# Quality and Content of Internet-Based Information on Temporomandibular Disorders

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***Aims:*** *To use a range of evaluation instruments to assess the content and quality of websites about temporomandibular disorders (TMD) and thereby provide guidance regarding the actual accuracy and comprehensiveness of the information of the sites.* ***Methods:*** *Sixty-seven websites resulting from an Internet search with the word "TMD" were evaluated using Journal of the American Medical Association (JAMA), DISCERN, and Health on the Net (HON) criteria, along with an evaluation method to assess the scientific quality of the website contents. Results were compared according to reviewer, website type, and presence of HON seal. One-way analysis of variance (ANOVA), Student* t *test, chi-square test, and Pearson correlation analysis were used as appropriate.* ***Results:*** *The mean content, HON, and DISCERN scores were 38.9%, below 50%, and 53.9% of the maximum possible score, respectively. Fewer than 50% of the sites displayed the author or reference of the information according to the JAMA benchmarks criteria. Every evaluation criteria showed good agreement among reviewers. Commercial websites were the most common, while sites of nonprofit organizations showed the highest content scores. The overall quality was poor to moderate for all website types.* ***Conclusion:*** *Sites concerning TMD were poorly organized and maintained. Also, most sites contained insufficient or scientifically incorrect information that could have a negative effect on the treatment outcome and prognosis of TMD. Clinicians should guide patients to reputable sources of information that will enhance patient comprehension and better treatment outcomes.* J OROFAC PAIN 2012;26:296–306

**Key words:** content, evaluation criteria, Internet, quality, TMD

Over the past two decades, the increasing use of the Internet has greatly affected the everyday practice of medical professionals and information acquisition of patients and the public in general. Currently, 28.7% of the world's total population has access to the Internet, and more than 50% (1.8 billion) of adults have been reported to use the Internet to gain health-related information at least once a month. The user growth of the Internet worldwide was an astonishing 444.8% from the year 2000 to 2010.[1,2] Patients have now gained the power to acquire as much information as their medical professional, and sometimes more, by searching the Internet for the most up-to-date and applicable health information. Compared with the quick growth of Internet usage to access health information, quality control and assessment of the existing online information have been relatively slow. Until now, the quality and content of Internet-based information has been assessed

for conditions such as gastrointestinal diseases, prostate cancer, orthopedic diagnoses, and depression.[3–6] Quality evaluation concerning online information on subjects in dentistry is relatively rare.[7–10] As a result, patients are easily misguided by low-quality information, and it is unclear to patients whether the information they access is complete, accurate, and timely.

Temporomandibular disorders (TMD) are a group of chronic pain disorders clinically characterized by pain and dysfunction in the masticatory muscles or temporomandibular joint (TMJ).[11] TMD are the most common form of chronic orofacial pain.[12] The etiology of TMD is regarded to be multifactorial, but the pathophysiology remains controversial.[11] The presence of chronic pain is known to have the potential to induce psychologic distress, notably depression and somatization.[13] Also, in spite of their clinical and empirical success, the noninvasive, nonsurgical therapies most commonly applied for the management of TMD have yet to overcome the controversy that exists concerning their effectiveness for TMD treatment.[14] Such a psychologic state and unclear treatment prognosis of chronic TMD pain renders the patient vulnerable and dependent on outside information, regardless of its quality. One study showed that 63% of chronic pain patients used the Internet to obtain pain-related medical information. Of these patients, more than 50% believed that the information was useful and credible.[15] Compared with the usage rate of the general population, chronic pain patients are about twice as likely to search the Internet for information concerning their pain condition.

However, only one previous study has attempted to assess online TMD information. However, this study was limited to assessing the quality of information on TMD in German and concluded that there is a lack of evidence-based, high-quality online information for patients seeking information related to TMD.[16]

There has been widespread concern about the quality of web-based health information, which has led to the development of a valid method for evaluating the quality of Internet health sites.[17,18] Such rating tools include DISCERN (www.discern.org.uk), an instrument designed to judge the quality of written information about treatment choices.[19] This tool is widely recommended and used by authoritative sources for the evaluation of websites.[20–22] *The Journal of the American Medical Association* (JAMA) benchmarks[23] and Health on the Net (HON) code[24] are also methods for health website evaluation.

The aim of this study was to use a range of evaluation instruments to assess the content and quality of websites about TMD and thereby provide guidance regarding the actual accuracy and comprehensiveness of the information of the sites. The results promised to provide both clinicians and patients with guidelines to distinguish between beneficial and misleading online information concerning TMD.

## Materials and Methods

### Selection of Websites

Websites were identified using two search engines: Google and Yahoo!. Both engines were accessed on April 26, 2011, with the search terms "temporomandibular disorders" and "temporomandibular joint disorders." Among the resulting sites of each search, the first 100 consecutive sites in common between the two search engines were visited and classified. The search was not restricted in terms of file format or domain, but was limited to the English language. Duplicate sites were excluded, as were nonoperative sites or those with denied direct access. Google and Yahoo! were selected for review on the basis of their popularity. Google especially is known to examine all aspects of page content and regularly update indexing by recalculating the page ranking of websites.[25] Furthermore, medical search engines have been proven to be no better than general search engines in sourcing consumer information relevant to health.[26] All websites were analyzed and graded by three reviewers, each with more than 5 years of clinical experience in TMD treatment. Prior to grading, an education session was held to enhance reviewers' understanding of the evaluating methods. At this session, 10 randomly selected websites were evaluated for mutual calibration. Grading was done within 4 weeks of the original search. This study was based on information acquired from the Internet. The study is exempt from institutional review board approval.

### Evaluation of Type and Content of Sites

Websites were categorized as academic, commercial, news-oriented, personal, physician, or nonprofit. Academic websites included those affiliated with a university, medical journal, or medical society. Commercial websites were those that received industry funding, displayed advertisements, or included devices or other products for sale. News-oriented websites included nonmedical sites with articles and other anecdotal stories about the specified diagnosis. Personal websites included nonphysician websites such as physical trainer or therapist

Table 1 Evaluation Criteria for the Content of Websites

| Category | Maximum points | Points per checkpoint | Checkpoints |
|---|---|---|---|
| Disease summary | 30 | 3 | Pain, mouth-opening limitation, biting or chewing difficulty, joint noise, headache, ear pain, malocclusion, muscle weakness, anatomy of TMJ, physical examination of TMJ |
| Etiology | 10 | 1 | Injury, parafunctional habit, skeletal malformation, bruxism, poor posture, stress, depression, anxiety, malocclusion, overuse of TMJ |
| Evaluation and diagnosis | 10 | 1 | Joint palpation, muscle palpation, history taking, mouth-opening measurement, radiographic examination, joint noise evaluation, intraoral evaluation, magnetic resonance imaging, psychological assessment, diagnostic joint injection |
| Treatment options | 30 | 4 | Stabilization splint, oral anti-inflammatory medications, physical therapy, 6 X 6 exercise |
| | | 2 | Behavioral modification, joint injection, botulinum toxin injection, joint manipulation, biofeedback, arthrocentesis, TMJ surgery |
| Complications of treatment | 10 | 2 | Tooth pain, malocclusion, acute mouth-opening limitation, skin irritation, pain |
| Prognosis and outcomes | 10 | 5 | Prognosis and treatment outcomes of nonsurgical treatment<br>Prognosis and treatment outcomes of surgical treatment |

websites or layperson blogs. Physician websites included professional sites for individual physicians, as well as physician groups not affiliated with an academic institution. Sites categorized as nonprofit included organizational websites operating from only government funding or donations, such as the National Institutes of Health (www.nih.gov) and Wikipedia (www.wikipedia.org). To determine site popularity, the Google ranking of links was used by entering each site's URL into the search string. Links within each site were pursued until all medical information on the topic was evaluated.[5] A range of 1 to 39 pages was evaluated for each site. Scientific content was compared with the latest peer-reviewed information about TMD.[27–35]

Since there were no previously established criteria to evaluate the TMD content of websites, criteria were developed based on previous studies evaluating other disease entities to evaluate the information more scientifically.[5,36,37] Unlike most studies limited to evaluating the user-friendliness or content of the website from the patients' perspective, these studies developed and applied a content score as a weighted score ranging from 0 (poor) to 100 (outstanding). Such criteria were designed to assess how well the contents educated the patient about the disease. The categories applied in this study were derived from the above studies,[5,36,37] while the specific check points were newly selected to best suit TMD.

The categories were overall disease summary, etiology, diagnostic tests, treatment options and complications, and prognosis and outcomes. A relative value was placed on each category, with a possible maximum of 100 points. The evaluation guidelines are presented in Table 1.

### Evaluation of Quality of Sites

The second section evaluated each website for quality on the basis of the HON criteria. The HON criteria were developed in 1996 by a Swiss-based nonprofit group with the objective of improving the quality of Internet-based health information. They are designed to monitor the transparency of website information and purpose.[24] Sites may display the HON code seal if they agree to comply with the standards listed, and they are subject to random audits for compliance. A custom 16-point method developed in a previous study was applied to include all key elements of the HON code and objectively assess the compliance of each site to the principles outlined by the HON code for responsible health information websites.[5] The categories that were evaluated included transparency and honesty, authority, privacy and data protection (ie, a policy on the use of personal information gathered as a result of using the website), updating of information, accountability, and accessibility. The evaluation guidelines are presented in Table 2.

Also, the presence of a displayed banner (HON seal) indicating the site's HON code-compliance was checked and recorded.

The quality of information of the selected websites was also assessed using the JAMA benchmarks.[23] These include a display of authorship of medical content, display of attribution or references, display of currency (date of update), disclosure

Table 2 Core Criteria for HON Code for Responsible Websites

| Item | Evaluation criteria | Points |
|---|---|---|
| Transparency and honesty | | |
| Transparency of provider of site | Name<br>Physical or electronic address | Absent (0)/present (1)<br>Absent (0)/present (1) |
| Objective of site | Defined on site | Unclear (0)/clear (1) |
| Target audience | Defined on site | Unclear (0)/clear (1) |
| Sources of funding | Transparency | Uncertain (0)/transparent (1) |
| Authority | | |
| Sources for information | Clarity of statement<br>Date of publication | None (0)/some (1)/all (2)<br>Absent (0)/present (1) |
| Authors of information | Names and credentials | None (0)/some (1)/all (2) |
| Privacy and data protection | Privacy and data protection policy<br>System for the processing of personal data | Absent (0)/present (1) |
| Updating of information | Clear and regular update with date of update displayed for each page | Unlisted (0)/listed (1) |
| Accountability | | |
| Accountability | User feedback | Absent (0)/present (1) |
| Oversight responsibility | Named quality compliance officer | Absent (0)/present (1) |
| Editorial policy | Procedure for selection of content clearly stated | Unclear (0)/clear (1) |
| Accessibility | | |
| Readability | Organization of topics without embedded advertisement | Unclear (0)/clear (1) |

HON, Health on the Net.

of ownership, sponsorship, advertising policies, or conflicts of interest.

The DISCERN instrument is a validated rating tool of 16 questions and can be used by health consumers or professionals alike.[19] The 16 questions are organized into three sections: questions 1 to 8 address the reliability of the publication and help users decide whether it can be trusted as a source of information relating to treatment choice, while questions 9 to 15 address specific details of the information relating to treatment alternatives. Question 16 corresponds to the global quality assessment at the end of the instrument. Each question is scored on a scale of 1 to 5 (where 1 indicates the publication is poor and 5 means the publication is of good quality).

There are no established criteria to assess the overall quality of a website based on scores resulting from evaluating methods. Some studies have defined a website having a score that is less than 33% of the maximum score as poor, 34% to 66% of the maximum score as medium, and 67% to 100% of the maximum score as excellent, while other studies have only defined a high- and low-quality website with a score that is 75% of the maximum score as a cutoff level.[5,25] In this study, websites with scores more than 75% of the maximum score of a certain evaluating method were considered high quality and those with a score less than 50% of the maximum score were considered low quality.

Finally, the Google PageRank of each site was investigated. Page rankings are based on the number and PageRank metric of all pages that link to it. The Google Toolbar's PageRank feature displays a page's PageRank as a number ranging from 0 (least popular) to 10 (most popular).[38] Figure 1 shows an overview of this study's website selection and evaluation process.

## Statistical Analysis

After grading was completed, raw data were evaluated to compare interobserver variability. The site categorizations were compared for agreement. In cases of disagreement between two types for a site, the final decision was assigned on the basis of whichever type was agreed on by two of the three reviewers. In cases in which each reviewer classified the site as a different type, the site was reviewed together and a consensus was reached.

Next, the interrater agreement of each evaluation score was assessed by calculating the Cohen kappa score. Data from all three reviewers were combined, and score comparisons for content score, HON score, and DISCERN score were made on the basis of the website type and analyzed by one-way

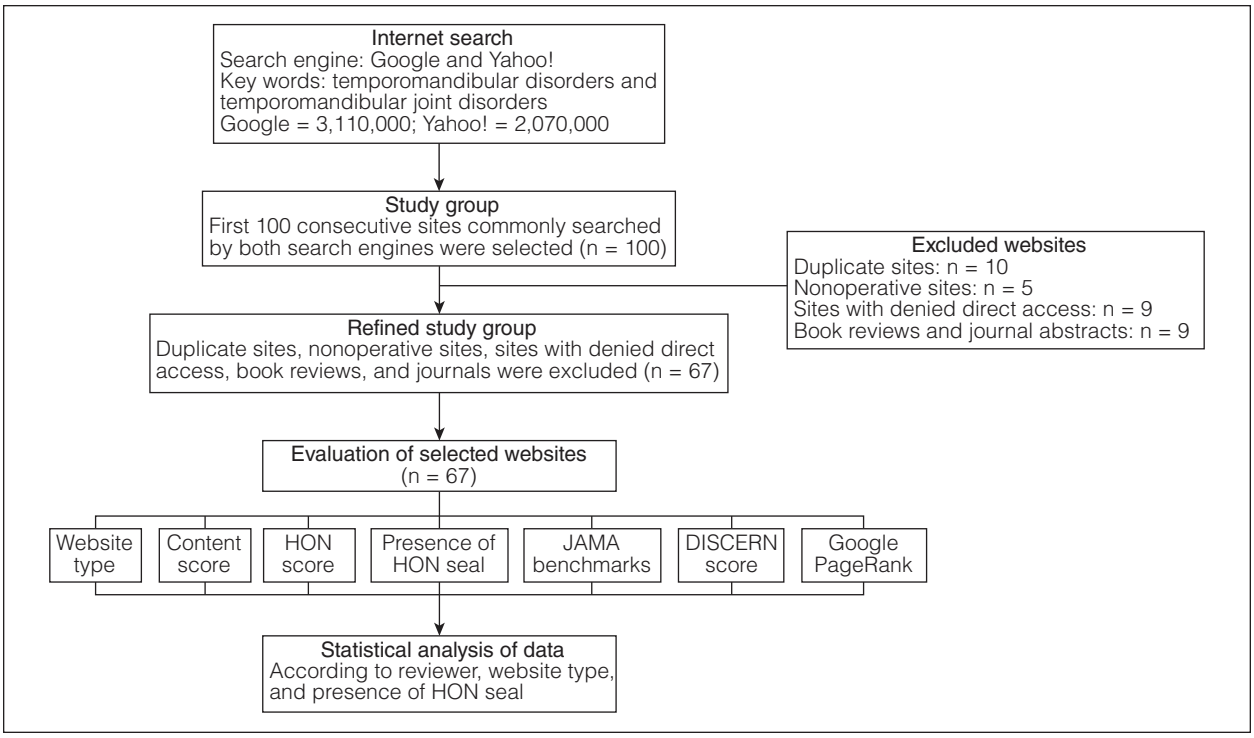


**Fig 1** Overview of the website selection and evaluation process.

analysis of variance (ANOVA). The identical process was conducted based on the presence or absence of the HON code seal and analyzed by the Student *t* test. The presence of JAMA benchmarks was compared according to website type and analyzed with the chi-square test.

The correlation between different evaluation scores, the presence of HON seal, and Google page rankings were analyzed with the Pearson correlation analysis.

Statistical analysis was performed using SPSS 12.0 (IBM). The results were considered statistically significant at $P < .05$.

## Results

The Google and Yahoo! search engine generated 3,110,000 and 2,070,000 sites, respectively. Of the first 100 sites, 10 were duplicate sites, 9 were inaccessible, 5 sites were nonoperative, and 9 corresponded to book reviews or journal abstracts. Sites irrelevant to TMD were excluded. Sixty-seven websites were reviewed in total.

Content scoring results showed that the content quality of the evaluated websites were relatively poor, with a mean score of 38.9% of the possible maximum score. The sites had better information concerning the summary of the disease and treatment options, while little was explained about complications of treatment and disease prognosis. The mean kappa value of 0.636 indicated substantial agreement among the three raters.

The mean HON score was also below 50% of the maximum possible score and so indicated poor credibility of the websites in their sources of information and purpose. The mean kappa value of 0.796 indicated substantial agreement among the three raters.

The mean DISCERN score was 53.9% of the maximum possible score, indicating moderate quality and reflecting potentially important but not serious shortcomings of the website content. The mean kappa value of 0.813 indicated nearly perfect agreement among the three raters. Descriptive values are given in Table 3.

Table 4 shows the results according to the JAMA benchmarks criteria. The criterion most often met (over 50% of the total sites) was disclosure of ownership, followed by display of currency. However, less than 50% of the sites displayed the author or reference of the information given in the site. None of the sites met all four criteria. The mean kappa value was > 0.572 for all four criteria, thus indicating more than moderate agreement among the three raters.

Table 3 Evaluation Scores (mean ± SD) According to Reviewer

| Scoring method | Reviewer 1 | Reviewer 2 | Reviewer 3 | % of maximum possible score* | Kappa (95% CI) Kappa | Lower | Upper |
|---|---|---|---|---|---|---|---|
| Content score | | | | | | | |
| Disease summary | 17.19 ± 5.90 | 16.57 ± 6.65 | 17.81 ± 6.47 | 57.3 | 0.748 | 0.651 | 0.827 |
| Etiology | 2.85 ± 1.86 | 2.49 ± 2.31 | 3.19 ± 1.93 | 28.5 | 0.601 | 0.472 | 0.715 |
| Evaluation and diagnosis | 3.54 ± 2.96 | 1.88 ± 2.55 | 3.63 ± 3.06 | 30.2 | 0.613 | 0.486 | 0.724 |
| Treatment options | 15.46 ± 7.43 | 11.19 ± 8.50 | 15.10 ± 7.53 | 46.4 | 0.575 | 0.442 | 0.694 |
| Complications of treatment | 0.42 ± 0.89 | 0.27 ± 0.69 | 0.30 ± 0.87 | 3.3 | 0.499 | 0.356 | 0.632 |
| Prognosis and outcomes | 2.01 ± 3.15 | 1.72 ± 3.20 | 0.97 ± 2.34 | 15.7 | 0.543 | 0.405 | 0.668 |
| Total score | 41.48 ± 15.74 | 34.12 ± 16.56 | 41.00 ± 16.57 | 38.9 | 0.636 | 0.514 | 0.743 |
| HON score | 7.49 ± 3.17 | 6.72 ± 2.91 | 7.54 ± 3.29 | 45.3 | 0.796 | 0.714 | 0.861 |
| DISCERN score | 42.17 ± 11.48 | 42.98 ± 13.78 | 44.08 ± 12.03 | 53.9 | 0.813 | 0.726 | 0.880 |

SD, standard deviation; CI, confidence interval; HON, Health on the Net. *Percentage was calculated based on the mean score of the three reviewers.

Table 4 JAMA Benchmarks According to Reviewer

| Category | Reviewer 1 | Reviewer 2 | Reviewer 3 | % of total sites* | Kappa (95% CI) Kappa | Lower | Upper |
|---|---|---|---|---|---|---|---|
| Authorship | 28 | 26 | 28 | 40.8 | 0.776 | 0.688 | 0.847 |
| Attribution | 18 | 21 | 15 | 26.9 | 0.850 | 0.786 | 0.899 |
| Disclosure | 43 | 46 | 30 | 59.2 | 0.572 | 0.439 | 0.692 |
| Currency | 34 | 35 | 33 | 50.7 | 0.922 | 0.885 | 0.948 |

CI, confidence interval.
Values are given as number of sites with contents corresponding to each benchmark.
*Percentage was calculated based on the mean score of the three reviewers

Table 5 Evaluation Scores (mean ± SD) and Number of High-Quality Sites According to Website Type

| Type of website | Content score | HON score | DISCERN score | No. of high-quality sites (HON score)† | No. of sites with HON seal | No. of high-quality sites (content score)‡ |
|---|---|---|---|---|---|---|
| Academic (n = 11) | 40.91 ± 13.49 | 7.70 ± 2.88 | 42.85 ± 13.34 | 0 | 1 | 0 |
| Commercial (n = 28) | 40.55 ± 11.44 | 7.85 ± 2.59 | 42.89 ± 11.11 | 2 | 7 | 0 |
| News-oriented (n = 2) | 9.83 ± 0.47 | 9.83 ± 5.42 | 51.00 ± 12.73 | 1 | 0 | 0 |
| Personal (n = 3) | 18.33 ± 15.88 | 3.11 ± 0.19 | 24.89 ± 9.06 | 0 | 0 | 0 |
| Physician (n = 17) | 35.76 ± 19.20 | 5.78 ± 2.33 | 34.24 ± 11.75 | 0 | 0 | 0 |
| Nonprofit (n = 6) | 43.17 ± 6.28 | 9.00 ± 3.12 | 51.50 ± 11.31 | 1 | 0 | 0 |
| Total (n = 67) | 38.87 ± 14.46 | 7.25 ± 2.92 | 40.90 ± 12.82 | 4 | 0 | 0 |
| *P* value | .111 | .005* | .072 | – | – | – |

SD, standard deviation; HON, Health on the Net. Results were obtained through one-way ANOVA.
*Significant, $P < .05$. †A high-quality site was one with a HON score of ≥ 12 points (≥ 75% of the maximum possible score). ‡A high-quality site was one with a content score of ≥ 75 points (≥ 75% of the maximum possible score).

As far as website type (Table 5), commercial was the most common type (with 28 sites), while news-oriented was the rarest (2 sites). The content score was highest for the nonprofit sites, followed by the academic and commercial sites, with news-oriented sites showing the lowest score. The HON score was highest for the news-oriented sites, followed by the nonprofit and commercial and academic sites, with personal sites showing the lowest score. The DISCERN score was highest for the nonprofit sites followed by the news-oriented and commercial and academic sites, with personal sites showing

Table 6 JAMA Benchmarks According to Website Type

| Type of website | Authorship | Attribution | Disclosure | Currency |
|---|---|---|---|---|
| Academic (n = 11) | 3 | 3 | 11 | 6 |
| Commercial (n = 28) | 12 | 8 | 15 | 19 |
| News-oriented (n = 2) | 1 | 1 | 1 | 1 |
| Personal (n = 3) | 0 | 0 | 1 | 0 |
| Physician (n = 17) | 10 | 3 | 11 | 5 |
| Nonprofit (n = 6) | 1 | 3 | 5 | 3 |
| Total (n = 67) | 27 | 18 | 44 | 34 |
| *P* value | .238 | .541 | .075 | .090 |

Values are given as number of sites with contents corresponding to each benchmark. Results were obtained through the chi-square test.

Table 7 Evaluation Scores (mean ± SD) According to HON Seal

| Presence of HON seal | Content score | HON score | DISCERN score |
|---|---|---|---|
| Present (n = 8) | 44.33 ± 9.45 | 9.83 ± 2.15 | 46.31 ± 6380 |
| Absent (n = 59) | 38.12 ± 14.91 | 6.90 ± 2.84 | 40.16 ± 13.29 |
| *P* value | .124 | .134 | .015* |

SD, standard deviation; HON, Health on the Net. Results were obtained through the Student *t* test.
*Significant difference, $P < .05$.

Table 8 Correlation Between Different Evaluation Scores and the Presence of HON Seal

| | Content score | HON score | DISCERN score | HON seal | Google PageRank |
|---|---|---|---|---|---|
| Content score | – | 0.365† | 0.737† | 0.140 | 0.193 |
| HON score | 0.365† | – | 0.672† | 0.329† | 0.479† |
| DISCERN score | 0.737† | 0.672† | – | 0.157 | 0.385† |
| HON seal | 0.140 | 0.329† | 0.157 | – | 0.288* |

HON, Health on the Net. Results were obtained through the Pearson correlation analysis correlation coefficient. *Significant at a level of < .05.
†Significant at a level of < .05.

the lowest score. The HON score showed a statistically significant difference among different websites ($P = .005$), while the scores based on other evaluation methods did not. Two commercial, one news-oriented, and one nonprofit website were of high quality according to the HON criteria (≥ 12 points, ≥ 75% of the maximum possible score). Seven commercial and one academic website displayed a HON seal. None of the sites were of high quality according to the content score (≥ 75 points, ≥ 75% of the maximum possible score).

According to the JAMA benchmark criteria (see Table 6), commercial sites showed the highest percentage of display of authorship, followed closely by physician sites, with none of the personal sites presenting authorship. Commercial sites also showed the highest percentage of display of attribution, disclosure of ownership, and currency. Personal websites showed the poorest quality concerning the four criteria. However, there was no statistically significant difference among the various website types according to the JAMA benchmarks.

The DISCERN score was significantly higher in sites with a HON seal ($P = .015$). The content and HON scores were also higher for sites with HON seals, but the difference was not statistically significant (Table 7).

Correlation analysis showed that content scores were significantly correlated with HON and DISCERN scores. The presence of a HON seal was correlated only to the site's HON score. Google PageRank numbers were significantly correlated with HON and DISCERN scores and the presence of a HON seal but not with the site's content score (Table 8).

## Discussion

The only previous study of the quality of Internet information about TMD was conducted in 2001 and based on a total of 27 websites among the 47 identified through a simple search with the keyword "Kiefergelenk" (temporomandibular joint).[16] A mere

10 years after this study, the results of the present search yielded an astonishing 55,000 times more sites related to the same subject. Considering only the quantitative aspect of the information available for both the doctor and patient, the Internet could be considered to have made a positive development.

However, the results of the present study show that the majority of the information online is not accurate from a professional view, nor is it a clear or well-maintained source of information. Most of the information provided on the websites consisted of short summaries of the disorders followed by an introduction of treatment options. While there were a vast number of potential treatments proposed on the Internet, many websites did not suggest all of the recommended treatments, but frequently suggested treatments that do not have much evidence to support their use. Approximately one third of the sites suggested treatment that could be potentially harmful when considering the risk-benefit ratio. The content score for complication of treatment was lowest among the content categories, with a score equal to 3.3% of the maximum possible score. This bias of information may lead patients to have unreasonable expectations of treatment outcomes and select treatments without knowledge of their complications and adverse effects.

Patient education is known to play a crucial role in the treatment process of chronic pain patients. Therapeutic patient education appears to reduce the negative consequences of fear-avoidance behavior and promote treatment compliance and alleviate actual pain in patients with lower back pain and whiplash.[39,40] TMD are also a group of chronic pain conditions that requires a high level of understanding by the patient for a successful treatment outcome. It is crucial for the patient to understand the pathophysiology and spontaneously control contributing and perpetuating factors that further burden the temporomandibular structure.[41] Previous studies have documented that effects are almost always positive when TMD patients receive education about their condition.[42,43] More and more patients are gathering information about medical conditions online.[1] However, the results of this study show that the information provided usually lacks important aspects of the etiology and prognosis of the condition. This may lead to a misconception of the condition, potentially causing the patient to lose an important treatment modality, self-regulation of aggravating TMD factors based on accurate information.

The HON, JAMA benchmarks, and DISCERN method's primary objective is to guide users to reliable, understandable, accessible, and well-maintained sources of medical information.[18–20] However, the fact that the given information is trustworthy does not necessarily ensure it is scientifically accurate. No reference is made to the accuracy or scientific quality of the information. This could explain the results that showed there were four high-quality sites based on the HON scores, but none of these sites could be classified as containing high-quality information based on content-scoring results. Also, most of the sites with high HON and JAMA benchmark scores were commercial. Commercial websites were relatively well organized and administered. Also, the content scores showed that the information was also scientifically accurate compared with other website types. The absolute number of commercial sites was also the largest, while the number of nonprofit sites with the highest content scores was one fifth of that. However, commercial sites contained a large amount of advertisement irrelevant to TMD, and the suggested treatment options were frequently not founded on accurate scientific theory. This leads to the need for further studies focused on the development of a health website evaluation method based not only on what the site contains but also on the amount of incorrect and unnecessary information, to avoid sites with misleading information gaining a high evaluation score based solely on the amount of correct contents. Considering that most of the current evaluation methods have little or no emphasis on scientific content, the newly developed evaluation method must allot a large portion to the categorization and identification of scientific contents about TMD. The content evaluation method suggested in this study could be further evaluated and certified in this field by experts.

The presence of a HON seal was intended to represent the reliability of a health-related site.[24] However, the display of a HON seal did not guarantee content with scientific evidence. The results of this study showed that among the eight sites displaying a seal, one was academic and the other seven were commercial. None of the nonprofit sites with the highest content scores displayed a HON seal. Compared with the other scoring methods in this study, the HON seal is the easiest way to judge the quality of a given site. So many Internet users may rely on the presence of a seal than going through a scoring process based on multiple questions. However, this may lead users to believe scientifically incorrect information and expose themselves to an excessive amount of commercials, further confusing their proper treatment selection. The fact that only 8 out of 67 TMD sites displayed the HON seal is also problematic, considering the simplicity it holds for the Internet users in identifying a high-quality site by identifying a certain seal. The presence of a

HON seal for TMD sites did reflect that the site had a higher HON, DISCERN, and content scores compared with a site without a seal, but the difference was significant only for the DISCERN score. Further modifications of the principle based on expert medical opinions should be incorporated to enhance the value of the HON seal as a representation of high-quality online health information that is also scientifically correct. Until the presence of a seal comes to imply the containment of scientifically correct information, it is dangerous to consider a website with a HON seal as one of comprehensive high quality despite its convenience as an evaluation tool.

Correlation analysis showed that the content, HON, and DISCERN scores were significantly correlated. This suggests that each scoring method has validity and can be combined to supplement one another. The possibility of combining the methods to produce a highly reliable scoring method that addresses both the maintenance and content quality aspect of a TMD health site holds significance. Further studies are necessary to analyze their interrelation and its implication among such scoring methods.

It is interesting that a high Google PageRank was significantly correlated with HON and DISCERN scores, as well as the presence of a HON seal, but not with content scores. Search engine makers attempt to rank websites according to content and popularity. However, it is well known that such ranks can be manipulated in various ways, further exacerbating the difficulty for patients to find good sites with evidence-based information. This may result from more active marketing by less evidence-based sites such as commercial sites that have more funding to maintain a well-organized site with a more user-friendly interface. Thus, websites with less evidence-based information will achieve a higher Google PageRank than more evidence-based sites.[44] Health care professionals with expertise in TMD should take an active role in guiding their patients toward good-quality websites and provide links to such sites to avoid unnecessary conflict for patients about information acquired online.

Shared decision-making is becoming more and more common in health care, particularly regarding treatment modalities, so for efficient doctor-patient communication, the scientific quality and accuracy of the content of websites is of importance when viewing information online. Dependence on information online is higher for chronic pain conditions such as TMD compared with other conditions.[15] There are no previous studies that have methodologically analyzed the content of websites containing medical information on TMD through multiple evaluating methods and criteria to assess its content from a medical-scientific aspect. The fact that the overall HON, DISCERN, and JAMA benchmark scores were low for the majority of TMD sites, along with content scores, implies that most TMD-related sites were of less than moderate quality.

Despite the Internet's potential to cause harm, the information provided online is growing exponentially and the number of people seeking health advice through the web is also expanding.[1,2] Future studies should first seek evidence of the potential harm of websites containing incorrect information. Based on such results, comprehensive criteria to create a high-quality TMD health-information site in both the maintenance and scientific aspect should be established through a joint effort of experts in TMD. Once established, the site should be continuously updated and managed based on the change and advancements in treatment modalities and understanding of TMD pathophysiology. Such efforts must be backed up financially and scientifically by an authoritative group. From then on, it is the responsibility of the practitioner to guide the patient on the scientific reliability of information and to direct the patient in filtering the information based on the comprehensive criteria.

The potentially subjective aspect of the website grading is a limitation of this study which should be considered. The authors attempted to make each grading process as standardized and objective as possible, and the high kappa values show that the level of interrater reliability was acceptable. However, the fact that mutual calibration was conducted only once before gathering the data may have biased the outcomes since the results are based on subjective scorings and differentiation of website types by three different reviewers. The validity of the scoring would be improved if a lower level of variability was reached. In addition, it is possible that the methods used for selecting websites for review may not have accurately reflected the way in which patients locate a website for medical information about TMD. The utilization of other search engines or keywords may lead to different websites of diverse content and quality.

## Conclusions

It appears that the role of the Internet as an information provider is growing in the field of TMD. However, the quality of such sites based on the currently certified evaluating methods showed that most sites were poorly organized and maintained. Also, most sites contained insufficient or scientifically incorrect

information that could have a negative effect on the treatment outcome and prognosis of TMD. Joint efforts should be made in future studies toward investigating the current evaluation methods and developing a more comprehensive method to enable the assessment of the website from both a scientific and administrative aspect. Such endeavors must be carried over by the clinician in guiding patients to reputable sources of information that will enhance comprehension of TMD patients and lead to better treatment outcomes.

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