Patient education for carpal tunnel syndrome: analysis of readability

Kyle R. Eberlin · Christina R. Vargas ·
Danielle J. Chuang · Bernard T. Lee

Published online: 9 December 2014
© American Association for Hand Surgery 2014

Abstract

Background The National Institutes of Health and American Medical Association recommend a sixth grade reading level for patient-directed content. This study aims to quantitatively evaluate the readability of the most commonly used resources for surgical treatment of carpal tunnel syndrome.

Methods A web search for “carpal tunnel surgery” was performed using an Internet search engine, and the 13 most popular sites were identified. Relevant, patient-directed articles immediately accessible from the main site were downloaded and formatted into plain text. A total of 102 articles were assessed for readability using ten established analyses: first overall, then by website for comparison.

Results Patient information about carpal tunnel surgery had an overall average reading level of 13.1. Secondary analysis by website revealed a range of mean readability from 10.8 (high school sophomore level) to 15.3 (university junior level). All sites exceeded the recommended sixth grade reading level.

Conclusions Online patient resources for carpal tunnel surgery uniformly exceed the recommended reading level. These are too difficult to be understood by a large portion of American adults. A better understanding of readability may be useful in tailoring more appropriate resources for average patient literacy.

Keywords Carpal tunnel syndrome · Health literacy · Online resources · Patient education · Readability

Background

Carpal tunnel syndrome is the most common compressive neuropathy in the upper extremity and has been estimated to occur in 3–5 % of the population [6, 17]. Patients can present with myriad symptoms including pain, weakness, or clumsiness in the hand or more proximally in the arm [13, 15, 23, 28, 33]. For this reason, patient education about pathophysiology and treatment can be challenging, particularly in patients who have atypical symptoms.

With the increasing availability of Internet access, patients have turned to online resources to gather information about diagnoses and possible methods of treatment. Greater than 90 % of patients utilize Internet resources for purposes of medical decision-making [24], which has increased significantly since 2002 [9]. There is a discrepancy between the reading level of patient health information and the functional literacy of the adult population in the USA; educational materials are often more complicated and intricate than understandable by the general public. This forms a barrier to patient decision-making, compliance with medical recommendations, patient satisfaction, and outcomes [1, 5, 18]. Patients with average literacy may not be able to comprehend information listed on popular and commonly utilized websites, creating additional challenges for effective transfer of information [25].

To provide patients with appropriate information, the National Institutes of Health (NIH) and American Medical Association (AMA) have advised the provision of patient information at a sixth grade reading level [1]. Professional

K. R. Eberlin (✉)
Division of Plastic Surgery, Massachusetts General Hospital,
Harvard Medical School, Boston, MA, USA
e-mail: keberlin@mgh.harvard.edu

C. R. Vargas · D. J. Chuang · B. T. Lee
Division of Plastic Surgery, Beth Israel Deaconess Medical Center,
Harvard Medical School, Boston, MA, USA

Table 1 Readability metrics used for analysis

Test	Score type	Qualities assessed	Formula
Coleman-Lieu	Grade level	Word length sentence length	$G=((5.88*C)/W)-((29.5*S)/W)-15.8$
Flesch-Kincaid	Grade level	Word complexity sentence length	$G=(11.8*(B/W))+(0.39*(W/S))-15.59$
Flesch Reading Ease	Index score range (0–100; 100=easiest)	Word complexity sentence length	$I=206.835-(84.6*(B/W))-(1.015*(W/S))$
FORCAST	Grade level	Word complexity	$G=20-(M/10)$
Fry Graph	Grade level	Word complexity sentence length	1. Extract 100 word samples 2. Count number of sentences 3. Count number of syllables 4. Plot on the Fry Graph 5. Fry score=average of samples
Gunning Fog	Grade level	Word complexity sentence length	$G=0.4*(W/S+((X/W)*100))$
New Dale-Chall	Grade level	Word familiarity sentence length	$G=(0.0496*(W/S))+(0.1579*(U/W))+3.6365$
New Fog Count	Grade level	Word complexity sentence length	$G=((E+(3*X))/S)-3)/2$
Raygor Estimate	Grade level	Word length sentence length	1. Extract 100 word samples 2. Count number of sentences 3. Count number of words >6 letters 4. Plot on the Raygor graph 5. Raygor estimate=average of samples
SMOG	Grade level	Word complexity sentence length	$G=1.0430*\sqrt{X}+3.1291$

G grade level, *I* index, *W* number of words, *C* number of characters, *S* number of sentences, *B* number of syllables, *M* number of monosyllabic words, *X* number of complex words (>3 syllables), *E* number of unfamiliar words (based on a list of 3000 common words known to average fourth grade students)

organizations have developed instruments to ensure the readability of patient materials [27]; however, most online resources remain above the recommended grade level [2, 3, 7, 10, 14, 19, 20, 26, 31]. Prior studies of readability have not addressed carpal tunnel syndrome, a problem commonly treated by hand surgeons.

The aims of this study were to identify the most popular online resources for patients with carpal tunnel syndrome and to evaluate the readability of these documents in the context of average literacy within the USA.

Methods

Article Collection

A web search was performed using the two largest Internet search engines (Google and Bing) on August 18, 2013, using the term “carpal tunnel surgery,” and the 13 most popular, patient-directed sites common to both results were identified. The searches were performed systematically by a single investigator with all location and account information disabled

Table 2 Top websites identified through online web search

Website	Organization	Number of articles
AAOS.org	American Academy of Orthopaedic Surgeons	2
ASSH.org	American Society for Surgery of the Hand	3
Carpal-tunnel.net	Carpal-tunnel.net	11
Carpaltunnelsyndromepain.com	Carpaltunnelsyndromepain.com	5
Emedicine.com	Medscape	15
Emedtv.com	Cliniaero, Inc.	10
Health.nytimes.com	The New York Times Company	11
Healthgrades.com	Health Grades, Inc.	3
Joint-pain-solutions.com	Joint Pain Solutions	6
NINDS.nih.gov	National Institute of Neurological Disorders and Stroke	4
Surgeryencyclopedia.com	Advameg, Inc.	8
WebMD.com	WebMD, LLC.	16
Wikipedia.org	The Wikipedia Foundation, Inc.	8
	Total	102

Table 3 Grade level analysis by readability test

Readability test	Mean reading grade level
Coleman-Liau	13
Flesch-Kincaid	12.6
FORCAST	11.6
Fry	14
Gunning Fog	13.9
New Dale-Chall	12.8
New Fog Count	10.8
Raygor Estimate	15
SMOG	13.9
Average	13.1

to avoid inadvertent search bias. Articles, defined by topic as they might be in a newspaper, were collected from each site. All relevant articles accessible within one click from the parent site were included. Articles pertaining to other topics, pages intended to refer patients to specific health-care providers or practices, and links to outside sites were excluded. Each article was downloaded and formatted into a plain text Microsoft Word 2007 (Microsoft Corp., Redmond, WA) document by a single investigator. All pictures, videos, links, captions, advertisements, and multimedia adjuncts were removed.

Readability Analysis

Assessment of article readability was performed using the Readability Studio Professional Edition v2012.2 software (Oleander Software, Ltd., Vandalia, OH). Analysis was performed for all 102 articles overall, then separately for each

parent website. The readability for each group was assessed using ten well-established tests: Coleman-Liau Index, Flesch Kincaid Grade Level, FORCAST Formula, Fry Graph, Gunning Fog Index, New Dale-Chall, New Fog Count, Raygor Readability Estimate, Simple Measure of Gobbledygook (SMOG) Formula, and Flesch Reading Ease (Table 1).tgroup

Results

A total of approximately 3.5 million results were returned by each search engine. The first 13 websites produced by both search engines were identified and included in the study (Table 2). Two sites were ultimately excluded from the ordered list of Google results relative to those returned by Bing. A total of 102 articles were collected from these sites; these were organized by parent website for readability analysis.tgroup

Overall, patient articles about carpal tunnel surgery from the 13 most popular websites have a mean reading level of 13.1. Average reading level for each test is displayed in Table 3. Mean Coleman-Liau grade level was 13.0, Flesch-Kincaid 12.6, and FORCAST 11.6. Fry readability (Fig. 1) was 14.0 and Gunning Fog was 13.9. New Dale-Chall analysis revealed a reading level of 12.8. New Fog Count produced the lowest average reading level at 10.8, and Raygor Estimate (Fig. 2) the highest at 15. Average SMOG reading level was 13.9. Flesch Reading Ease, which expresses readability as an index score from 0 to 100, with 100 being easiest to read, produced a score of 42 when all articles were included.

Fig. 1 Fry readability graph. For each article, the average number of syllables and average number of sentences per hundred words are plotted on the X- and Y-axes, respectively. The majority of articles fall well above the recommended sixth grade level

Fig. 2 Raygor readability estimate. Each mark indicates an article's readability as a function of the average number of sentences and number of long words per hundred words. Raygor analysis reveals that

all 102 articles were found to have a higher required reading level than that recommended by the AMA and NIH

When articles were analyzed by website, a range of readability from 10.8 (AAOS.org) to 15.3 (Wikipedia.org) was identified (Fig. 3). All 13 of the sites analyzed exceeded the recommended sixth grade level. Flesch

Reading Ease analysis produced an index score range from 29 (Wikipedia.org) to 58 (AAOS.org) (Fig. 4). None of the sites achieved a score between 60 and 70 (considered “Plain English”) or higher.

Fig. 3 Mean reading level by website. All 13 sites exceed the recommended sixth grade reading level

Fig. 4 Mean Flesch Reading Ease score by website. FRE Index scores are shown. These are reported on a scale from 0 to 100 (*Y-axis*), where 100 indicates the easiest to read information. Average documents in

Website

“plain English” should score between 60 and 70; websites about carpal tunnel surgery ranged from 29 to 58

Discussion

As patient Internet access becomes more universal, effective online education requires presentation of comprehensive and sophisticated information in a way that is understandable for the general public. For this reason, the AMA and the NIH have recommended a sixth grade reading level for such patient-directed information [1]. In this study, we found that the most popular Internet resources for carpal tunnel syndrome are all above this recommended reading level and on average were approximately that of a college university freshman.

The different stages, severity, and time of presentation for patients with carpal tunnel syndrome make effective education a critical part of care delivery. Patients with mild or moderate disease may experience more complete recovery than those with severe disease, although all patients may in fact receive some benefit from surgical release [8, 22]. Patients with severe disease with demyelination may not fully regain sensory or motor function post-operatively, despite complete surgical release [21]. These nuances are an important part of clinical discussion and surgical planning, as the goals of surgical intervention vary depending on the patient’s age, disease severity, expectations, and occupation, among others.

Prior studies in the hand surgery literature have investigated the readability of hand-related websites [32], and others have studied patient educational materials in the management of distal radius fractures [10]. Certain hand surgery conditions, including distal radius fractures, may be more concrete and easily explained to patients than the treatment of the various stages of carpal tunnel syndrome. Despite the high prevalence of carpal tunnel syndrome in the general population, no prior studies have specifically examined the online materials available for patient education for this condition.

Studies in other disciplines have evaluated the readability of online patient materials and have similarly found that the reading level far exceeds recommendations. In a 2005 review of Internet sites pertaining to cancer treatment, the Flesch Reading Ease score was 47.7, Flesh-Kincaid score was 10.8, and SMOG readability was 13.1 [12]. A more recent study investigating the operative treatment of breast cancer demonstrated that the average reading level was 12.9 [29], and another studying patient education related to hernia repair had an average reading grade level of 13.6 [30]. Other studies have corroborated these findings [2, 3, 11, 14, 26]. Collectively, these studies underscore the importance of developing more appropriate and effective online patient educational

materials, particularly those that require decision-making for surgery.

There are many possible ways to address the discrepancy between reading level and patient education. Modification of online content to reflect the reading ability of the general public could be achieved, although the number of websites that would need to be altered is significant. Computer-based learning modules can be effective in the decisions related to surgical breast reconstruction [18] and may be of benefit to patients with carpal tunnel syndrome given the elective and complex nature of surgical decision-making. Decision aids have been used in many surgical disciplines and can be helpful in patient education and decision-making; they can also make patients more likely to prefer non-operative or less invasive treatment options [16]. As patients increasingly use online resources to obtain medical information, effective communication and delivery are paramount for patient care. Not only is effective communication important, but the specific language used for this purpose also matters [4].

There are limitations to this study, including the nature of the search and the websites used for analysis. The search was performed using the term “carpal tunnel surgery”; inevitably, different search terms would have produced different websites and articles for analysis. However, given its ubiquity, the term “carpal tunnel surgery” may be more commonly recognized by the general public than many other hand surgery conditions. Additionally, the use of multimedia adjuncts such as videos and simulations was not assessed and could potentially improve the comprehensibility of the information presented. Future studies are needed to better identify other means of patient education for carpal tunnel syndrome and methods to enhance effective online communication.

Conflict of Interest Kyle R. Eberlin declares that he has no conflict of interest. Christina R. Vargas declares that she has no conflict of interest. Danielle J. Chuang declares that she has no conflict of interest. Bernard T. Lee declares that he has no conflict of interest.

Statement of Human and Animal Rights This article does not contain any studies with human or animal subjects.

Statement of Informed Consent Informed consent was not necessary, as this study did not contain animal or human subjects.

References

- Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, A.M.A. Health literacy: report of the council on scientific affairs. *JAMA*. 1999;281(6):552–7.
- Agarwal N et al. A comparative analysis of neurosurgical online education materials to assess patient comprehension. *J Clin Neurosci*. 2013;20(10):1357–61.
- Aliu O, Chung KC. Readability of ASPS and ASAPS educational web sites: an analysis of consumer impact. *Plast Reconstr Surg*. 2010;125(4):1271–8.
- Anthony S, Lozano-Calderon S, Ring D. Stigmatization of repetitive hand use in newspaper reports of hand illness. *Hand (N Y)*. 2008;3(1):30–3.
- Ashraf AA et al. Patient involvement in the decision-making process improves satisfaction and quality of life in postmastectomy breast reconstruction. *J Surg Res*. 2013;184(1):665–70.
- Atroshi I et al. Prevalence of carpal tunnel syndrome in a general population. *JAMA*. 1999;282(2):153–8.
- Bailey MA et al. Quality and readability of online patient information for abdominal aortic aneurysms. *J Vasc Surg*. 2012;56(1):21–6.
- Capasso M, Manzoli C, Uncini A. Management of extreme carpal tunnel syndrome: evidence from a long-term follow-up study. *Muscle Nerve*. 2009;40(1):86–93.
- Diaz JA et al. Patients' use of the Internet for medical information. *J Gen Intern Med*. 2002;17(3):180–5.
- Dy CJ et al. The effect of search term on the quality and accuracy of online information regarding distal radius fractures. *J Hand Surg [Am]*. 2012;37(9):1881–7.
- Eloy JA et al. Readability assessment of patient education materials on major otolaryngology association websites. *Otolaryngol Head Neck Surg*. 2012;147(5):848–54.
- Friedman DB, Hoffman-Goetz L, Arocha JF. Health literacy and the world wide web: comparing the readability of leading incident cancers on the Internet. *Med Inform Internet Med*. 2006;31(1):67–87.
- Gupta SK, Benstead TJ. Symptoms experienced by patients with carpal tunnel syndrome. *Can J Neurol Sci*. 1997;24(4):338–42.
- Hansberry DR et al. Analysis of the readability of patient education materials from surgical subspecialties. *Laryngoscope*. 2014;124(2):405–12.
- Katz JN, Stirrat CR. A self-administered hand diagram for the diagnosis of carpal tunnel syndrome. *J Hand Surg [Am]*. 1990;15(2):360–3.
- Knops AM et al. Decision aids for patients facing a surgical treatment decision: a systematic review and meta-analysis. *Ann Surg*. 2013;257(5):860–6.
- Lawrence RC et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States. Part II. *Arthritis Rheum*. 2008;58(1):26–35.
- Lee BT et al. Computer-based learning module increases shared decision making in breast reconstruction. *Ann Surg Oncol*. 2010;17(3):738–43.
- McInnes N, Haglund BJ. Readability of online health information: implications for health literacy. *Inform Health Soc Care*. 2011;36(4):173–89.
- Misra P et al. Readability analysis of healthcare-oriented education resources from the American Academy of Facial Plastic and Reconstructive Surgery. *Laryngoscope*. 2013;123(1):90–6.
- Nobuta S et al. Clinical results in severe carpal tunnel syndrome and motor nerve conduction studies. *J Orthop Sci*. 2005;10(1):22–6.
- Nolan 3rd WB et al. Results of treatment of severe carpal tunnel syndrome. *J Hand Surg [Am]*. 1992;17(6):1020–3.
- Nora DB et al. Clinical features of 1039 patients with neurophysiological diagnosis of carpal tunnel syndrome. *Clin Neurol Neurosurg*. 2004;107(1):64–9.
- Pourmand A, Sikka N. Online health information impacts patients' decisions to seek emergency department care. *West J Emerg Med*. 2011;12(2):174–7.
- Sand-Jecklin K. The impact of medical terminology on readability of patient education materials. *J Community Health Nurs*. 2007;24(2):119–29.
- Sanghvi S et al. Readability assessment of Internet-based patient education materials related to facial fractures. *Laryngoscope*. 2012;122(9):1943–8.

27. Shedlosky-Shoemaker R et al. Tools for assessing readability and quality of health-related web sites. *J Genet Couns*. 2009;18(1):49–59.
28. Stevens JC et al. Symptoms of 100 patients with electromyographically verified carpal tunnel syndrome. *Muscle Nerve*. 1999;22(10):1448–56.
29. Vargas CR et al. Readability of online patient resources for the operative treatment of breast cancer. *Surgery*. 2014;156(2):311–8.
30. Vargas CR, Chuang DJ, Lee BT. Online patient resources for hernia repair: analysis of readability. *J Surg Res*. 2014;190(1):144–50.
31. Walsh TM, Volsko TA. Readability assessment of Internet-based consumer health information. *Respir Care*. 2008;53(10):1310–5.
32. Wang SW, Capo JT, Orillaza N. Readability and comprehensibility of patient education material in hand-related web sites. *J Hand Surg [Am]*. 2009;34(7):1308–15.
33. Zanette G, Marani S, Tamburin S. Proximal pain in patients with carpal tunnel syndrome: a clinical-neurophysiological study. *J Peripher Nerv Syst*. 2007;12(2):91–7.