Quality and Readability Assessment of Internet-Based Information on Common Prosthodontic Treatments

Authors:
Abeer Alshehri ¹, Nasser Alghofaili ², Renad ALshunaiber ³ and Lubna Alkadi ⁴,*
1 College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia; abeer.1415h@hotmail.com
2 College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia; ne-44@hotmail.com
3 College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia; renadabdullaziz@gmail.com
4 College of Dentistry, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia; King Abdullah International Research Center, Riyadh, Saudi Arabia; lubna.alkadi@gmail.com

*Correspondence: Lubna Alkadi
lubna.alkadi@gmail.com; Tel.: +966555348811
P.O.BOX 57374 Riyadh 11574 Saudi Arabia

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Purpose: To evaluate the readability and quality of patient-oriented information online among different common prosthodontic search areas using multiple quality and readability assessment tools. Materials and Methods: The prosthodontic keywords
most commonly searched by patients on the internet were included. The search was performed through two online search engines (Google and Yahoo) to create the study sample. The first 50 websites listed by each search engine were chosen for each keyword. The quality of each website’s information was evaluated using the DISCERN questionnaire and the Health on the Net (HON) criteria. Readability assessment was performed using the Flesch-Kinkaid Reading Grade Level (FKRGL) and the Flesch Reading Ease Score (FRES). Results: A total of 225 websites were included in the study. The median score for the DISCERN instrument indicated poor information quality. A significant difference was found between the educational and commercial websites in both quality and readability. Overall, the median readability indices showed that the websites’ information was difficult to read. Conclusion: Internet-based health information on different prosthodontic treatments is difficult to read and poor in quality and readability. It is necessary for health care providers to establish and promote websites that have reliable, high-quality information about common prosthodontic treatments. Int J Prosthodont 2021. doi: 10.11607/ijp.7063

1. Introduction

With the revolutionary development of technology, access to the internet is found nearly everywhere. Currently, people tend to search for health-related information through websites before seeking health care providers’ advice. It has been estimated that ninety-eight million American adults have used the internet to obtain health-related information (1). The Pew Research Center for Internet and Technology explains that patients utilize the internet to find health-related information due to the convenience of
obtaining information at any time or location in addition to anonymity (2). The revolution of online health care information has greatly influenced patients’ health literacy. In the United States, approximately 21 million healthcare seekers have reported that their decision about treatment has been influenced greatly by an internet search. Additionally, approximately 30% of them reported that internet-based information has even affected their decision on whether or not to visit a physician (2). The great influence the internet has on patients who are seeking medical information is considered problematic and worrisome to health care professionals. For patients with low health literacy who cannot fully comprehend the information obtained, the result can be compromised health decisions (3). In fact, patients with lower health literacy have been shown to have less knowledge of their oral health and more missing and fewer filled teeth than people with adequate health literacy (4,5).

A literature review reveals that only eight studies have been published regarding the quality and readability of patient-oriented online information in the dental health field (6-13). These studies assessed various subjects in dentistry, such as orthodontic treatment (6), temporomandibular disorders (7), dental caries (8), maxillofacial trauma (9), and multiple other oral dental and maxillofacial conditions (10-12). In 2016, a study assessed websites on dental caries and found that these websites had good accessibility, usability, and readability, while the reliability of the information was found to be poor (8). Furthermore, all studies that assessed orthodontic treatment (6), temporomandibular disorders (7), and maxillofacial trauma (9) consistently reported similar results; although websites’ readability was found to be generally good, the reliability of the information was of concern. Only one study had been done in prosthodontics, and it was specific to
assessing internet-based information about dental implants. The study found that the available internet-based health information on dental implants was difficult to read for the average patient, in contrast to the results of the previously mentioned studies. However, there was a consensus in all studies about the poor quality of information (14). Dental literature in this area of study is scarce, and more conclusive evidence is needed. This area of research aims to improve the efficacy and accuracy of a powerful instrument, the internet, in providing evidence-based dental information to the patient. The current study aims to evaluate the readability and quality of patient-oriented online information among different common prosthodontic search areas using multiple quality and readability assessment tools.

2. Materials and Methods

Searching strategy

This study was conducted at King Saud bin Abdulaziz University for Health Sciences, College of Dentistry, in Riyadh. The search was performed through two online search engines (Google and Yahoo) to create the study sample. For two weeks, a daily search of the keywords “veneers”, “crowns”, “bridges” and “implants”, independently, was performed through both Google and Yahoo. The first 50 websites listed by each search engine were chosen for each keyword. Each website was assessed according to the study inclusion criteria: websites should provide patient-targeted information about the five prosthodontic treatment keywords chosen for this study, and the most recent update on the website should not be before 2010. Websites targeting dentists were excluded.
Quality and readability assessment

Three general dentists working under the supervision of a prosthodontist were involved in the assessment of the identified websites. Two types of assessments were performed; the first is a quality assessment utilizing the DISCERN questionnaire and the Health on the Net Code (HONcode) certification and seal, while the second is a readability assessment performed using the Flesch-Kinkaid Reading Grade Level (FKRGL) and the Flesch Reading Ease Score (FRES) tests. Assessors were calibrated on the use of the mentioned quality and readability assessment tools prior to their utilization. As part of their calibration, the assessors met multiple times to exchange pilot samples in order to ensure that they have arrived at similar conclusions. This was done until homogeneity of assessment has been achieved among them.

Quality assessment

DISCERN questionnaire:

The DISCERN questionnaire was used to evaluate the quality of each website’s information. It is a five-point Likert scale consisting of 16 questions that may be used without the need for specialized knowledge to assess the quality of published information. The questionnaire is scored on a continuous scale ranging from 1-5, where 1 is a definite NO (worst score), 5 is a definite YES (best score) and values in between 1 and 5 suggest that the area in question is present to a certain extent.

The questionnaire is divided into three sections. The first section (Questions 1–8) addresses the reliability of the publication. Simply, it helps the examiner make a decision on whether the publication can be trusted as a source of information. The second section (Questions 9–15) focuses on specific details regarding information
related to treatment choices. The last section, which contains only one question, rates the overall quality of the published information \(^{(14)}\). The specific questions within each section are outlined in Table 1.

HONcode certification and seal:

The HONcode certification and seal were used as a second tool to assess the quality of websites included in this study. The certification is done through the HON organization, a world-renowned not-for-profit portal to medical information on the internet. Any website that has been certified and awarded the HONcode seal has undergone assessment in eight different aspects: transparency, honesty, authority, privacy, personal data protection, updating of information, accountability, and accessibility. Each website included in this study was assessed by the authors based on whether or not it has obtained the HONcode seal.

Readability assessment

Readability assessment was performed using the FKRGL and the FRES. These are two of the many validated English-written information readability tests. They were chosen for their ease of use, as they only require user-friendly online computer software to assess the content. The text found on each website was transferred into this software, which automatically calculates these indices for each text.

The FRES ranges from 0 to 100. The scores were categorized as very difficult, the level of college graduates (scores 0–30); difficult (30–50); fairly difficult (60); normal, meaning easily understood by 13- to 15-year-old students (60–70); fairly easy (70–80); easy (80–90); and very easy (90–100). Moreover, websites underwent FKRGL scale assessment
and were graded as either $\leq 6$th-grade level, which is easy to read, or $\geq 10$th-grade level, which is difficult to read $^{15, 16}$.

Data Management and Analysis Plan

Statistical analysis was performed using IBM SPSS Statistics 22.0 software. Data were coded into the software, and variables were described using measurements of central tendency and spread. The Mann–Whitney test was used to compare different aspects between the variables.

3. Results

Of the 400 websites identified from the two search engines, Google and Yahoo, approximately 17 websites were excluded for being dentist targeted or for including visual content. A total of 158 websites were duplicates, as they were found on both search engines. Thus, only 225 websites met the study’s inclusion criteria. Table 2 presents the distribution of the websites by keywords, purpose, and the HONcode seal. The sample was evenly distributed between the keywords “crown” and “bridge”, while the “implant” keyword was found within the highest portion of the sample and the “veneer” keyword found within the lowest portion. The purpose of 59% of the sites was commercial. Moreover, only 6.7% of all websites included were granted the HONcode seal.

When all 225 included websites were analyzed with the DISCERN instrument, the median score for the overall rating was 3. This low rating suggests potentially important shortcomings in the quality of the information obtained. These critical weaknesses were
particularly relevant in terms of details on questions 4 to 8, 11, 12 and 15 from the DISCERN instrument (Figure 1).

Table 3 demonstrates a significant difference when comparing the purpose of the websites, educational or commercial, as it relates to readability and quality of information. Commercial websites have poorer quality of information than educational websites (Table 3). Moreover, reading assessment tests show difficult-to-read and college graduate-level written information on both educational and commercial websites.

When each keyword was assessed individually for the quality of information, no significant difference was found. However, a significant difference was found with regard to their readability. Websites containing the “implant” keyword had the most difficult-to-read information, followed by websites with the keywords “veneers”, “crowns”, and then “bridges” (Table 4).

4. Discussion

This is the first study in the prosthodontic field to assess the quality and readability of available internet-based information about common prosthodontic treatments, particularly on prosthodontic-related websites. This assessment is of importance considering the increasing number of patients who seek health-related information online. This situation is commonly exploited by websites with marked commercial interests, frequently providing misleading information to internet users (13). Fortunately, more than 200 websites met the study inclusion criteria, which reduces the possibility of
website selection bias because this number is considered to represent, according to Zimmer et al., more than what an average patient would search \(^{(17)}\).

The assessment tools that were used in this study are all valid and widely accepted instruments that are commonly used for quality and reliability assessment of consumer targeted health-related websites \(^{(18)}\). The DISCERN instrument is the first standardized, validated and reliable instrument that has been widely used in the evaluation of written consumer-targeted information about treatment choices in different fields.\(^{6,9,12,13,19-25}\)

According to the literature, the DISCERN instrument is not dependent of specialist knowledge of a health condition or treatment and is consistent among conditions with variable base of evidence.\(^{14,20}\) Literature also proves that although the use of the instrument improves with training, the instrument can also be utilized effectively by patients without any previous experience.\(^{20}\) The DISCERN instrument comes equipped with a comprehensive handbook that explains the process of its development and validation and contains general and specific instructions for rating each of its 15 questions in all three sections along with examples, which considerably decreases the subjectivity of the assessment.\(^{26}\)

The HONcode is an eight-point code of conduct initiated in 1996 by the HON organization. It is a set of acknowledged ethical, honesty, transparency and quality indicators that guide website content managers and developers in creating and maintaining health website content and ensuring the quality, transparency and objectivity of consumer targeted health related information. Websites voluntarily submit a formal application for HONcode certification enabling experts to verify their compliance with HONcode standards and their eligibility for certification. Following their
certification, websites can then display the HONcode seal and are regularly monitored for adherence with the standards. Similar to the current study, various studies in multiple disciplines have used the HONcode certification and seal as an indicator for the quality of the assessed websites. A study done in collaboration with HON organization compared a sample of HONcode certified websites with a control sample of non-certified websites. The study found that adherence with HONcode principles was extremely low in the non-certified group (0.6%) compared with 89% in the certified group.

The FKRGL and the FRES tests utilized in this study for the assessment of readability are both user-friendly tests that are simple to apply as the process is fully automated using an online software which eliminates any chance for subjectivity during assessment. The formula used to calculate the FKRGL and FRES indices are dependent on two criteria. The first is syntactic difficulty, measured by calculating the number of words per sentence. The second is word difficulty, calculated by the number of syllables per word. They are also commonly used in studies assessing readability of patient targeted information.

The present study reported poor overall quality of information published on websites regarding some of the common prosthodontic treatments. Similarly, another study conducted by Yago et al. regarding internet-based information about dental implants reported low overall quality of website content. In websites related to the maxillofacial pathology field, poor-quality patient-targeted information was also a common finding. Inaccurate information with low quality was also found among most halitosis-associated websites in a study by Jung Hawan et al. On the other hand, for
orthodontic-related information online, McMorrow et al. reported moderate overall information quality, which was better than most of the findings from previously conducted studies (6). Despite all the mentioned studies reporting poor quality of information, the literature lacks data about possible reasons and solutions.

For the readability assessment, the results found that prosthodontic-related websites are “difficult to read” with scores far from what is considered suitable for patients. Websites containing “implant”-related content were the most difficult to read. Similarly, another study by Yago et al. assessed internet-based information about dental implants and reported that they were difficult to read for the average patient. Moreover, the study’s reported results for readability assessment were lower than those reported in a study by Walsh and Volsko assessing website information regarding cardiac diseases, pulmonary diseases, strokes, cancer, and diabetes (31).

The current study’s findings regarding websites’ readability scores were worse than those of the studies by Patel et al. and Anastasiya et al. assessing orthodontic and dental caries-related websites, respectively (19,8).

Researchers should discuss the results and how they can be interpreted in light of previous studies and working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

None of the previous dental studies showed a difference between educational and commercial websites in the quality and readability of written information. In this study, both educational and commercial websites showed low quality of information and
difficult-to-read written content. However, the results are not conclusive, and more specific research questions should be examined.

The findings in this study are concerning and could adversely affect patients due to the increased number of individuals with low levels of health literacy along with an increased number of websites providing poor-quality, inaccurate information⁹. As a result, it is important for dental practitioners to have awareness regarding the quality and content of these websites by actively participating in the creation and promotion of accurate scientific content on websites for patients seeking online health-related information. Furthermore, dental practitioners should educate and direct their patients to approved, trusted online resources.

The assessment of websites in this study was performed by three general dentists working under the supervision of a prosthodontist. Although none of the instruments used in this study requires a specialized level of knowledge, the presence of a prosthodontist within the team helped further ensure homogeneity of the assessment and clarified any confusion related to the content.

There were some limitations in this study, such as the search process being conducted solely among English-based websites, which limits the ability to generalize the results. Moreover, the dynamic nature of website content makes it possible for previously evaluated information to change over time. Finally, there remains a chance for some subjectivity while using the DISCERN questionnaire for the quality assessment of websites. This was overcome to a great extent through calibration, pilot samples, adhering to questionnaire instructions and criteria in its handbook as well as utilizing a large sample. No subjectivity is expected with any of the other assessment tools as they
do not rely on the authors’ personal judgement but rather on an expert organization’s official certification (HONcode seal) or complete automation through a software (the FKRGL and the FRES).

5. Conclusions
In conclusion, the study results show that internet-based health information on different prosthodontic treatments is difficult to read and poor in quality and readability. All variables, keywords and purposes of the websites examined have the same results with regard to quality and readability. The results of the current study may prompt future research questions on the possible reasons and solutions for this issue. Additionally, it is necessary for health care providers to establish and promote websites that have reliable, high-quality information about common prosthodontic treatments.

6. Clinical Significance
This paper addresses the current issue of patients’ exposure to health-related online information. Because patients today are actively involved in making health-related decisions, this exposure leads them to arrive at the healthcare provider with multiple levels of misconceptions and incorrect expectations. Being aware of the quality and readability of available online prosthodontic information sources can help prosthodontists predict the difficulties they may face with their patients. Moreover, the findings emphasize the importance of patient education about trusted online resources that are under the supervision of qualified practitioners.
7. Acknowledgements

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8. References


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Fig 1 Median scores on the DISCERN instrument.
### Table 1: Median quality ratings across the 225 included websites using the DISCERN instrument

<table>
<thead>
<tr>
<th>DISCERN question</th>
<th>Median Quality Score (N= 225)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Are the aims clear?</td>
<td>5</td>
</tr>
<tr>
<td>2. Does it achieve its aims?</td>
<td>3</td>
</tr>
<tr>
<td>3. Is it relevant?</td>
<td>5</td>
</tr>
<tr>
<td>4. Is it clear what sources of information were used?</td>
<td>1</td>
</tr>
<tr>
<td>5. Is it clear when the information used was produced?</td>
<td>1</td>
</tr>
<tr>
<td>6. Is it balanced and unbiased?</td>
<td>1</td>
</tr>
<tr>
<td>7. Does it provide additional sources of support/information?</td>
<td>1</td>
</tr>
<tr>
<td>8. Does it refer to areas of uncertainty?</td>
<td>1</td>
</tr>
<tr>
<td>9. Does it describe how the treatment works?</td>
<td>4</td>
</tr>
<tr>
<td>10. Does it describe the benefits of each treatment?</td>
<td>4</td>
</tr>
<tr>
<td>11. Does it describe the risks of each treatment?</td>
<td>1</td>
</tr>
<tr>
<td>12. Does it describe what would happen if no treatment is used?</td>
<td>1</td>
</tr>
<tr>
<td>13. Does it describe how the treatment choices affect quality of life?</td>
<td>3</td>
</tr>
<tr>
<td>14. Is it clear there may be more than one possible treatment choice?</td>
<td>2</td>
</tr>
<tr>
<td>15. Does it provide support for shared decision making?</td>
<td>1</td>
</tr>
<tr>
<td>16. Overall quality of publication as source of information?</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 2. Frequency distribution of baseline parameters

<table>
<thead>
<tr>
<th>Variables</th>
<th>Responses</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keywords</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crown</td>
<td></td>
<td>53 (23.6%)</td>
</tr>
<tr>
<td>Bridge</td>
<td></td>
<td>58 (25.8%)</td>
</tr>
<tr>
<td>Veneer</td>
<td></td>
<td>36 (16%)</td>
</tr>
<tr>
<td>Implant</td>
<td></td>
<td>78 (34.7%)</td>
</tr>
<tr>
<td>Purpose of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td>website</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educational</td>
<td></td>
<td>91 (40.4%)</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td>134 (59.6%)</td>
</tr>
<tr>
<td>HON code</td>
<td>Coded</td>
<td>15 (6.7%)</td>
</tr>
</tbody>
</table>
Table 3. Comparative inferential analysis of educational and commercial websites with baseline parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Median</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Educational (N = 91)</td>
<td>Commercial (N = 134)</td>
</tr>
<tr>
<td>Overall quality</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>FRES</td>
<td>48.06</td>
<td>54.79</td>
</tr>
<tr>
<td>FKRGL</td>
<td>13</td>
<td>9</td>
</tr>
</tbody>
</table>

* Mann–Whitney p-value <0.05
Table 4. Comparative inferential analysis of the four keywords with baseline parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Median</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crown (N=53)</td>
<td>Bridge (N=58)</td>
</tr>
<tr>
<td>Overall Quality</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>FRES</td>
<td>55.34</td>
<td>57.26</td>
</tr>
<tr>
<td>FKRGL</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

* Mann–Whitney p-value <0.05