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SURGERY ARTICLES

Does the quality, accuracy, and readability of information about lateral epicondylitis on the internet vary with the search term used?

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Abstract
Background Concern exists over the quality, accuracy, and accessibility of online information about health care conditions. The goal of this study is to evaluate the quality, accuracy, and readability of information available on the internet about lateral epicondylitis.
Methods We used three different search terms ("tennis elbow," "lateral epicondylitis," and "elbow pain") in three search engines (Google, Bing, and Yahoo) to generate a list of 75 unique websites. Three orthopedic surgeons reviewed the content of each website and assessed the quality and accuracy of information. We assessed each website's readability using the Flesch–Kincaid method. Statistical comparisons were made using ANOVA with post hoc pairwise comparisons.
Results The mean reading grade level was 11.1. None of the sites were under the recommended sixth grade reading level for the general public. Higher quality information was found when using the terms "tennis elbow" and "lateral epicondylitis" compared to "elbow pain" ($p<0.001$). Specialty society websites had higher quality than all other websites ($p<0.001$). The information was more accurate if the website was authored by a health care provider when compared to non-health care providers ($p=0.003$). Websites seeking commercial gain and those found after the first five search results had lower quality information.
Conclusions Reliable information about lateral epicondylitis is available online, especially from specialty societies. However, the quality and accuracy of information vary significantly with the search term, website author, and order of search results. This leaves less educated patients at a disadvantage, particularly because the information we encountered is above the reading level recommended for the general public.

Keywords Internet · Patient education · Health literacy · Lateral epicondylitis · Tennis elbow · Online education · Readability

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Introduction

The internet is rapidly growing as a means for patients to access information about health conditions [15, 23, 28]. The internet's relative ease of use and versatility give patients an unprecedented opportunity to independently investigate medical diagnoses and treatments [31]. This increase in patient access to health care topics has caused many health care providers to modify their practices to incorporate online information into their patient encounters [19, 31]. However, there is concern about the quality, accuracy, and readability of the information available on the internet about health care conditions [11, 16, 31]. Recent health policy has increased the role of shared decision making and patient-centered outcomes research [24], which has subsequently emphasized the need for patient access to accurate and understandable health care information online.

The quality of patient-directed health information available on the internet has been related to commercial gain [5, 17, 20, 29]. While physician specialty organizations have provided high-quality information, these websites are often written at a level above comprehension level of the general

public [2, 4, 8, 12, 14, 22, 26, 30, 32]. Because poorly informed patients may affect shared decision making, physicians and the general public must be aware of the potential for misinformation on the internet.

Baseline inequality in access to the internet (the so-called digital divide) [6] may be compounded by a less apparent disparity. Because access to information on the internet is largely filtered by search engines, we asked whether the patient education information retrieved was dependent on the search term used. In the current study, we evaluated the quality, accuracy, and readability of information available about lateral epicondylitis on the internet. We used three different search terms of varying sophistication ["lateral epicondylitis," (LE) "tennis elbow," (TE) and "elbow pain" (EP)] in three different searches and analyzed the patient education information available through those search efforts. We hypothesized that the quality, accuracy, and readability of information about lateral epicondylitis would vary depending on the search term used.

Materials and Methods

We selected the search terms "lateral epicondylitis," "tennis elbow," and "elbow pain" to simulate the variability of search terms used when seeking information about lateral epicondylitis. We entered each of the three search terms into Google, Yahoo, and Bing on September 19, 2011 within a single session for a total of nine separate searches. We selected these search engines because they represent approximately 93 % of internet searches performed [10]. Search histories and internet caches (including cookies) were cleared between searches. We compiled the first 25 results from each search and eliminated duplicate results and non-functional websites, leaving a list of 100 unique websites (Fig. 1). We accessed all of the websites during a 2-h period and created an electronic capture of each website after excluding 16 websites with only news items or website menus (without information content). We also excluded sites from further review if they contained materials explicitly intended for peer review (six sites). Seventy-eight unique websites remained (Fig. 1).

We assessed the quality and accuracy of the information on the websites in a manner similar to prior investigations of information about scoliosis [18] and disc herniation [13, 20]. We generated a content quality score that included 30 items related to the pathophysiology, evaluation, and treatment of lateral epicondylitis (Table 1). The 30 items in the content quality score represent what should be presented to patients if they are seeking information about LE on the

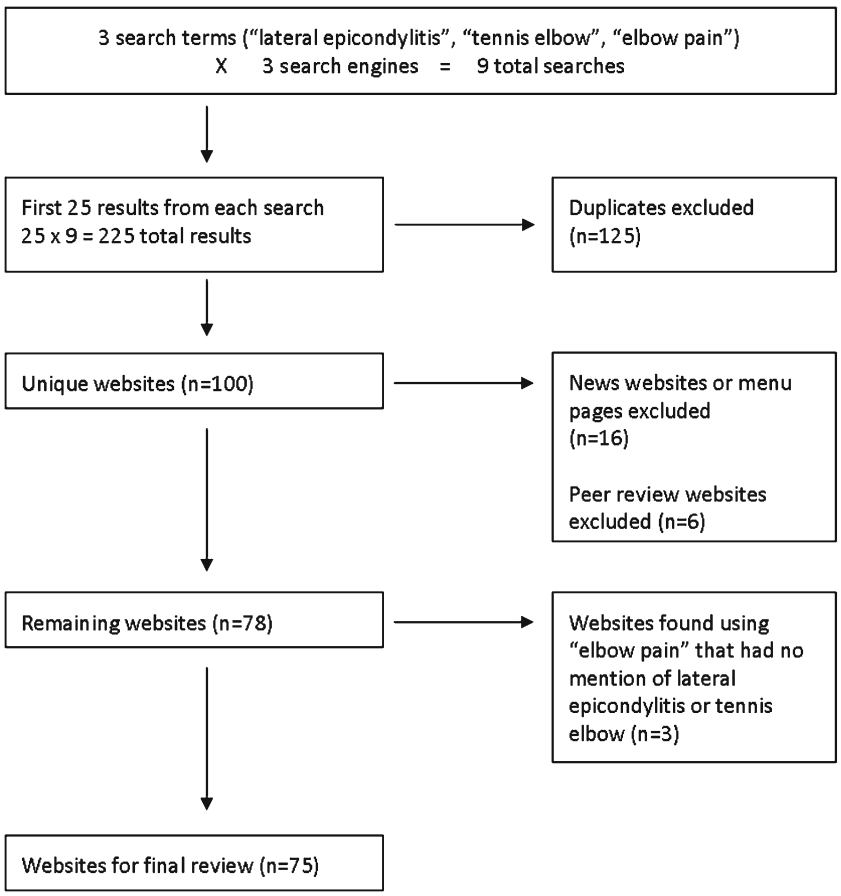

Fig. 1 Flow chart outlining the search process to determine the websites for evaluation

Table 1 Items used for quality assessment of websites

Diagnosis and evaluation
Lateral epicondylitis is also known as tennis elbow.
Lateral epicondylitis involves tendons on lateral/"outside" elbow.
Tendons attach/anchor muscle to bone.
The extensor carpi radialis brevis is involved,
The extensor carpi radialis brevis attachment to bone is involved.
The lateral epicondyle is part of the humerus.
Lateral epicondylitis is caused by overuse.
Lateral epicondylitis does not only occur in athletes.
Lateral epicondylitis can cause pain on lateral/"outside" elbow.
Pain from lateral epicondylitis can be worsened by gripping/lifting.
Patients can have weakened grip.
The symptoms of lateral epicondylitis can develop gradually.
The diagnosis of lateral epicondylitis includes test of resisted wrist extension.
A physician may order an EMG to rule out nerve compression.
Treatment
Treatment of lateral epicondylitis begins with rest and activity modification.
Treatment of lateral epicondylitis includes oral anti-inflammatories.
Equipment modification may be recommended for lateral epicondylitis.
Physical therapy and stretching may be helpful for lateral epicondylitis.
Bracing may be recommended for lateral epicondylitis.
Steroid injections may be recommended to treat lateral epicondylitis.
Shockwave therapy is a possible treatment for lateral epicondylitis.
Surgery is an option if there is no response to 6–12 months of non-operative treatment.
Surgery involves removing diseased tissue.
Surgery may be done open or arthroscopically.
Physical therapy is required after surgery.
Gradual strengthening before full activity.
Recovery can take months after surgery.
Complications and results
There is a risk of neurovascular damage with surgery.
There is a risk of infection with surgery.
There is a risk of loss of strength with surgery.

internet and were largely based on the American Academy of Orthopaedic Surgeons' website about LE [1]. Similar to prior investigation [13], we reviewed the website quality and awarded one point if a website contained correct information for each item, with a maximum score of 30. Three independent reviewers evaluated the quality of each website using an identical electronic capture of the website. The scores of the three reviewers were averaged to provide a mean score for each website.

To assess website accuracy, three independent appraisers rated the accuracy of information on the website on a scale of 1 to 4 [18, 20]. An accuracy score of 1 represents agreement with less than 25 % of the information on the website; 2 represents agreement with 26–50 %; 3 represents agreement with 51–75 %; and 4 represents agreement with 76–100 %. The summed scores of the three appraisers were analyzed with a maximum score of 12 [18, 20].

The readability of each website was evaluated using the Flesch–Kincaid (FK) method of analysis, which has previously been used when evaluating information about orthopedic [2, 26, 30] and upper extremity conditions [33]. After preparing the text identically to Wang and colleagues [33], we used Microsoft Word (Redmond, WA) to determine the FK readability grade level of each website. The FK grade level indicates that a person who has completed that academic grade level will be able to read and comprehend the material. A higher FK grade level is assigned to a material that is more difficult to read and to understand [2, 26].

We grouped the websites by the search term used to find them—"lateral epicondylitis," "tennis elbow," or "elbow pain." If a website was retrieved using more than one search term, we categorized the website by the search term that yielded the earliest result. We also grouped the websites by the highest priority result ("hits" 1–5, 6–10, 11–15, 16–20, and 21–25). We grouped websites into those with an FK score above sixth grade level and into those at or below sixth grade level in accordance with prior recommendations for patient education materials [7, 9, 34]. Additionally, we noted whether the websites were seeking commercial gain (contained advertisements for elbow or sports-related products or services). Finally, we categorized the websites by authorship: health care provider (HCP; physician, nurse, or physical therapist with explicitly stated credentials), non-HCP, or physician specialty society. We reviewed the websites found using the term "elbow pain" and excluded them from analysis if there was no information about lateral epicondylitis (Fig. 1).

Descriptive statistics were calculated for quality score, summed accuracy assessment, and FK level. Normality of the data was evaluated using skewness and kurtosis; non-normally distributed data were analyzed using nonparametric tests. Analysis of variance (for normally distributed data) and Kruskal–Wallis tests (for non-normally distributed data) with post hoc pairwise comparisons were used to determine any difference in quality, accuracy, and readability based on search term used, order of search results, and website author. Independent sample t tests (for normally distributed data) or Mann–Whitney U tests (for non-normally distributed data) were used to determine any difference in quality, accuracy, or readability based on whether a website was seeking commercial gain. Correlation analysis was also used to evaluate for an association between quality and FK score, as well as accuracy and FK score. Multivariate regression models were constructed to determine whether website quality or accuracy was significantly influenced by search term used while controlling for website FK score. The threshold for statistical significance was $p<0.05$ in all statistical tests.

Results

A Wide Range of Quality, Accuracy, and Reading Levels Exists Across all Lateral Epicondylitis Content on the Internet

Seventy-eight unique websites were initially included for review, but three were excluded because they did not contain information about lateral epicondylitis. Of the 75 websites included for final review, quality [11.9 (mean)±6.1 (SD) of a maximum score of 30; range 0 to 30] and accuracy (10.5±2.5 of a maximum score of 12; range 3 to 12) varied greatly. The average FK grade level was 11.1±2.1 (range, 6.4 to 16.3). None of the 75 websites had the recommended FK score below or equal to the sixth grade reading level. Five of the 75 (6.7 %) websites had an FK score below the eighth grade reading level. Data for quality and FK score were normally distributed, while data for accuracy were not normally distributed. Parametric statistical tests were used to compare quality and FK scores, while nonparametric tests were used to compare accuracy.

Of the 75 total websites, 30 were identified using the search term "lateral epicondylitis," 25 with "tennis elbow," and 20 with "elbow pain." We categorized 40 (51.3 %) as seeking commercial gain. Twenty-six websites were authored by HCP, 45 were written by non-health care providers, and 4 were written by physician specialty societies.

Quality of Information About Lateral Epicondylitis, but Not Accuracy or Reading Level, Is Dependent on Search Term Used

There was a significant difference in quality when comparing the "LE," "TE," and "EP" groups ($p<0.001$; ANOVA). The post hoc pairwise comparisons demonstrated a significant difference between the "LE" (14.9±5.7) and "EP" groups (6.4±4.3; $p<0.001$), as well as a significant difference between the "TE" (12.7±4.7) and "EP" groups ($p<0.001$). There was no difference in quality between "LE" and "TE."

There was no difference in accuracy when comparing the different search term groups. The FK readability scores also did not vary significantly between the different search term groups.

A multivariate linear regression model was constructed to evaluate the influence of search term on quality while controlling for the FK score of each website. When controlling for FK level, search term significantly affects website quality ($p<0.001$; $\beta=-4.519$).

Website Authorship and Commercial Gain, but not Order of Return of Search Engine Results, Affect Quality and Accuracy

There was a significant difference in website quality when comparing websites by authorship ($p=0.001$; ANOVA), with the post hoc pairwise comparisons showing a significantly higher quality on specialty society websites (22.3±5.6) when compared to HCP websites (12.2±5.4; $p=0.001$) and when compared to non-HCP websites (10.7±5.7; $p<0.001$).

The accuracy of the information was significantly different between the authorship groups ($p=0.001$; Kruskal–Wallis test), with the post hoc pairwise comparisons showing a significantly higher accuracy on HCP-authored websites (11.3±2.0) when compared to non-HCP websites (10.0 ±2.7; $p=0.002$). There was no statistically significant difference between accuracy of specialty society sites (12.0± 0.0) and websites authored by HCP ($p=1.0$) and non-HCP ($p=0.052$). There was no significant difference in FK score regardless of who authored the site.

Websites seeking commercial gain had significantly lower quality (10.0±5.7; $n=39$ vs 13.9±5.8; $n=36$; $p=0.005$; t test). There was no significant difference in accuracy or FK score based on the presence of commercial gain.

There was no significant difference in quality, accuracy, and FK score when comparing the websites by the order of search results ("hits" 1–5, 6–10, 11–15, 16–20, and 21–25). There was no significant difference in quality or FK score when comparing the websites that were in the first five hits to all other websites. However, websites found in the first five search results (11.8±0.6; $n=16$) were more accurate than websites found after the first five search results (10.1±2.7; $n=59$; $p=0.008$).

Discussion

Patients are rapidly turning to the internet as a source of health care information [15, 21, 25, 28]. There is concern among physicians that the information that patients are finding is not entirely accurate or understandable to the general public [11, 16, 31]. In the current study, we have shown that the quality of the information about lateral epicondylitis depends on a variety of factors, including the search term used, the author of the website, and whether a website was seeking commercial gain. This potential for misinformation may make the process of shared decision making unnecessarily more challenging for a physician and patient.

While we attempted to evaluate websites based on what patients should know, the lack of consensus among health care professionals about the pathophysiology, natural history, and treatment of this condition may make this task relatively impossible. We attempted to remove any personal biases about lateral epicondylitis from the website evaluations by basing the scoring system on the items included on the AAOS patient education website [1]. The scoring system we have used should not be considered as a comprehensive assessment of knowledge about lateral epicondylitis since the body of knowledge is still in evolution. Rather, our assessments should be viewed as

the ability of a website to appropriately represent a group of commonly believed concepts about lateral epicondylitis.

Patients who are more educated are more likely to encounter high-quality information about the condition that they are seeking. In the current study, we have shown that searches using the term “lateral epicondylitis” and “tennis elbow” both yielded information of significantly higher quality (with regard to lateral epicondylitis) than a search using the term “elbow pain.” While “elbow pain” is admittedly a less specific search term (particularly when grading websites based on their content about lateral epicondylitis), we tried to minimize the effect of this limitation by excluding websites that were found using the term “elbow pain” but did not include information about lateral epicondylitis. There is a fair likelihood (51 %) that patients seeking information about lateral epicondylitis will encounter a website that is seeking commercial gain, which lowers the quality of the information that is ultimately found. Websites authored by health care providers were significantly more accurate than those authored by non-health care providers, suggesting that health care providers should play a more active role in providing information to patients on the internet. Regardless, patients seeking information about lateral epicondylitis will find websites that are written near the 11th grade level on average. None of the websites met the recommendation of a below sixth grade reading level. This is particularly concerning because less educated patients are at a particular disadvantage. Not only are they less likely to have access to the internet but also the quality of information they find will be influenced by the sophistication and specificity of the search term used, and they will likely be unable to understand the materials that they find. Furthermore, our results suggest that individuals who are informed about their diagnosis (“lateral epicondylitis”) will find better quality information for their conditions, but individuals who are unaware of their diagnosis (“elbow pain”) are less likely to find high-quality information. This presents an opportunity for physicians to take advantage of the internet’s capabilities by educating their patients and directing to reliable sources of information on the internet about their diagnosis [27].

Although the order of search results did not significantly influence the quality, accuracy, and readability in our study, the role of search engines in controlling access to information cannot be underestimated. Health care providers (and the specialty societies to which they belong) should work either independently, or in conjunction with search engines programmers, to ensure that high-quality, accurate, and understandable information about health care conditions is presented to patients on the internet. Our results show that more accurate information is found within the first five search results. Search engine programmers should continue to prioritize these websites but should also strive to direct users towards information written at an appropriate grade level for the general public. Patients who do not have the ability to access, understand, and apply health care information are at a disadvantage in utilizing and benefiting from health care services [3]. We must ensure that these patients are not left behind as the internet continues to expand as a portal for health care information.

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