Masticatory muscle pain: Causes, consequences, and diagnosis

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Chapter 6

Comorbidity negatively influences the outcomes of diagnostic tests for musculoskeletal pain in the orofacial region.

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ABSTRACT

The aim of this study was to investigate whether diagnostic tests for musculoskeletal pain in the orofacial region (temporomandibular disorder (TMD) pain) are influenced by the presence of comorbid conditions, and to determine whether this influence decreases when the presence of "familiar pain" is used as outcome measure. In total, 117 patients (35 males, 82 females; 75 TMD-pain patients, 42 pain-free patients; mean age±SD=42.94±14.17 years) were examined with palpation tests and dynamic/static tests. After each test, they were asked whether any pain was provoked and whether this pain response was familiar or not. For four clinical outcome measures (pain on palpation, familiar pain on palpation, pain on dynamic/static tests, and familiar pain on dynamic/static tests), multiple logistic regression analyses were performed with the presence of TMD pain as the primary predictor and regional (neck/shoulder) pain, widespread pain, depression, and somatization as comorbid factors. Pain on palpation was not associated with the primary predictor but with regional pain (P=0.02, OR=4.59) and somatization (P=0.011, OR=8.47), whereas familiar pain on palpation was associated with the primary predictor (P=0.003, OR=5.23) but also with widespread pain (P=0.001, OR=2.02). Pain on dynamic/static tests was associated with the primary predictor (P<0.001, OR=11.08) but also with somatization (P=0.037, OR=4.5), whereas familiar pain on dynamic/static tests was only associated with the primary predictor (P<0.001, OR=32.37). In conclusion, diagnostic tests are negatively influenced by the presence of comorbidity. This influence decreases when the presence of familiar pain is used as outcome measure.

Key words: temporomandibular disorders, comorbidity, familiar pain, palpation, dynamic/static tests

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INTRODUCTION

Musculoskeletal pain, like low-back pain and neck/shoulder pain, is a common complaint that is reported by 8-44% of the general population and has a higher prevalence in women than in men (McBeth and Jones, 2007). It is usually characterized by a dull, aching pain, which aggravates on function. Musculoskeletal pain in the orofacial region is referred to as temporomandibular disorder (TMD) pain (de Leeuw, 2008), and has a point prevalence of approximately 10% (LeResche, 1997). In chronic pain patients, comorbid conditions like other physical symptoms or psychological factors are quite common (Hestbaek et al., 2003; Hoffmann et al., 2011; Velly et al., 2010; Visscher et al., 2001b).

Several classification systems for musculoskeletal pain have been proposed (e.g., (Dworkin and LeResche, 1992; Merksey and Bogduk, 1994; Spitzer et al., 1987; Spitzer and Skovron, 1995)). Among these systems, the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) (Dworkin and LeResche, 1992) is unique in its detailed description and standardization of the clinical examination needed for the classification. In the recognition of the various subtypes of TMD pain, i.e. myofascial pain and arthralgia, palpation tests play a crucial role. Also the classification system for the widespread pain condition fibromyalgia is largely based on the outcome of palpation tests (Wolfe et al., 1990). However, in more recent papers, the use of palpation as a diagnostic tool has been challenged (Wolfe, 2003). Critics have indicated that palpation is more an indication of general distress than of muscle pain (Croft, 2000), while others have reported that palpation is merely related to a generalized heightened pain perception (Goldenberg, 1999).

Evidence for the validity of diagnostic tests for musculoskeletal pain is scarce. Recently, two multicenter studies to the validity of the RDC/TMD have been published (Truelove et al., 2010; Visscher et al., 2009). Although the results of these studies are quite contradictory, they agree that the validity of the RDC/TMD is not acceptable. As an alternative to be used in the recognition of musculoskeletal pain, dynamic/static tests have been proposed (Naeije and Hansson, 1986; Visscher et al., 2009). These tests make use of the characteristic of musculoskeletal pain that it aggravates on dynamic or static function (Cyriax and Patricia, 1993).

The above-mentioned validity studies were performed in chronic TMD-pain patients, of which the majority reported physical or psychological comorbidity. It is well known that comorbidity negatively influences treatment outcome (Hoffmann et al., 2011). However, whether comorbidity also influences the outcomes of diagnostic tests is unknown. Ideally, for the recognition of a specific musculoskeletal pain disorder, like TMD pain, the outcomes of the tests should only be related to the presence of that disorder, and not to the presence of comorbidity.

A concept that may further improve the validity of diagnostic tests, is the concept of ‘familiar pain’: only a pain response which resembles the patient’s pain complaints is

interpreted as a positive test outcome (Truelove et al., 2010; Visscher et al., 2009). As compared to the various classification systems (where 'any pain' is interpreted as a positive outcome), it may be expected that the use of familiar pain will lead to a decrease of false positive responses.

The aim of this study was to investigate whether diagnostic tests (palpation and dynamic/static tests) for musculoskeletal pain in the orofacial region are influenced by the presence of comorbid conditions, and to determine whether this influence decreases when the presence of "familiar pain" is used as outcome measure.

MATERIALS AND METHODS

Participants

Participants were all patients who visited the tertiary care clinic of Oral Kinesiology at the Academic Centre for Dentistry in Amsterdam (ACTA) for an intake appointment. Over a period of nine months, all consecutive patients (N = 220), were invited to participate in the study. They were referred to the clinic by their dentist or medical specialist because of orofacial pain, functional complaints of the temporomandibular joints (e.g., joint sounds or movement limitations), and/or tooth wear. So, the sample included patients with an orofacial pain complaint as well as patients without pain complaints. They were all given detailed information about the protocol. 77 of the 220 patients denied participation in the study, most often because of time constraints. Furthermore, patients reporting orofacial pain with characteristics compatible with dental pain (N=7) or neuropathic pain (N=4), or patients with incomplete records (N=15), were excluded. Dental pain was considered present when the patient complained of toothache provoked or aggravated by cold or warm food, or by chewing. It was confirmed by clinical signs of dental pathology, like the presence of caries or pain provocation on tooth percussion, on temperature test, or on bite tests, or by periapical radiolucencies or radiological signs of caries. Neuropathic pain was recognized when the pain complaints presented like shock-like pain, or burning pain (Treede et al., 2008). Thus, in total, 117 patients (35 males, mean age±SD = 42.9±14.2 years) were included.

Protocol overview

Prior to their intake appointment, as part of the regular procedure of the clinic of Oral Kinesiology of ACTA, all patients received a set of questionnaires that included a general health questionnaire and the depression and somatization subscale of the Dutch version of the Symptom Checklist 90 (SCL-90) (Dworkin and LeResche, 1992; Lobbezoo et al., 2005). After the intake visit, patients who agreed to participate in the study underwent an additional standardized clinical examination and filled in the body drawing of the McGill pain questionnaire (Melzack, 1975).

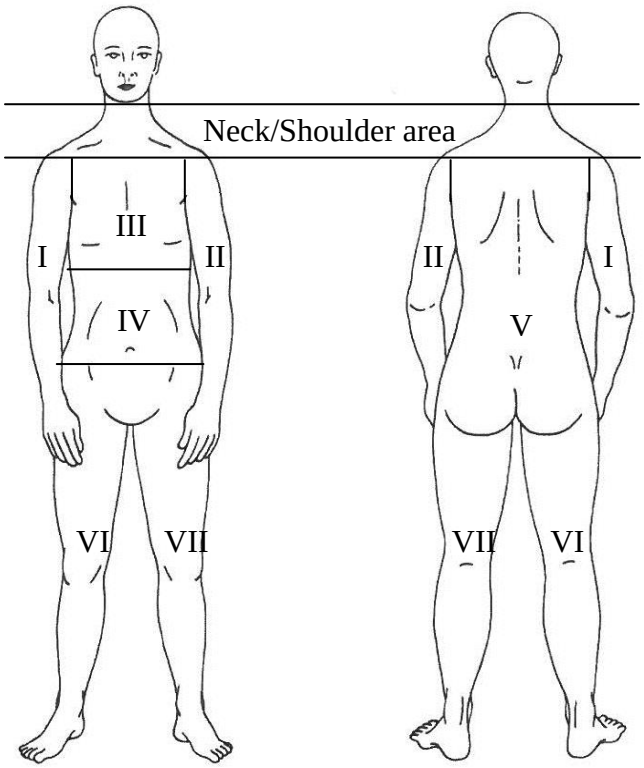

Figure 1. The pain drawing of the McGill pain questionnaire with the body areas' division as used for the analysis of the data.

Standardized clinical examination

The additional standardized clinical examination consisted of palpation tests and dynamic/static tests of the masticatory system. Following each palpation, dynamic, and static test, patients were asked whether or not the test had provoked any pain in the orofacial region. If so, patients were asked whether this pain was familiar or not. The term "familiar pain" was explained to the participants as the pain that resembled their complaints (Truelove et al., 2010; Visscher et al., 2009). The following was asked to the patients: "Do you recognize this pain as (part of) your complaint(s)?" The examination was performed by an examiner who was blind for the presence of orofacial pain complaints and comorbid factors (see below). The examiner was either a thoroughly trained dental student (N=4), or an experienced dentist specialized in TMD patients' management (MK). The students followed a thorough calibration course that included theoretical knowledge about the clinical examination and extensive training of clinical skills under the supervision of a calibrated examiner (MK).

Palpation of the masticatory system

The muscle and joint palpation sites described by the RDC/TMD (Dworkin and LeResche, 1992), with the exception of the intraoral sites and the posterior temporomandibular joint site, were palpated. The intraoral sites and the posterior temporomandibular joint site were excluded because they have a high rate of false positive results (Visscher et al., 2009) and are proposed to be excluded from future classification systems (Schiffman et al.). First, the sites at the left side of the face were examined and then those at the right side. In total, 14 sites were palpated. As specified by the RDC/TMD, a pressure of 2 lbs was applied to the following muscle palpation sites: the posterior, middle, and anterior part of the temporalis muscle, and the origin, body, and insertion of the masseter muscle. A pressure of 1 lb was applied to the posterior mandibular region (corresponding to the stylohyoid/posterior digastric muscles), the submandibular region (corresponding to the medial pterygoid, suprahyoid, anterior digastric muscles), and the lateral pole of the temporomandibular joint. In order to standardize the pressure applied, palpation was performed with the use of a custom-made algometer. The algometer had a stainless-steel handgrip and had a round tip covered with rubber with a diameter of 1 cm. The examiner was holding the algometer perpendicular to the skin above the muscle bulge or the temporomandibular joint. With the use of custom-made software, the examiner received visual feedback on a computer screen while examining the muscles or the temporomandibular joints. The feedback corresponded to a standardized increase of the pressure by 30 kPa/sec until reaching a plateau of 2 lbs or 1 lb, depending on the palpation site. This plateau was kept constant for 3 sec. Then patients were asked whether the test provoked any pain and whether the provoked pain resembled their complaints.

Dynamic/static tests of the masticatory system

The dynamic and static tests (Naeije and Hansson, 1986; Visscher et al., 2007; Visscher et al., 2009) were performed in the following movement directions of the mandible: opening, closing, and protrusion. During dynamic tests, patients performed mandibular movements while the examiner applied a slight manual counter pressure to the movement. During static tests, patients were instructed to hold the mandible motionless, while the examiner gradually increased a manual counter pressure, until either the patient or the examiner reached their maximal effort. This effort was then maintained for about 3 seconds (Visscher et al., 2009). Then patients were asked whether the test provoked any pain and whether the provoked pain resembled their complaints.

Primary predictor – TMD pain

To avoid circularity, the presence of TMD pain cannot be established with the use of the diagnostic tests under study. Since other causes of orofacial pain than TMD pain (e.g., dental pain and neuropathic pain) were excluded, patients reporting pain in the orofacial region were classified as having TMD pain (N=75). When there was no report of orofacial pain at all, they were presumed not to have a TMD pain (N=42).

Comorbid factors (other physical and psychological complaints)

Regional (neck/shoulder) pain and widespread pain: The body drawing of the McGill Pain Questionnaire was used to determine the presence of regional (neck/shoulder) pain and widespread pain (Fig. 1.). After excluding the orofacial area, the body drawing was divided in two parts: the neck/shoulder area (corresponding to regional pain) and the rest of the body (corresponding to widespread pain) (Turp et al., 1997; Visscher et al., 2001a). The "neck/shoulder" area was rated as a separate variable (i.e., not incorporated in the "widespread pain" variable), because of the close association between TMD and cervical spine disorders (De Laat et al., 1998; Visscher et al., 2001b). When pain was marked on the neck/shoulder region, patients were classified as having regional pain, otherwise they were classified as not having regional pain. To rate widespread pain, the body area below the neck and shoulders was divided into seven parts, viz., the right arm, the left arm, the chest, the abdomen, the back, the right leg, and the left leg (Lobbezoo et al., 2004). The total number of painful body areas (ranging from 0-7) was used as an indication of the degree of widespread pain (Fig. 1).

Depression and somatization: These measures were scored with the Dutch version of the SCL-90 (Arrindell and Ettema, 1981). The depression scale assesses negative mood and vegetative symptoms of poor functioning, while the somatization scale assesses distress related to bodily symptoms, such as faintness and stomach upset. The shortened somatization scale, excluding the four pain-related questions, was used in order to avoid confounding with the variables assessing TMD pain or other physical pain complaints (van Selms et al., 2009). Each item of the depression and somatization scale is rated on a five-point Likert scale, ranging from 1 (not at all) to 5 (very much). The total score, taking into account the patient's gender, classifies the patient into one of the 7 categories regarding the severity of the depression and somatization (ranging from very low to very high; 1-7) (Arindell and Ettema, 2003). Finally, the outcomes were dichotomized: patients with scores $\geq$6 (representing high and very high levels of depression and somatization, respectively) were classified as depressed/highly somatized. The others were classified as not-depressed/low on somatization, respectively (Derogatis and Cleary, 1977).

Statistical analysis

To study whether the outcomes of the clinical tests (i.e., palpation and dynamic/static tests) 1) were influenced by the presence of comorbidity and 2) were improved by the addition of the term "familiar" to the pain response, multiple logistic regression models were built for four outcome measures:

- pain on palpation tests
- familiar pain on palpation tests
- pain on dynamic/static tests
- familiar pain on dynamic/static tests

When the patient indicated that orofacial pain was provoked by at least one of the 14 palpation tests, the outcome of the variable 'pain on palpation' was considered positive (scored as 1). When at least one of these pain responses on palpation was recognized as a familiar pain, the variable 'familiar pain on palpation' was considered positive (scored as 1). In all other cases, 'pain on palpation' and 'familiar pain on palpation' were considered absent (scored as 0). Similar rules applied for the classification of 'pain on dynamic/static tests' and 'familiar pain on dynamic/static tests'.

For each outcome variable, first its associations with the primary predictor (TMD pain) and with the comorbid factors [i.e., regional (neck/shoulder) pain, widespread pain, depression, and somatization] were assessed by single logistic regression analyses. Variables that showed at least a moderate association with the outcome variable (i.e., p-value ≤ 0.10) were entered in the multiple regression analysis. Then, the factor with the weakest, non-significant association with the outcome variable was removed from the multiple regression model. This was repeated in a backward stepwise manner until all variables that were retained in the model showed a p-value ≤ 0.05. All regression models (single and multiple) were corrected for age and gender. Odds ratios (ORs) and their 95% confidence intervals (CIs) were estimated in all analyses.

RESULTS

Table 1 shows descriptive data of the responses to the clinical tests and the outcomes of the primary predictor (TMD pain) and the comorbid factors (regional pain, widespread pain, somatization, and depression). Results of the single and multiple regression analyses are presented in Tables 2 to 5, and are also illustrated in Fig. 2.

Single regression models suggested that "pain on palpation" was not only associated with the presence of TMD pain but also with all of the comorbid factors (regional pain, widespread pain, somatization, and depression). When entered into the multiple regression model, the associations with the primary predictor (TMD pain) and with depression were lost, and only the association with regional pain and somatization was retained in the model (Table 2).

"Familiar pain on palpation" was also associated with all of the predictive factors (single regression analyses). The multiple regression model showed that the association with the primary predictor was retained in the final model, but the association with "widespread pain" remained also present (Table 3).

Single regression models suggested that "pain on dynamic/static tests" was associated with the primary predictor (TMD pain) and the psychological comorbid factors (depression and somatization), but not with the physical comorbid factors (regional and widespread pain). When entered into the multiple regression model, the association with the primary predictor (TMD pain) and also with somatization was retained in the model (Table 4).

"Familiar pain on dynamic/static tests" was also associated with the presence of TMD pain and the psychological comorbid factors (single regression analyses). When entered into the multiple regression analysis though, "familiar pain on dynamic/static tests" was only associated with the primary predictor (TMD pain) and not anymore with any of the comorbid factors (Table 5).

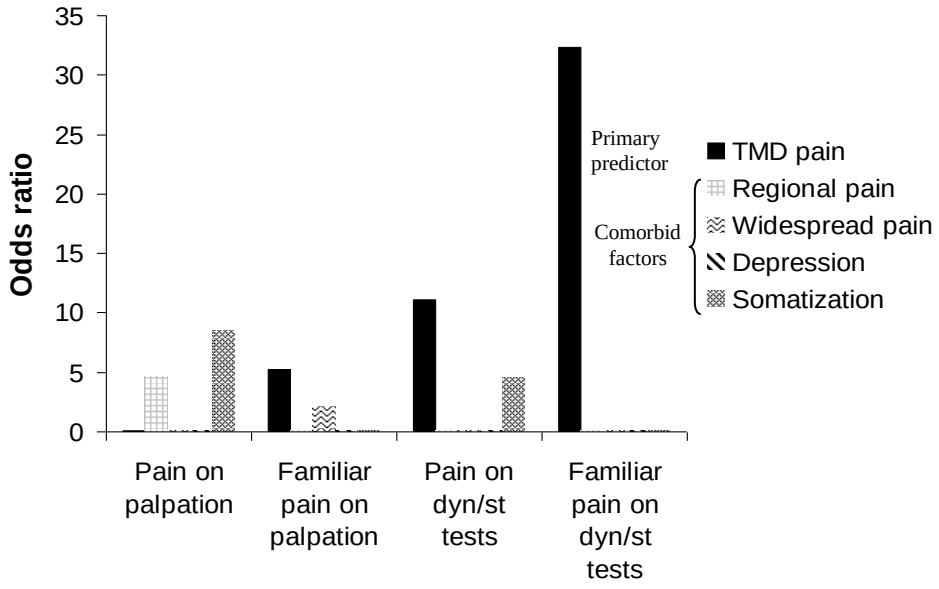

Figure 2. Diagram with the results representing the Odds Ratios of the predictors of the multiple regression analyses for each outcome variable.

Table 1. Descriptives showing the number of participants that responded positively or negatively on the predictive variables (primary predictor and comorbid factors) and on the diagnostic tests. For the comorbid factor "Widespread pain", the median value and the range are reported.

		Palpation tests				**Dynamic/Static tests**			
		Pain		Familiar pain		Pain		Familiar pain	
		No (N=58)	Yes (N=59)	No (N=74)	Yes (N=43)	No (N=63)	Yes (N=54)	No (N=69)	Yes (N=48)
Primary predictor									
TMD pain	No (N=42)	29	13	36	6	37	5	40	2
	Yes (N=75)	29	46	38	37	26	49	29	46
Comorbid factors									
Regional pain	No (N=90)	52	38	64	26	52	38	56	34
	Yes (N=27)	6	21	10	17	11	16	13	14
Depression	No (N=93)	50	43	63	30	54	39	58	35
	Yes (N=24)	8	16	11	13	9	15	11	13
Somatization	No (N=96)	54	42	67	29	58	38	61	35
	Yes (N=21)	4	17	7	14	5	16	8	13
Widespread pain*		0(0-4)	0(0-5)	0(0-4)	0(0-5)	0(0-5)	0(0-5)	0(0-5)	0(0-5)

Table 2. Regression analyses for pain on palpation tests (N=117)

Pain on palpation

	single regression				multiple regression			
	b	p-value	OR	95% CI	b	p-value	OR	95% CI
Primary Predictor								
TMD pain (no/yes)	1.15	**0.01**	3.16	1.32-7.57				
Comorbid factors								
Regional pain (no/yes)	1.97	**0.001**	7.13	2.14-23.81	1.53	**0.02**	4.59	1.28-16.57
Widespread pain (0-7)	0.69	**0.003**	1.99	1.27-3.14				
Depression (no/yes)	1.19	**0.033**	3.29	1.10-9.86				
Somatization (no/yes)	2.56	**0.001**	12.87	2.71-61.14	2.14	**0.011**	8.47	1.63-44.05

The interaction between the variables retained in the multiple regression model was not significant (p-value=0.8). All regression models were corrected for age and gender. Significant results are highlighted with bold letter types (b = regression coefficient, OR = odds ratio; 95% CI = 95% confidence interval).

Table 3. Regression analyses for familiar pain on palpation tests (N=117)

Familiar pain on palpation

	single regression				multiple regression			
	b	p-value	OR	95% CI	b	p-value	OR	95% CI
Primary predictors								
TMD pain (no/yes)	1.7	**0.001**	5.49	1.97-15.29	1.653	**0.003**	5.225	1.76-15.53
Comorbid factors								
Regional pain (no/yes)	1.69	**0.002**	5.46	1.91-15.58				
Widespread pain (0-7)	0.71	**0.001**	2.04	1.35-3.06	0.703	**0.001**	2.02	1.32-3.09
Depression (no/yes)	1.19	**0.025**	3.29	1.16-9.31				
Somatization (no/yes)	2.26	**0.001**	9.55	2.42-37.61				

The interaction between the variables retained in the multiple regression model was not significant (p-value=0.67). All models were corrected for age and gender. Significant results are highlighted with bold letter types (b = regression coefficient, OR = odds ratio; 95% CI = 95% confidence interval).

Table 4. Regression analyses for pain on dynamic/static tests (N=117)

Pain on Dyn/St tests

	single regression				multiple regression			
	b	p-value	OR	95% CI	b	p-value	OR	95% CI
Primary predictor								
TMD pain (no/yes)	2.62	**<0.001**	13.78	4.63-40.96	2.41	**<0.001**	11.08	3.68-33.36
Comorbid factors								
Regional pain (no/yes)	0.72	0.131	2.06	0.81-5.26				
Widespread pain (0-7)	0.21	0.219	1.24	0.88-1.73				
Depression (no/yes)	1.05	**0.042**	2.86	1.04-7.85				
Somatization (no/yes)	1.99	**0.002**	7.36	2.05-26.48	1.51	**0.037**	4.50	1.09-18.57

The interaction between the variables retained at the multiple regression model was not significant (p-value=0.14). All models were corrected for age and gender. Significant results are highlighted with bold letter types (b = regression coefficient, OR = odds ratio; 95% CI = 95% confidence interval).

Table 5: Regression analyses for familiar pain on dynamic/static tests (N=117)

Familiar pain on Dyn/St tests

	single regression				multiple regression			
	b	p-value	OR	95% CI	b	p-value	OR	95% CI
Primary predictor								
TMD pain (no/yes)	3.48	**<0.001**	32.37	7.01-149.53	3.48	**<0.001**	32.37	7.01-149.53
Comorbid factors								
Regional pain (no/yes)	0.59	0.214	1.81	0.71-4.62				
Widespread pain (0-7)	0.21	0.229	1.23	0.88-1.73				
Depression (no/yes)	0.88	**0.084**	2.42	0.89-6.56				
Somatization (no/yes)	1.29	**0.026**	3.64	1.17-11.33				

Significant results are highlighted with bold letter types (b = regression coefficient, OR = odds ratio; 95% CI = 95% confidence interval).

DISCUSSION

To our knowledge, this is the first study that investigated the effects of comorbidity on the outcomes of diagnostic tests for musculoskeletal pain in the orofacial region. The results indicated that the presence of comorbidity influences the outcomes of both palpation and dynamic/static tests, especially when "pain" is used as outcome measure. The use of "familiar pain" reduced the influence of comorbidity for both clinical tests: for palpation, the primary predictor (TMD pain) was now retained in the final multiple regression model, whereas for dynamic/static tests the use of familiar pain even eliminated the influence of comorbid factors.

Several methodological aspects of the study need to be addressed. First of all, different examiners performed the standardized clinical examination. The use of different examiners is a problem when the interexaminer reliability of the clinical tests is poor. For the palpation tests and the dynamic/static tests that were used in this study, the interexaminer reliability of well-trained examiners, either students or calibrated examiners, has been found to be fair-to-good to excellent (Dworkin et al., 1990; Leher et al., 2005; Look et al., 2010; Visscher et al., 2007). Since all examiners received intensive training before participating in the clinical examination, the reliability is expected to be at least fair-to-good also.

Second, the recognition of TMD pain was mainly based on exclusion of other causes for orofacial pain. Usually, the presence of TMD pain is based on the results of an oral history and a clinical examination of the masticatory system. However, to avoid circularity (Cohen and Quintner, 1993), the results of the clinical examination could not be used for the recognition of TMD pain. The most prevalent cause of pain in the orofacial region is dental pain (de Leeuw, 2008), which was objectified and excluded by the patients' pain description and a thorough dental examination. The presence of neuropathic pain was excluded according to the criteria of the Special Interest Group on Neuropathic Pain of the International Association for the Study of Pain (Treede et al., 2008). Other causes of orofacial pain, like vascular pain or referred pain from the neck/shoulder area, are rare causes of pain in the patient population referred to our clinic. Hence, it is likely that most, if not all, pain patients included in the study were indeed suffering from TMD pain.

A clinical test for the recognition of musculoskeletal pain should only be associated with the patients' local musculoskeletal pain complaint (TMD pain) and not with comorbid factors. Our findings indicated that comorbidity influences both the outcomes of palpation and of dynamic/static tests for the recognition of TMD pain. For example, the regression analyses showed that pain on palpation is mostly related to the presence of neck/shoulder pain and somatization. Previous studies have also indicated that the validity of palpation (Truelove et al., 2010) and of dynamic/static tests (with the presence of pain as outcome measure) is insufficient (Visscher et al., 2009). In those study populations, however, comorbidity was not taken into consideration, which might explain the

insufficient validity of the clinical tests. The current findings indicated that the use of the presence of familiar pain as outcome measure, reduced the influence of comorbidity on both palpation and dynamic/static tests. "Familiar pain" has only recently been introduced in the scientific orofacial pain literature (Staud, 2009; Visscher et al., 2009). When familiar pain was used, the outcomes of dynamic/static tests were only associated with the presence of TMD pain and not with any of the comorbid factors. Even with the presence of familiar pain as the outcome measure, palpation was still also associated with widespread pain. This may confirm the assumption that palpation is more related to a generalized hypersensitivity (Diatchenko et al., 2006; Treede et al., 2002) than to local musculoskeletal complaints. Hypersensitivity is caused by complex neurophysiological mechanisms characterized by a heightened pain sensitivity and/or reduced pain inhibition (Staud, 2009). This results in decreased pain thresholds (Staud, 2009) and may lead to an increased pain reaction to clinical tests, like palpation.

The positive effect of the use of "familiar pain" as outcome measure in the clinical tests for the recognition of musculoskeletal pain in the orofacial region, suggests that it might probably improve diagnostic tests for other musculoskeletal pains as well, like low-back pain, or even other kinds of pain. This should be taken into account when patients with comorbid factors are evaluated for musculoskeletal complaints. The use of familiar pain may prevent over-diagnosis and unnecessary treatment.

In conclusion, diagnostic tests for musculoskeletal pain in the orofacial region are negatively influenced by the presence of comorbidity. This influence is decreased when the presence of familiar pain is used as outcome measure.

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