim of this study was to investigate the associations between oral health measures and oral health-related quality of life as captured by OIDP.

Materials and methods

Study sample

The study was carried out at three clinics in general dentistry situated in southern Sweden from November 2006 to June 2007. The three clinics represented a range of socio-economic profiles (9). The sample included patients in three age strata: 20–39 years, 40–59 years and ≥60 years, who were consecutively invited to the study in connection with their routine dental examination. In total, 204 patients from the three clinics participated.

Procedure

The patients were first interviewed with the OIDP and then answered a self-administered questionnaire. A medical anamnesis was carried out before a clinical examination. Results from the anamnestic interview have previously been reported by Östberg *et al.* (21). The data collection was performed by trained and calibrated personnel: the interview technique with the OIDP was calibrated between two dentists and one dental hygienist, and the clinical examination between three dental hygienists (other than the interviewers).

Four bite-wing radiographs in the premolar and molar regions were taken with a standardized parallel technique before the clinical examination in two of the three clinics

($n = 154$). The radiographs were mounted in frames. The bite-wings taken in one of the clinics were analysed by one dentist and those in the other clinic by another dental hygienist. Before the start of the radiographic analyses, a calibration between the two examiners was performed. The inter-examiner reliability of caries assessment (DT, decayed teeth) was tested, showing a kappa coefficient of 0.61. The inter-examiner reliability of alveolar bone level measurements was determined by the dual examination of eight randomly selected patients from both clinics (167 sites), showing an average intra-class correlation (ICC) of 0.92 (95% CI 0.90–0.95). The intra-examiner reproducibility was calculated by repeated measurements of eight randomly selected subjects from each clinic, with a single rater ICC equalling 0.91 (95% CI 0.89–0.93) for one examiner (197 sites) and 0.98 (0.95% CI 0.97–0.99) for the other (174 sites). The third molars were excluded from the radiographic analysis.

Measures

OIDP

The Swedish version of the OIDP index was used to collect data about the patients' OHRQoL. This includes nine physical, psychological and social aspects of daily performances (9). The participants were verbally asked whether they had experienced any difficulties with the following activities due to problems with their mouth or teeth (or dentures) during the past 6 months: eating and enjoying food; speaking and pronouncing clearly; going out (for example to shop or visit someone); cleaning teeth (or dentures); sleeping and relaxing; smiling; laughing and showing teeth without embarrassment; maintaining emotional state (for example becoming more easily upset than usual); carrying out major work or social role and enjoying contact with other people. Patients who answered 'yes' to any item were asked about the frequency and severity using a five-point scale. For those who experienced regular difficulties, the scale alternatives varied from 'less than once a month' [1] to 'every day or nearly every day' [5], and for patients with difficulties in a part of the period the alternatives varied from '5 days or less' [1] to 'more than 3 months' [5]. The severity of the difficulties in everyday life was then rated between 'no effect' [1] and 'a very severe effect' [5]. The nine performance scores were calculated by multiplying frequency and severity scores. The sum of the nine scores was divided by the possible maximum performances scores (225) and multiplied by 100 to obtain an individual OIDP score (OIDPsc) (5, 9). The OIDPsc was dichotomized into having 'at least one daily performance affected' versus 'no daily performance affected'.

Clinical and radiographic variables

The clinical and radiographic examination included dental and periodontal status, caries experience and maximal jaw opening.
Clinical diagnostic criteria:
• Number of teeth, prevalence of dentures and implants.

• Maximal jaw opening was measured in mm using a steel ruler. Maximal opening was dichotomized as '<40 mm' versus '≥40 mm'. A maximal opening of 35 mm was used as an alternative cut-off value (22).

• Number of probing pockets ≥6 mm at approximal sites (buccal and lingual) from the gingival margin to the bottom of the pocket was measured using a mm-graded manual colour-coded periodontal probe. The number of pockets was divided into: 'no probing pockets exceeded ≥6 mm' and 'one or more probing pockets ≥6 mm'. The probing pocket depth ≥6 mm was chosen according to the community periodontal index of treatment needs (CPITN) (23).

Radiographic examination:

• Alveolar bone loss was defined as 4 mm or greater from the cemento-enamel junction (CEJ) to the top of the alveolar bone to the nearest 0.5 mm level on mesial and distal surfaces using a magnifying loupe (10×). Only surfaces with a distinct bone level were recorded. The cut-off value was chosen due to data demonstrating that an alveolar bone loss ≥4 mm constitutes a pathological condition (24). The proportion of sites with alveolar bone loss was calculated in per cent and divided into three categories: 'no alveolar bone loss', 'bone loss in <30% of all the sites' and 'bone loss in ≥30% of all the sites' (25).

• Caries experience was recorded by decayed and filled teeth in premolars and molars by using bite-wing radiographs and a Mattson viewer (26). A *caries lesion* was recorded when there was a clearly defined reduction in mineral content in enamel, in dentine or on restored tooth surfaces (initial or manifest caries). These data were divided into three categories according to Tsakos *et al.* (18): 'no decay', 'one tooth decayed' and 'two or more teeth decayed'. *Filled teeth* were recorded for the presence of amalgam, glassionomer cement or composite material. The number of filled teeth was divided into four categories: 'no fillings', '1–3 filled teeth', '4–8 filled teeth' and '≥9 filled teeth' (18).

Questionnaire

Self-reported socio-demographic data were used as covariates in the multivariate analyses: (i) educational level ('≤9 years of education or less' versus '>9 years'), (ii) ethnic origin ('born abroad' versus 'born in Sweden') and (iii) marital status ('unmarried/not cohabitant' versus 'married/cohabitant'). Other findings from the questionnaire are to be reported elsewhere.

Ethics

The Research Ethics Committee of Karlstad University, Sweden (C2006/105) approved the study. The patients were informed orally and in writing. Written consent to participate was obtained.

Statistical analysis

The statistical analysis was performed using the SPSS software package, PC version 16.0 (SPSS Inc., Chicago, IL, USA). Miss-

ing values for the variables varied from 0 to 1% for socio-demographic and clinical data and from 0 to 5% for radiographic data. Clinical and radiographic variables were compared in relation to age groups and gender with chi-squared test for categorical data (missing teeth, periodontal pocket depth, jaw opening, alveolar bone loss, filled and decayed teeth), in relation to age groups with ANOVA, and to gender with Mann–Whitney's U-test for interval data (numbers of teeth and maximal jaw opening). *Post hoc* pair-wise comparisons for the age groups were adjusted by the Bonferroni method (27).

Bivariate and multivariate logistic regression analyses were applied to explore associations between the independent variables: clinical and radiographic variables in relation to the OIDPsc (dependent variable). Adjustments were made for the possible confounding variables: age, gender, education level, ethnic origin and marital status separately. These possible confounders were all included in the final multivariate regression model. Odds ratios (OR) with 95% confidence intervals (CI) were estimated. P-values <0.05 or when the 95% confidence interval excluded 1.0 were regarded as statistically significant.

Results

The socio-demographic characteristics of the subjects by age groups are presented in Table 1. The sample consisted of 89 (43.8%) men and 114 (56.2) women with a mean age of 47.2 years (SD 16.9).

One or more problems with the mouth or teeth during the last 6 months as measured with the OIDP were reported in 44.1% of all subjects and of these 39.7% (n = 81) were affected in their daily life. Of those who were affected in their daily life, 35.8% (n = 29) had two or more problems related to their oral health. The OIDPsc ranged from 0 to 24.4 (mean 4.5; median 2.7).

Clinical findings and relation to OIDP

The subjects had a mean of 27.2 teeth (range 3–32) (Table 2). Five of the subjects had removable dentures, complete or partial, and one had implants. Almost 40% of the oldest individuals (≥60 years) had ≥10 missing teeth. Significant differences were shown in an overall comparison, as well as in pair-wise comparisons between the age groups ≥60 years and 20–39 years, and between ≥60 years and 40–59 years (P < 0.001, respectively) (Table 2). No significant differences in this matter were found in relation to gender.

Limited jaw opening (<40 mm) was more common among the oldest subjects (≥60 years). In an overall comparison between age groups, a significant difference was shown (P = 0.006) (Table 2). Pair-wise group comparisons showed that a significantly higher proportion of subjects ≥60 years more often than 40–59-year olds had a limited jaw opening (P = 0.004). However, no difference was shown in relation to subjects 20–39 years (P = 0.085). The mean of maximal jaw opening was significantly less among women than among men

Variable	Total group $n = 204$	20–39 years $n = 72$	40–59 years $n = 79$	≥60 years $n = 53$
Gender*				
Men	89 (43.6)	32 (44.4)	35 (44.3)	22 (41.5)
Women	114 (56.2)	40 (55.6)	44 (55.7)	31 (58.5)
Marital status				
Married/cohabitant	129 (63.5)	41 (56.9)	54 (69.2)	34 (64.2)
Unmarried/not cohabitant	74 (36.5)	31 (43.1)	24 (30.8)	19 (35.8)
Education				
>9 years	162 (80.2)	68 (94.4)	70 (90.9)	24 (45.3)
≤9 years	40 (19.8)	4 (5.6)	7 (9.1)	29 (54.7)
Ethnic origin				
Born in Sweden	192 (94.6)	70 (97.2)	74 (94.9)	48 (90.6)
Born abroad	11 (5.4)	2 (2.8)	4 (5.1)	5 (9.4)

Table 1. **Characteristics of the total study population and by age group**

Data are numbers and percentages if nothing else is indicated.
*Missing in one subject.

Variable	Total group $n = 204$	20–39 years $n = 72$	40–59 years $n = 79$	≥60 years $n = 53$	Overall P-value between the groups
Number of teeth					
Mean (SD)	27.2 (4.7)	29.6 (1.9)	28.1 (3.4)	22.5 (5.8)	<0.001
Missing teeth					
<10	180 (88.2)	72 (100)	76 (96.2)	32 (60.4)	<0.001
≥10	24 (11.8)	0 (0)	3 (3.8)	21 (39.6)	
Maximal jaw opening					
Mean (SD)	46.8 (6.9)	47.9 (7.5)	47.8 (5.9)	43.8 (6.7)	0.001
≥40 mm	170 (84.6)	61 (85.9)	71 (92.2)	38 (71.7)	
<40 mm	31 (15.4)	10 (14.1)	6 (7.8)	15 (28.3)	0.006
Probing pocket depth					
<6mm	143 (70.8)	58 (80.6)	54 (68.4)	31 (60.8)	0.049
≥6mm	59 (29.2)	14 (19.4)	25 (31.6)	20 (39.2)	

Table 2. **Clinical findings in the total sample by age group**

Data are numbers and percentages if nothing else is indicated.

(45.5 mm, SD 6.8 and 48.5 mm, SD 6.7, respectively; $P < 0.001$).

One third of the total sample had periodontal pockets ≥6 mm (Table 2). A borderline statistical significant difference was found in an overall comparison ($P = 0.049$), however, in pair-wise group comparisons, this difference vanished. There was no significant difference regarding pocket depth in relation to gender.

One or more oral health-related impacts were reported in 58.3% of subjects with ≥10 missing teeth, in 54.8% of subjects with jaw opening <40 mm and in 45.8% of those with pocket depth ≥6 mm. The bivariate analyses showed borderline or no significant associations between the independent variables missing teeth ≥10 (OR 2.36, 95% CI 0.99–5.61), jaw opening <40 mm (OR 2.06, 95% CI 0.95–4.46), periodontal pocket depth ≥6 mm (OR 1.43, 95% CI 0.77–2.65) and the dependent variable OIDPsc (having one or more oral health-related impacts). The possible confounders' age, gender, education level, ethnic origin and marital status did not change this pattern. A subanalysis showed that subjects with a limited jaw opening <35 mm, more often than those with a greater jaw opening, experienced one or more oral health-related impacts

(OR 5.70, 95% CI 1.15–28.21). This association was unchanged when adjusted for the possible confounders.

Radiographic findings and relation to OIDP

Data from bite-wing radiographs were analysed in a subsample of 154 subjects. In this subsample, 37.8% of the subjects in the oldest age group (≥60 years) had ≥30% tooth sites with an alveolar bone loss 4 mm or more (Table 3). Subjects who are ≥60 years had significantly more sites with alveolar bone loss than the younger age groups, which was shown in both overall and pair-wise comparisons ($P < 0.001$).

All individuals ≥40 years in the subsample had one or more filled teeth, and 95% had ≥4 fillings (Table 3). Subjects aged 40–59 and ≥60 more often had ≥9 filled teeth ($P < 0.001$) than subjects aged 20–39. Decayed teeth were equally common in all age groups. Likewise, there were no gender differences in alveolar bone loss, number of fillings or decayed teeth.

Oral health-related impacts on daily performances were experienced by approximately 50%, respectively, in subjects who had ≥30% tooth sites with alveolar bone loss, one or more decayed teeth and filled teeth. The bivariate analyses showed

Table 3. **Radiographic findings in a subsample by age group**

Variable	Total group n = 154	20–39 years n = 54	40–59 years n = 55	≥60 years n = 45	Overall P-value between the groups
Alveolar bone loss					
No bone loss	117 (76.0)	54 (100.0)	47 (85.5)	16 (35.5)	
<30% sites	19 (12.3)	0 (0.0)	7 (12.7)	12 (26.7)	
≥30% sites	18 (11.7)	0 (0.0)	1 (1.8)	17 (37.8)	<0.001
Decayed teeth					
No decay	82 (53.2)	30 (55.5)	34 (61.8)	18 (40.0)	
1 tooth decayed	37 (24.1)	9 (16.7)	11 (20.0)	17 (37.8)	
≥2 teeth decayed	35 (22.7)	15 (27.8)	10 (18.2)	10 (22.2)	0.074
Filled teeth					
No fillings	13 (8.8)	13 (24.1)	0 (0.0)	0 (0.0)	
1–3 filled teeth	22 (15.0)	18 (33.3)	2 (3.9)	2 (4.8)	
4–8 filled teeth	37 (25.2)	13 (24.1)	15 (29.4)	9 (21.4)	
≥9 filled teeth	75 (51.0)	10 (18.5)	34 (66.7)	31 (73.8)	<0.001

no associations among ≥30% alveolar bone loss (OR 1.18, 95% CI 0.74–1.88), one or more decayed teeth (OR 1.14, 95% CI 0.77–1.67), filled teeth (OR 0.98, 95% CI 0.71–1.36) and the OIDPsc. This pattern was unchanged when adjusted for the possible confounders.

No significant differences were found regarding clinical data (missing teeth, jaw opening and periodontal pockets depth) in subjects with radiographic data (n = 154) in relation to those without radiographic data.

Multivariate regression analysis

All independent variables (clinical and radiographic), and the confounders (age, gender, education level, ethnic origin and marital status), were analysed together in a logistic multivariate regression model. Two significant factors for the probability of having one or more oral health-related impacts were identified: 10 or more missing teeth (OR 6.50, 95% CI 1.48–28.43) and limited jaw opening (<40 mm) (OR 2.87, 95% CI 1.03–7.96) (Table 4).

Discussion

In this study, oral health problems were more common among the oldest subjects (≥60 years) than the younger participants. Missing ≥10 teeth and having a limited jaw opening were consistently and significantly associated with impaired oral health-related quality of life as measured with the OIDP instrument.

A variety of clinical as well as radiographic examinations were performed to capture the oral health status in relation to the OIDPsc. All adult age groups were included in the study, and not only a specific age as has previously been common (19, 28, 29). The sample represented a broad range of characteristics in age, gender and socio-economic status and was consecutively recruited in connection with their routine dental examination. The data collection was performed by experienced dental hygienists or dentists. Structured assessment tools were used, as well as training and calibration before the start of the study, to avoid differences in performance between the data collectors. However, a higher power would have been reached in the three age groups with the inclusion of more subjects. Another shortcoming of the study is the lack of bite-wing radiographs in one of the dental clinics due to organizational difficulties regarding the data collection.

Missing teeth have previously been reported to be associated with OIDPsc by Tsakos et al. (18, 19) and Åstrom et al. (20). Both missing teeth and limited jaw opening may diminish functional oral health status and thus result in an apparent self-perceived discomfort. In individuals with 10 or more missing teeth, the numbers of occluding pairs of teeth are fewer, which impair chewing ability and eating (30). Dietary habits and food types may change to more unhealthy choices. There is a risk of developing nutritional deficiencies and malnutrition, resulting in serious conditions, such as an impaired immune system and the development of general diseases (31). Limited jaw opening is a symptom of temporomandibular disorders and may be related to pain or other discomfort (22, 32). This condition occurs in all ages (32, 33), and in our study it varied between 8 and 28% in the three age groups. An association between OHRQoL and temporomandibular disorders was reported by John et al. (34) and was also found in our study when both <40 mm and the alternative cut-off value <35 mm were used. However, measurement of the jaw opening is seldom included in dental examinations, except when the patient experiences temporomandibular disorders. Thus, the OIDP instrument could be included as a routine part of the dental examination to avoid failure to detect problems related to missing teeth and limited jaw opening.

Despite the use of several variables to measure oral health status, only missing teeth and limited jaw opening were associated with the OIDPsc. A discrepancy between the clinicians' examinations and the patients' self-perceived oral health has been reported (35, 36). Although periodontal pocket depth and alveolar bone loss are basic measurements in examinations of periodontal status (37), no associations between these variables and oral health-related impacts were shown. However, individuals with periodontitis mostly do not experience discomfort until the periodontal disease has advanced (36). When symp-

Table 4. **Multivariate logistic regression model with the dependent variable OIDP (dichotomized as no oral impact versus one or more oral impacts) and included independent clinical and radiographic variables.**

Independent variables	Total group n (%)	Having one or more oral impact n (%)	Mann–Whitney Z	Mann–Whitney P	OR	CI
Missing teeth ≥10						
No	180 (88.2)	67 (37.2)				
Yes	24 (11.8)	14 (58.3)	1.872	0.013	6.50	1.48–28.43
Jaw opening <40 mm						
No	170 (84.6)	63 (37.1)				
Yes	31 (15.4)	17 (54.8)	1.053	0.043	2.87	1.03–7.96
Probing pocket depth ≥6 mm						
No	143 (70.8)	53 (37.1)				
Yes	59 (29.2)	27 (45.8)	0.417	0.313	1.52	0.68–3.41
Decayed teeth						
No	82 (53.3)	38 (46.3)				
1 tooth	37 (24.0)	16 (43.2)				
≥2 teeth	35 (22.7)	19 (54.3)	−0.027	0.907	0.97	0.62–1.53
Filled teeth						
No	13 (8.8)	8 (61.5)				
1–3	22 (15.0)	9 (40.9)				
4–8	37 (25.2)	15 (40.5)				
≥9	75 (51.0)	37 (49.3)	0.123	0.597	1.13	0.72–1.78
Alveolar bone loss sites						
No	117 (76.0)	53 (45.3)				
<30%	19 (12.3)	11 (57.9)				
≥30%	18 (11.7)	9 (50.0)	−0.290	0.462	0.75	0.35–1.62
Age group						
20–39 years	72 (35.3)	28 (38.9)				
40–59 years	79 (38.7)	29 (36.7)				
≥60 years	53 (26.0)	24 (45.3)	−0.369	0.320	0.69	0.33–1.43
Gender						
Men	89 (43.8)	33 (37.1)				
Women	114 (56.2)	48 (42.1)	−0.279	0.441	0.76	0.37–1.54
Marital status						
Married/cohabitant	130 (64.0)	49 (37.7)				
Unmarried/not cohabitant	73 (35.9)	32 (43.8)	−0.015	0.968	0.98	0.47–2.07
Education						
>9 years	162 (80.2)	63 (38.9)				
≤9 years	40 (19.8)	17 (42.5)	0.306	0.541	1.36	0.51–3.62
Ethnic origin						
Born in Sweden	192 (94.6)	76 (39.6)				
Born abroad	11 (5.4)	5 (45.5)	−0.624	0.451	0.54	0.11–0.27

OR, odds ratios; CI, 95% confidence interval and test statistics for the Mann–Whitney U-test. Adjusted for age, gender, education level, ethnic origin and marital status; OIDP, oral impacts on daily performances.

toms such as loose teeth, swollen and sore gums that occur in later stages of the disease have been used to measure self-experienced oral health-related impacts, associations with OHRQoL have been reported (38, 39). In this study, as well as in those by Tsakos et al. (18, 19), no association between caries experience (dental caries and fillings) and oral impacts was found. Both periodontitis and dental caries mostly have a slow progression. Furthermore, the subjects in this study were regular visitors to the dental clinics. Regular check-ups with periodontal and caries treatment when necessary, probably entailed that several of the subjects did not experience discomfort in relation to these dental diseases. Likewise, fillings mostly do not give symptoms unless fractured. However, it is impossible for the clinicians to know how patients experience their oral health status without asking the patient.

Dental caries was a frequent finding not only among the elderly participants, but also among the youngest age group. Younger people have more natural teeth than the elderly people and thus an increased probability of developing dental caries. During the last 25 years in Sweden, the occurrence of dental visits habits has decreased among young adults (40), and irregular dental check-ups can therefore be one explanation for the higher caries frequency among this group. Good oral health status is mostly reported in children and adolescents (41). They most often also rate their own oral health as good (42). However, Östberg et al. (43) reported that adolescents were rather unaware of their own resources regarding oral health. Thus, they probably do not give oral health sufficient priority, e.g. tooth cleaning, fluoride supplements and diet habits. Young adults in a recent study reported frequent oral

health-related problems (11). Thus, OHRQoL is important to all ages and should not only be elicited from elderly people.

In conclusion, diminished functional oral health status (missing teeth and limited jaw opening) increased the impacts on daily life and oral health-related quality of life. The OIDP instrument may be valuable for use in routine dental check-ups in patients with related problems to determine possible oral impacts on daily life.

Acknowledgements

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