A comparative analysis of minimally invasive and open spine surgery patient education resources

Clinical article

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Object. The Internet has become a widespread source for disseminating health information to large numbers of people. Such is the case for spine surgery as well. Given the complexity of spinal surgeries, an important point to consider is whether these resources are easily read and understood by most Americans. The average national reading grade level has been estimated to be at about the 7th grade. In the present study the authors strove to assess the readability of open spine surgery resources and minimally invasive spine surgery resources to offer suggestions to help improve the readability of patient resources.

Methods. Online patient education resources were downloaded in 2013 from 50 resources representing either traditional open back surgery or minimally invasive spine surgery. Each resource was assessed using 10 scales from Readability Studio Professional Edition version 2012.1.

Results. Patient education resources representing traditional open back surgery or minimally invasive spine surgery were all found to be written at a level well above the recommended 6th grade level. In general, minimally invasive spine surgery materials were written at a higher grade level.

Conclusions. The readability of patient education resources from spine surgery websites exceeds the average reading ability of an American adult. Revisions may be warranted to increase quality and patient comprehension of these resources to effectively reach a greater patient population.

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Key Words • spine surgery • minimally invasive • readability • health literacy • patient education • patient comprehension • health care • Internet

The Internet has become a widespread source for disseminating health information to large numbers of people. Spine surgery is no exception to this, and there exists a plethora of websites that try to educate people on the many types of conditions and surgeries that involve the spine. Given the intricacy of surgical procedures involving the spine, an important point to consider is whether these resources are easily read and understood by most Americans. The national reading grade level average has been estimated to be at about the 7th grade.8,13,14 Therefore, the American Medical Association (AMA) and the National Institutes of Health (NIH) have recommended that the reading level of patient education resources not exceed the 6th grade reading level and be no less than what a 4th grader is capable of reading.7,10,14

Our goal is to assess the readability of open spine surgery resources and minimally invasive spine surgery resources to offer suggestions to help improve the readability of patient resources. The long-term goal of this research is to improve patients’ understanding, leading to better informed decisions of their condition.

Methods

In 2013, patient education resources for both minimally invasive and traditional open back surgery were downloaded via a Google search using the key terms “minimally invasive spine surgery” and “spine surgery,” respectively. Patient information was compiled into individual documents from 25 professional medical websites listed under each search. See Tables 1 and 2 for a summary of the resources that we analyzed.
TABLE 1: Raw scores and averages of readability analysis conducted on patient information with regard to minimally invasive spinal surgery*

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* CLI = Coleman-Liau Index; FKGL = Flesch-Kincaid Grade Level; FRE = Flesch Reading Ease; Fry = Fry Graphical Analysis; GFI = Gunning Fog Index; NDC = New Dale-Chall; NFC = New Fog Count; RRE = Raygor Readability Estimate; T+ = text is too difficult to be classified into a specific grade level.
### TABLE 2: Raw scores and averages of readability analysis conducted on patient information with regard to traditional open back spine surgery

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Spine surgery education resources

Any text obtained from the resources that was irrelevant to the readability analysis—hyperlinks, copyright notices, and author information—was removed before any tests were conducted. Each resource was assessed using Readability Studio Professional Edition version 2012.1 (Oleander Software, Ltd.). The tests conducted on each of the resources included the Coleman-Liau Index, FORCAST Formula, SMOG Grading, New Dale-Chall Readability Formula, Flesch Reading Ease, Flesch-Kincaid Grade Level, Fry Graphical Analysis, Gunning Fog Index, the New Fog Count, and the Raygor Readability Estimate.

Results

Results are compared with the average American adult reading level of grade 7–8, and the recommended reading level suggested by the NIH, AMA, and United States Department of Health and Human Services: grade 4–6. Non–whole number grade levels are interpreted as an intermediate difficulty between the two nearest whole numbers. For example, a grade level score of 9.5 should be interpreted as a difficulty level between the 9th and 10th grade level.

The Coleman-Liau Index, New Dale-Chall, Flesch-Kincaid, Flesch Reading Ease, FORCAST, Fry, Gunning Fog, New Fog Count, Raygor Estimate, and SMOG assessments showed that the examined resources (see the institutions and physicians listed in Tables 1 and 2) produced patient information on open and minimally invasive spinal surgery at a level above the recommended and average American adult reading level. However, the New Fog Count readability test conducted using the open spinal surgery information provided by Johns Hopkins Medicine Orthopaedic Surgery, Christ Hospital Spine Surgery Center, Mayfield Clinic, Mayo Clinic, NYU Langone Medical Center, Orthopaedic and Laser Spine Surgery, WebMD, and KRAUS Back and Neck Institute were within the confines of the recommended reading level of the average American adult (Table 2). Fry Graphical Analysis and Raygor Estimate conducted on information pertaining to open spinal surgery provided by the KRAUS Back and Neck Institute resulted in text too difficult to be classified to a specific grade level. Similarly, minimally invasive spine surgery information for patients provided by Mount Sinai Hospital contained text too difficult to be classified to a grade level with the Fry and Raygor analyses. Overall, all sources of information for open and minimally invasive spinal surgery were above the recommended 6th grade reading level set forth by the NIH, AMA, and United States Department of Health and Human Services.

Conducting a Flesch Reading Ease readability analysis led to the observation that, in general, patient resources about minimally invasive spinal surgery provided by the cited institutions and physicians are at the least “Difficult” and at the most “Very Difficult” (Fig. 1 upper). Repeating this analysis on patient information with regard to open spinal surgery revealed the ease of reading to between “Fairly Difficult” and “Difficult” (Fig. 1 lower). The average Flesch Reading Ease index of the information for minimally invasive and open spinal surgery was calculated to be 34.5 and 42, respectively (Fig. 1). Of all cited sources of information, NYU Langone Medical Center’s patient information on open spinal surgery scored a Flesch Reading Ease index indicating the easiest level of readability, albeit “Fairly Difficult,” of 56 (Table 2 and Fig. 2). In contrast, Medtronic’s patient information on minimally invasive spine surgery fell under the category of “Very Difficult,” with a Flesch Reading Ease index of 12 (Table 1 and Fig. 1 upper). Overall, Flesch Reading Ease analysis indicated that patient information on minimally invasive spinal surgery is written at a higher grade level than that of open spinal surgery (Fig. 1).

Fry Graphical Analysis readability results paralleled the aforementioned trends with readability scores of patient information exceeding the average American adult reading level. Results from the Fry Graphical Analysis conducted on minimally invasive spinal surgery information for patients revealed a grade level spanning from 12th grade to higher, with a mean grade level of 15.9 (Table 1 and Fig. 2 upper). Fry Graphical Analysis conducted on open spinal surgery patient information revealed a wide variety of reading levels, from 10th grade level to higher, with a mean grade level of 13.6 (Table 2 and Fig. 2 lower). Overall, this analysis indicated that patient information on minimally invasive spinal surgery is written at a higher grade level than that on open spinal surgery (Fig. 2).

Discussion

Relevance of Readability

The implications of poor health literacy are far-reaching, affecting the consumers and providers of medical care. Medical literature written for patients is easily accessible via the Internet and media. Elderly Americans are the largest proportion of the population utilizing medical care. An aging population is at risk for possible physical limitations such as poor eyesight, decreased hearing, and reduced concentration and comprehension. As a result, there is an ever-increasing risk of misinterpreting or not fully comprehending medical information. Ensuring appropriate readability of patient information is the first line of defense in keeping consumers of medical information informed and aware of the services they receive. The United States Department of Education found that 12% of adults had “proficient” health literacy, 53% had “intermediate” health literacy, 22% had “basic” health literacy, and 14% had “below basic” health literacy.

The physicians and institutions providing patient information have the intention of informing consumers about the benefits, risks, indications, and outcomes of procedures they may undergo. The provider of patient information is faced with the formidable task of consolidating complex medical information into a form that is fully comprehensible by an average American adult. If the distillation of information is done successfully, a patient will have the ability to understand how and why a particular procedure best suits his/her situation instead of undergoing a procedure uninformed. A fully informed patient will be able to effectively communicate his or her concerns about specific aspects of medical care. This will encourage directed dialogue between patient and physician and promote a healthy

471
doctor-patient relationship. Also, dollars spent on medical care can be affected by readability of patient information.

Economically, on the individual level, problems arise in the form of preventable recurrent hospitalizations or visits. On the national level, there are negative economic consequences: it has been estimated that low health literacy is costing the United States economy between $106 and $236 billion annually. This cost is estimated to be as high as $1.6–$3.6 trillion when future costs related to health care either provided or foregone are taken into account.¹²

Readability Analyses

To fully assess the readability of institution- and physician-provided patient education material, 10 different readability analyses were used. Upon analyzing the level of readability across all 10 readability scales, not one patient education resource provided by the institutions or physicians we included met the recommended 6th grade maximum readability level or even the 7th–8th grade reading ability of the typical American adult. The source nearest to the recommended reading level was NYU Langone Medical Center in its information on open spinal surgery. The American Academy of Orthopedic Surgeons, Spine Universe, and University Spine had the same average reading grade level of information on minimally invasive spinal surgery. The New Fog Count readability assessment

Fig. 1. Flesch Reading Ease scores for minimally invasive spine surgery (upper) and traditional open back spine surgery (lower).
conducted on all sources of open and minimally invasive spinal surgery resulted in the lowest grade level readability—10.4 and 11.8, respectively. The average Flesch Reading Ease score for all sources of patient information on open spinal surgery was 42.0 (Difficult). Similarly, the average Flesch Reading Ease score for minimally invasive information sources was 34.5 (Difficult).

One trend was observed: greater degrees of readability difficulty were associated more with minimally invasive surgery information than with open surgery information for patients. A variety of factors may have contributed to this disparity. For example, minimally invasive spine surgery utilizes more anatomical descriptions than does open surgery. Understandably, simplifying text of this nature will be difficult, leading to scores portraying higher levels of reading difficulty.

**Fig. 2.** Fry Graphical Analysis of patient information for minimally invasive spine surgery (upper) and traditional open back spine surgery (lower).
Practical Solutions

A variety of methods can be used to improve upon the readability of patient information resources. One means to improvement is to communicate information in a very clear writing style, which may be beneficial regardless of an individual’s health literacy capabilities. One must also consider the difficulty of words used within a resource. Studies show that the difficulty of vocabulary is a great predictor of the readability of written materials. Replacing complex words with simpler words will lead to greater readability of patient information. Last, utilizing pictures is considered to be an important part of health literacy. Extending this concept, it has been shown in the health care setting that the use of videos may be an effective way of increasing a patient’s comprehension of their health. It has been suggested that the use of videos increases comprehension levels in low literacy populations more effectively than written education materials that were given to patients.

Future Analysis

Future studies should aim to evaluate the average reading level of patients receiving care from each of the analyzed medical specialties for a comparative analysis to determine if average reading levels differ among specialty-specific patient populations. This may provide a reference so that website revisions are appropriate for the patient population likely to access these resources. Future studies should also seek to better understand the relationship between readability and multimedia effectiveness, which would help to improve health literacy as well as patient outcomes.

Conclusions

The readability of patient education resources from spine surgery websites exceeds the average reading ability of an American adult. Revisions may be warranted to increase quality and patient comprehension of these resources to effectively reach a greater patient population. An emphasis on clear writing style may be beneficial regardless of an individual’s health literacy capabilities. Overall, future studies are required to further delineate the best approach to improve health literacy and patient outcomes.

Disclosure

Dr. Goldstein reports being a consultant for Zimmer, Biomet, and Alphatec Spine.

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References


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