Validation of the Temporomandibular Disorder Pain Screener in a Specialized Headache Center

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Aims: To investigate the sensitivity and specificity of the TMD pain screener in a headache population. **Methods:** A cross-sectional study was conducted at the Danish Headache Center (DHC). Patients were included if they had primary or secondary headache, trigeminal neuralgia, or facial pain. The pain screener was compared to the outcome of a full Diagnostic Criteria for TMD (DC/TMD) examination. **Results:** A total of 62 headache patients were included (77% women). The sensitivity of the pain screener short version (three questions) was 85% (95% CI: 70% to 94%), and the specificity was 64% (95% CI: 41% to 83%). In the full version (six questions), the sensitivity was 83% (95% CI: 67% to 93%), and the specificity was 82% (95% CI: 60% to 95%). **Conclusion:** The TMD pain screener seems to be a valid tool to accurately screen for the presence of TMD to provide the most optimal treatment for headache patients. These findings should however be confirmed in a larger sample with migraine, tension-type headache, and trigeminal neuralgia. *J Oral Facial Pain Headache 2021;35:150–156. doi: 10.11607/ofph.2787*

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Headache disorders are highly prevalent and have a profound socioeconomic impact.[1,2] Approximately one in two headache patients who visit a specialized headache clinic have a temporomandibular disorder (TMD).[3] TMD is an umbrella term for complaints and disorders in the masticatory system.[4,5] Common symptoms are pain in the jaw area or temporomandibular joint (TMJ), joint noises, and earache and/or headache.[5] Headache is present in 67% to 85% of patients with TMDs, with migraine being the most prevalent (23% to 60%), followed by tension-type headache (TTH; 30% to 38%) and headache attributed to TMD (section 11.7 of the International Classification of Headache Disorders [ICHD-3][6]; prevalence 5%).[7–9] Headache attributed to TMD is a direct symptom of TMD, but shares several features with TTH.[6,10–12] The location of bilateral TTH headache overlaps the temporal muscle, which is the location of headache attributed to TMD. Additionally, the pain intensity from both headaches is mild to moderate and usually does not present itself with extensive accompanying symptoms such as photo-/phonophobia, nausea, or vomiting.[6,10–12] The overlap in the area of pain presentation leads to diagnostic challenges of differentiating headache types when TMD pain is present. A proper diagnosis is required to give the patient the treatment they need, as these two headaches have different treatment approaches.[13–15] The ability to identify a TMD improves the ability to diagnose headaches correctly.

TMDs can be diagnosed based on a thorough examination that applies the Diagnostic Criteria for TMD (DC/TMD),[4] which looks at several aspects of jaw function and pain provocation. It is recommended that clinicians follow a special training course for optimal reliability in the assessment of all TMDs.[16] This examination therefore needs to be performed by a specialized dentist or physical therapist. Headache patients are often seen by a neurologist or a general practitioner, who, ideally, should screen for the presence of TMDs. Then, suspected TMD patients can be referred for further TMD examination and treatment if necessary.

For this purpose, the TMD pain screener is advised by the International Network for Orofacial Pain and Related Disorders Methodology (INfORM).[4,17] The Danish translation of the pain screener has been used in studies and published in scientific journals (eg, Skeie et al[18]). The English version of the six-item pain questionnaire has been validated in orofacial pain populations, but not in a population seen in a specialized tertiary headache center.[17,19]

The aim of this study was to establish the validity, expressed in sensitivity and specificity, of the TMD pain screener in a tertiary headache center population. It was hypothesized that the TMD pain screener would accurately identify the presence of a painful TMD in a headache population.

Materials and Methods

This study was conducted according to the Standards for Reporting Diagnostic accuracy studies (STARD)[20] and pre-registered at clinicaltrials.gov (NCT04193111). Ethical approval of this study was granted by the Danish Scientific Ethical Committee Capital Region (approval number H-19016296).

Study Design and Participants

A cross-sectional study with a blinded examiner (H.v.d.M.) was conducted at the Danish Headache Center (DHC), Rigshospitalet Glostrup, Glostrup, Denmark. Applying convenience sampling, all patients entering the clinic in a 10-day period in December 2019 were asked to participate in this study. Written consent was obtained from all patients before participation.

To be included, patients had to: *(1)* be at least 18 years of age; *(2)* have a confirmed headache diagnosis based on the ICHD-3; *(3)* be able to read Danish; and *(4)* be able to communicate in English. Exclusion criteria were: *(1)* difficulty communicating with the researcher; *(2)* a known, diagnosed pre-existing TMD or orofacial condition that may cause headache and treatment for such a condition; and *(3)* had anamnestic or clinical signs of a condition of any kind considered relevant by the physician (ie, cancer).

Index Test

The index test was the TMD pain screener, which is a questionnaire containing six questions about different aspects of orofacial pain.[17] It exists as a full version and as a short version (three questions).[17,21] For each question, except for the first, 1 point can be obtained. The maximum score for the first question is 2 points. If a patient scores ≥ 2 points in the first three questions, they score positive on the short screener. When all six questions are used (ie, the full version), a patient needs to score ≥ 3 points to have a positive score.[17]

Reference Test

The DC/TMD protocol was used as the reference test, which consisted of the Symptom Questionnaire (SQ), followed by a physical examination.[4] This protocol was executed blindly, in English, by a researcher (H.v.d.M.) who is a physical therapist specialized in orofacial pain and trained in the DC/TMD protocol by dentists from the Academic Center of Dentistry Amsterdam. Classification of the TMD diagnoses was done according to the DC/TMD, and patients were diagnosed with a painful TMD when they met the criteria for myalgia, arthralgia, or headache attributed to TMD.[4]

Test Methods

A neurologist evaluated all patients at the time of the first visit to the DHC. A headache diagnosis was established according to the ICHD-3 based on a headache diary, interview, and neurologic examination. The headache diagnoses were extracted from the patient's medical records. In case patients had more than one headache diagnosis, they were asked which one was most bothersome. In this text, this headache is therefore described as "first headache."

The patients first received and filled out the Danish translation of the TMD pain screener (index test). Then they were seen by a neurologist or a physical therapist for a follow-up consultation (Fig 1). If the patients fulfilled the inclusion criteria and agreed to participate in the study, they underwent a full DC/TMD examination protocol. The examiner was blinded to the headache diagnosis and results of the TMD pain screening. All participants filled out the SQ in Danish—as well as a questionnaire regarding their current facial pain, current headache pain intensity, and their medication use—before the physical examination protocol. Based on the answers on the SQ and the findings from the examination, one or more TMD diagnoses were established.

The research data were collected and entered in a database by two researchers (H.v.d.M. and B.K.M.).

Analysis

The diagnostic accuracy, depicted by sensitivity and specificity, was calculated by comparing the results of the TMD pain screener to the reference standard, the DC/TMD diagnosis. Two cut-off points were used for the TMD pain screener, as described in the original version: ≥ 2 points for the short version of the screener, and ≥ 3 points for the full screener. As the TMD pain screener gives an indication for the presence of a TMD pain diagnosis, patients were stratified based on a positive TMD pain diagnosis (eg, myalgia, arthralgia) or a negative TMD pain diagnosis. In addition to sensitivity and specificity, the positive likelihood ratio (LR+) and the negative like-

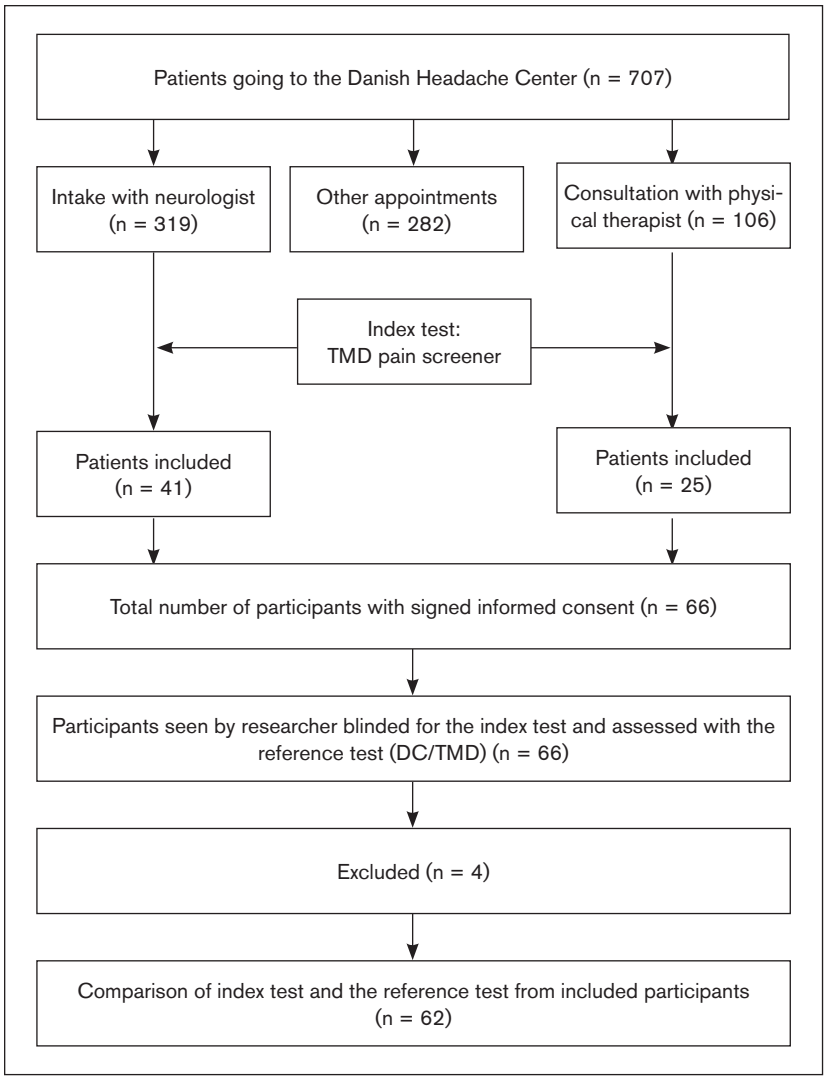

Fig 1 Flowchart of participant inclusion and methods used in the present study.

lihood ratio (LR–) were calculated based on the findings of the current study. Likelihood ratios could range from 0 to infinity, where values greater than 1 increased the probability of the disorder present (LR+) and values below 1 decreased the probability of the disorder present (LR–). Additionally, the positive predictive value (PPV) and negative predictive value (NPV) were calculated based on the prevalence of TMD in a headache clinic from other studies.[3,22]

Analysis of the data was performed using the Statistical Package for Social Sciences version 24.0 (IBM).

Results

Of the 425 patients visiting the neurologist or physical therapist, a total of 66 fulfilled the inclusion criteria and signed an informed consent form (Fig 1). Two participants were excluded due to a language barrier, and two were excluded because they had just received injections with botulinum toxin and therefore could not take part in the complete DC/TMD examination. From the included 62 patients, 77% were women, and the mean age was 38 years (SD = 2). Almost two-thirds of the sample had a myalgia diagnosis (63%), and migraine was the most common first headache in this sample (34%). Twenty-two patients did not have a painful TMD, of which 5 did have a TMJ disorder (ie, disc displacement, degenerative joint disease, or subluxation). The 28 patients who received a headache attributed to TMD were all "new" diagnoses, meaning this headache diagnosis was previously unknown before the DC/TMD examination. The patient characteristics are depicted in Table 1. If they had more than one headache, two were registered. In some cases, the patient did not provide information on all the questions regarding characteristics; for example, describing only the maximum pain intensity and not the current pain intensity. Therefore, there are some missing values.

Validity of the TMD Pain Screener

Short version

Of the sample, 32% had a score < 2 points on the short TMD pain screener, which indicated that 68% answered positively and experienced a painful TMD disorder. There were 8 false-positive cases and 6 false-negative cases, resulting in a sensitivity of 85% and a specificity of 64%. The overall diagnostic accuracy of the short TMD pain screener was 77%. All clinimetric values are depicted in Table 2.

Full version

Of the sample, 60% scored ≥ 3 points on the full TMD pain screener, which is indicative

Table 1 Patient Characteristics

	Total sample (N = 62)	< 3 points on TMD pain screener (n = 25)	≥ 3 points on TMD pain screener (n = 37)
Women, n (%)	48 (77.4)	19 (76.0)	29 (78.4)
Mean ± SD age, y	37.5 ± 11.9	39.7 ± 11.9	36.1 ± 11.8
HA days last month, mean ± SD	20.9 ± 9.8	18.3 ± 9.0	22.7 ± 10.0
Missing, n	2	0	2
Current HA pain intensity, mean ± SD (0–10 NRS)	3.7 ± 2.5	2.8 ± 2.9	4.3 ± 2.1
Missing, n	5	3	2
Maximum HA pain intensity, mean ± SD (0–10 NRS)	7.1 ± 2.4	6.2 ± 2.8	7.6 ± 2.0
Missing, n	0	0	0
Current facial pain intensity, mean ± SD	2.5 ± 2.6	1.4 ± 2.1	3.1 ± 2.7
Missing, n	6	4	2
Maximum facial pain intensity, mean ± SD	4.3 ± 3.1	2.6 ± 2.8	5.5 ± 2.6
Missing, n	2	1	1
First HA, n (%)			
Migraine	21 (33.9)	10 (40.0)	11 (29.7)
Episodic TTH	7 (11.3)	3 (12.0)	4 (10.8)
Chronic TTH	11 (17.7)	5 (20.0)	6 (16.2)
Cluster headache	4 (6.5)	3 (12.0)	1 (2.7)
Atypical facial pain	2 (3.2)	1 (4.0)	1 (2.7)
Posttraumatic HA	11 (17.7)	1 (4.0)	10 (27.0)
Hemicrania continua	1 (1.6)	0 (0.0)	1 (2.7)
HA after surgery	1 (1.6)	0 (0.0)	1 (2.7)
IIH	1 (1.6)	0 (0.0)	1 (2.7)
New DPH	1 (1.6)	1 (4.0)	0 (0.0)
MOH	2 (3.2)	1 (4.0)	1 (2.7)
Second HA, n (%)	**(n = 28)**	**(n = 15)**	**(n = 13)**
Migraine	12 (19.4)	7 (28.0)	5 (13.5)
Episodic TTH	8 (12.9)	3 (12.0)	5 (13.5)
Chronic TTH	3 (4.8)	1 (4.0)	2 (5.4)
Cluster headache	1 (1.6)	0 (0.0)	1 (2.7)
Atypical facial pain	1 (1.6)	1 (4.0)	0 (0.0)
Posttraumatic HA	1 (1.6)	1 (4.0)	0 (0.0)
Hemicrania continua	0 (0.0)	0 (0.0)	0 (0.0)
HA after surgery	0 (0.0)	0 (0.0)	0 (0.0)
IIH	2 (3.2)	2 (8.0)	0 (0.0)
New DPH	0 (0.0)	0 (0.0)	0 (0.0)
MOH	0 (0.0)	0 (0.0)	0 (0.0)
DC/TMD diagnosis, n (%)[a]			
Myalgia	39 (62.9)	7 (28.0)	32 (86.5)
MFP with RP	17 (27.4)	3 (12.0)	14 (37.8)
Arthralgia	10 (16.1)	1 (4.0)	9 (24.3)
HA attributed to TMD	28 (45.2)	5 (20.0)	23 (62.2)
TMJ disorder[b]	20 (32.8)	6 (24.0)	14 (38.9)
No painful TMD	22 (35.5)	14 (56.0)	4 (10.8)
No TMD diagnosis	17 (27.4)	11 (44.0)	6 (16.2)

TTH = tension-type headache; HA = headache; IIH = intercranial idiopathic hypertension; DPH = daily persistent headache; MOH = medication overuse headache; MFP = myofascial pain; RP = referred pain; NRS = numeric pain rating scale.
[a]Participants could have more than one TMD diagnosis.
[b]Disc displacement, degenerative joint disease, or subluxation.

of the presence of a painful TMD. There were 4 false-positive cases and 7 false-negative cases. The overall diagnostic accuracy of the TMD pain screener full version was 82%, based on a sensitivity of 83% and specificity of 82%. All clinimetric values are depicted in Table 2.

Discussion

This study is the first, to the authors' knowledge, to examine the validity of the TMD pain screener on a diagnosed headache sample in a headache center. The main findings were that the full version has a better diagnostic accuracy (82%) compared to the short version (77%). It was hypothesized that the TMD pain

Table 2 Diagnostic Accuracy and Associated Clinimetric Values of the TMD Pain Screener Short and Full Versions

		Painful DC/TMD diagnosis			Clinimetric values					
		Absent	Present	Total	Sensitivity (95% CI)	Specificity (95% CI)	LR+ (95% CI)	LR– (95% CI)	PPV (95% CI)	NPV (95% CI)
TMD pain screener short version	< 2 points	14	6	20	85.0 (70.2–94.3)	63.6 (40.7–82.8)	2.3 (1.3–4.1)	0.2 (0.1–0.5)	81.0 (70.7–88.2)	70.0 (51.1–83.9)
	≥ 2 points	8	34	42						
	Total	22	40	62	Diagnostic accuracy: 77.4 (65.0–87.1)					
TMD pain screener full version	< 3 points	18	7	25	82.5 (67.2–92.7)	81.8 (59.7–94.8)	4.5 (1.9–11.1)	0.2 (0.1–0.4)	89.2 (77.1–95.3)	72.0 (56.1–83.8)
	≥ 3 points	4	33	37						
	Total	22	40	62	Diagnostic accuracy: 82.3 (70.5–90.8)					

DC/TMD = Diagnostic Criteria for Temporomandibular Disorders; LR+ = positive likelihood; LR– = negative likelihood; PPV = positive predictive value; NPV = negative predictive value.

screener would accurately identify the presence of a painful TMD in a headache sample. The hypothesis was confirmed through patients with different types of headaches and orofacial pain who participated in this study.

In the original study developing and validating the TMD pain screener, the authors described the validity in a group of patients with painful TMD compared to healthy controls and patients with a nonpainful TMD.[17] Within these two control groups, they defined a subgroup of those having a headache in the temple region, but without having a painful TMD diagnosis. They found a sensitivity of 99.1% for both the short and full versions, and a specificity of 95.6% and 97.8%, respectively.[17] However, it is unknown which headache types these patients were diagnosed with based on the ICHD-2, except for the absence of a headache attributed to TMD. The strength of the current study is the inclusion of a sample with validated headache diagnoses according to the ICHD-3, as well as the inclusion of headache patients with and without a painful TMD. Just as in the original study, the current study found that the diagnostic accuracy of the TMD pain screener is higher for the full version (≥ 3/7 points), as well as the positive likelihood ratio. This could be because the full version asks more about function-related complaints, which are more likely to be present with a TMD rather than a (primary) headache or headache not attributed to TMD.[6,23] Therefore it is recommended to use the full version in a headache clinic.

In other populations, the diagnostic accuracy of the TMD pain screener is often acceptable.[19,24] When trying to distinguish patients with odontogenic pain from patients with a painful TMD, the TMD pain screener was able to identify those with a painful TMD (sensitivity = 92%), but was not able to fully exclude those with odontogenic pain (specificity = 59%).[19] It is therefore important to exclude the presence of odontogenic pain with an examination by a dental professional, as this is the most common pain in the orofacial area followed by TMDs.[5,25] However, not every headache center has a dentist or TMD expert, nor do all patients have access to proper dental care and treatment of TMDs.[26,27] For this reason, a dental pain screening questionnaire was also developed and validated,[28] though it is not yet validated in patients with headache.

To make the outcome of this study clinically applicable, all patients who came to the headache center were included, and no exclusion criteria were applied for those who had trigeminal neuralgia or atypical facial pain. This makes the sample in the current study representative of all patients who go to a specialized headache clinic. There were only two patients with atypical facial pain within this study, and they were divided between the TMD-positive and TMD-negative groups, so this sample did not have an effect on the outcome of the validity of the TMD pain screener. Interestingly, even though most headache types are well distributed between the positive and negative groups on the TMD pain screener, this is not the case for patients with posttraumatic headache. Almost all patients with posttraumatic headache scored positive on the TMD pain screener and were also diagnosed with a painful TMD disorder. However, it is difficult to explain the exact connection, since the impact of trauma in posttraumatic headache patients is highly complex and far from understood. It can, however, be speculated that the trauma had impact on the head, jaw, or TMJ directly, or that the structures and muscle function are influenced by the impact after a period of time.[29] However, no conclusions can be drawn per headache diagnosis group because these numbers are too small. With the current study, the diagnostic accuracy in a headache clinic in general where patients with different and multiple headache types present themselves is known. This study should be

seen more as a feasibility study for the screener in a headache clinic due to the low number of participants per specific headache diagnosis, and further research is needed to establish diagnostic accuracy for different headache groups.

This study has several limitations. First, the study sample was based on a convenience sample of patients and may be open to selection bias because this is a nonprobability type of sampling.[30] However, this sample represents an actual patient population as seen in a headache clinic, which makes the results easier to interpret in a clinical setting. A second limitation is that the DC/TMD examination was performed in English, which could have increased language bias. However, Danish people are fluent in English,[31] and all participants were asked about their English skill before the study and were excluded if they were unable to understand and speak English. So if there is a language bias, it should be minimal. Another linguistic bias may be translation bias, as the Danish version of the DC/TMD and the TMD pain screener have not yet been officially validated. Even though several research groups work with the Danish versions of these measurement instruments, the methods of translation are not yet published.[18,21] As the DC/TMD used in the current study is a preliminary version, there may be minor changes compared to the final validated version once published, which could potentially influence replication of this study. A fourth limitation is that there was no dental examination done to exclude the presence of odontogenic pain.

Future studies should assess the validity of the TMD pain screener in specific headache samples, especially in those that have a strong association with painful TMD, such as migraine,[7,8] and those that share clinical features, such as TTH.[6] Other diagnoses of orofacial pain resembling primary headaches should also be considered in future studies.[32] Furthermore, besides the Danish version of the TMD pain screener, other languages should also be studied to ensure validity when using the TMD pain screener in the clinic or for research purposes.

Conclusions

The TMD pain screener is a valid tool to use in a specialized headache center to identify the presence of a painful TMD, specifically when the full version is applied. In a group of patients with different headache diagnoses, the TMD pain screener has a good diagnostic accuracy and can therefore be used in a headache clinic.

Clinical Implications

- The TMD pain screener full version is a valid tool to identify a painful TMD in a population from a specialized headache center.
- Between different headache diagnoses, the TMD pain screener has a good diagnostic accuracy and can therefore be used in different headache populations.

Acknowledgments

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