

Readability of Orthopedic Trauma Patient Education Materials on the Internet

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Abstract

In this study, we used the Flesch-Kincaid Readability Scale to determine the readability levels of orthopedic trauma patient education materials on the American Academy of Orthopaedic Surgeons (AAOS) website and to examine how subspecialty coauthorship affects readability level.

Included articles from the AAOS online patient education library and the AAOS OrthoPortal website were categorized as *trauma or broken bones and injuries* on the AAOS online library or were screened by study authors for relevance to orthopedic trauma. Subsequently, the Flesch-Kincaid scale was used to determine each article's readability level, which was reported as a grade level. Subspecialty

coauthorship was noted for each article.

A total of 115 articles from the AAOS website were included in the study and reviewed. Mean reading level was grade 9.1 for all articles reviewed. Nineteen articles (16.5%) were found to be at or below the eighth-grade level, and only 1 article was at or below the sixth-grade level. In addition, there was no statistically significant difference between articles coauthored by the various orthopedic subspecialties and those authored exclusively by AAOS.

Orthopedic trauma readability materials on the AAOS website appear to be written at a reading comprehension level too high for the average patient to understand.

Take-Home Points

- The Flesch-Kincaid Readability Scale is a useful tool in evaluating the readability of PEMs.
- Only 1 article analyzed in our study was below a sixth-grade readability level.
- Coauthorship of PEMs with other subspecialty groups had no effect on readability.
- Poor health literacy has been associated with poor health outcomes.
- Efforts must be undertaken to make PEMs more readable across medical subspecialties.

Patients increasingly turn to the Internet to self-educate about orthopedic conditions.^{1,2} Accordingly, the Internet has become a valuable tool in maintaining effective physician-patient communication.³⁻⁵ Given the Internet's importance as a medium for conveying patient information, it is important that orthopedic patient education materials (PEMs) on the Internet provide high-quality information that is easily read by the target patient population. Unfortunately, studies have found that many of the Internet's orthopedic PEMs have been neither of high quality⁶⁻⁸ nor presented

such that they are easy for patients to read and comprehend.^{1,9-12}

Readability, which is the reading comprehension level (school grade level) a person must have to understand written materials, is determined by systematic formulae¹²; readability levels correlate with the ability to comprehend written information.² Studies have consistently found that orthopedic PEMs are written at readability levels too high for the average patient to understand.^{1,9,13} The readability of PEMs in orthopedics as a whole⁹ and within the orthopedic subspecialties of arthroplasty,¹ foot and ankle surgery,² sports medicine,¹² and spine surgery¹³ has been evaluated, but so far there has been no evaluation of PEMs in orthopedic trauma (OT).

We conducted a study to assess the readability of OT-PEMs available online from the American Academy of Orthopaedic Surgeons (AAOS) in conjunction with the Orthopaedic Trauma Association

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(OTA) and other orthopedic subspecialty societies. We hypothesized the readability levels of these OT-PEMs would be above the level (sixth to eighth grade) recommended by several healthcare organizations, including the Centers for Disease Control and Prevention.^{9,11,14} We also assessed the effect that orthopedic subspecialty coauthorship has on PEM readability.

Methods

In July 2014, we searched the AAOS online patient education library (Broken Bones & Injuries section, <http://orthoinfo.aaos.org/menus/injury.cfm>) and the AAOS OrthoPortal website (Trauma section, http://pubsearch.aaos.org/search?q=trauma&client=OrthoInfo&site=PATIENT&output=xml_no_dtd&proxystylesheet=OrthoInfo&filter=0) for all relevant OT-PEMs. Although OTA does not publish its own PEMs on its website, it coauthored several of the articles in the AAOS patient education library. Other subspecialty organizations, including the American Orthopaedic Society for Sports Medicine (AOSSM), the American Society for Surgery of the Hand (ASSH), the Pediatric Orthopaedic Society of North America (POSNA), the American Shoulder and Elbow Surgeons (ASES), the American Association of Hip and Knee Surgeons (AAHKS), and the American Orthopaedic Foot and Ankle Society (AOFAS), coauthored several of these online OT-PEMs as well.

Using the technique described by Badarudeen and Sabharwal,¹⁰ we saved all articles to be included in the study as separate Microsoft Word 2011 files. We saved them in plain-text format to remove any HTML tags and any other hidden formatting that might affect readability results. Then we edited them to remove elements that might affect readability result accuracy—deleted article topic-unrelated information (eg, copyright notice, disclaimers, author information) and all numerals, decimal points, bullets, abbreviations, paragraph breaks, colons, semicolons, and dashes.¹⁰

Mr. Mohan used the Flesch-Kincaid (FK) Readability Scale to calculate grade level for each article. Microsoft Word 2011 was used as described in other investigations of orthopedic PEM readability^{2,10,12,13}: Its readability function is enabled by going to the Tools tab and then to the Spelling & Grammar tool, where the “Show readability statistics” option is selected.¹⁰ Readability scores are calculated with the Spelling & Grammar tool; the readability score is displayed after completion of the spelling-and-grammar check. The formula used to calculate FK grade level is¹⁵: $(0.39 \times \text{average}$

$\text{number of words per sentence}) + (11.8 \times \text{average number of syllables per word}) - 15.59$.

Statistical Analysis

Descriptive statistics, including means and 95% confidence intervals (CIs), were calculated for the FK grade levels. Student *t* tests were used to compare average FK grade levels of articles written exclusively by AAOS with those of articles coauthored by AAOS and other orthopedic subspecialty societies. A 2-sample unequal-variance *t* test was used, and significance was set at $P < .05$. Total number of articles written at or below the sixth- and eighth-grade levels, the reading levels recommended for PEMs, were tabulated.^{1,9-12} Intraobserver and interobserver reliabilities were calculated with intraclass correlation coefficients (ICCs): Mr. Mohan, who calculated the FK scores earlier, now 1 week later calculated the readability levels of 15 randomly selected articles^{10,11}; in addition, Mr. Mohan and Dr. Yi independently calculated the readability levels of 30 randomly selected articles.^{10,11} The same method described earlier—edit plain-text files, then use Microsoft Word to obtain FK scores—was again used. ICCs of 0 to 0.24 correspond to poor correlation; 0.25 to 0.49, low correlation; 0.5 to 0.69, fair correlation; 0.7 to 0.89, good correlation; and 0.9 to 1.0, excellent correlation.^{10,11} All statistical analyses were performed with Microsoft Excel 2011 and VassarStats (<http://vassarstats.net/tu.html>).

Results

Of the 115 AAOS website articles included in the study and reviewed, 18 were coauthored by OTA, 10 by AOSSM, 14 by POSNA, 2 by ASSH, 2 by ASES, 1 by AAHKS, 3 by AOFAS, 1 by AOSSM and ASES, and 1 by AOFAS and AOSSM.

Mean FK grade level was 9.1 (range, 6.2-12; 95% CI, 8.9-9.3) for all articles reviewed and 9.1 (range, 6.2-12; 95% CI, 8.8-9.4) for articles exclusively written by AAOS. For coauthored articles, mean FK grade level was 9.3 (range, 7.6-11.3; 95% CI, 8.8-9.8) for AAOS-OTA; 8.9 (range, 7.4-10.4; 95% CI, 8.4-9.6) for AAOS-AOSSM; 9.4 (range, 7-11.8; 95% CI, 8.9-10.1) for AAOS-POSNA; 7.8 (range, 7.8-9.1; 95% CI, 7.2-9.8) for AAOS-ASSH; 9 (range, 8.2-9.6; 95% CI, 7.6-10.2) for AAOS-ASES; 9 (range, 7.9-9; 95% CI, 7.9-9.3) for AAOS-AOFAS; 8.1 for the 1 AAOS-AAHKS article; 8.5 for the 1 AAOS-AOSSM-ASES article; and 8 for the 1 AAOS-AOFAS-AOSSM article (**Figure**). Nineteen articles (16.5%) were found to be at or below the eighth-

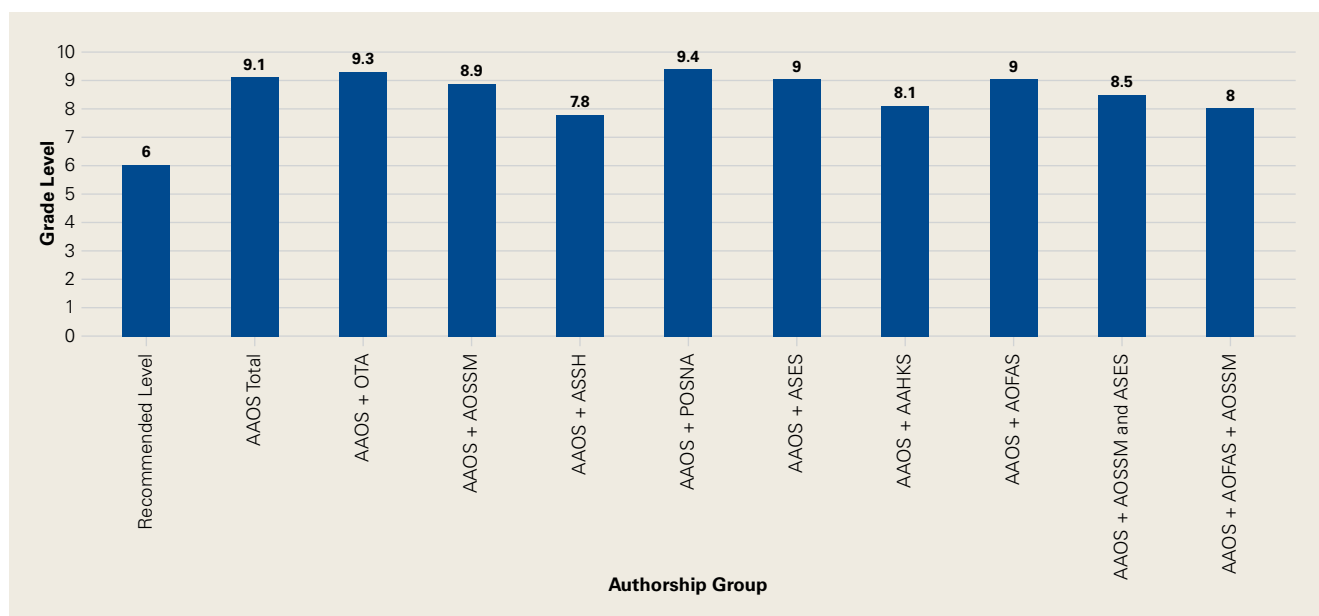


Figure. Flesch-Kincaid grade levels for articles coauthored by various orthopedic subspecialty groups.

Abbreviations: AAHKS, American Association of Hip and Knee Surgeons; AAOS, American Academy of Orthopaedic Surgeons; AOFAS, American Orthopaedic Foot and Ankle Society; AOSSM, American Orthopaedic Society for Sports Medicine; ASES, American Shoulder and Elbow Surgeons; ASSH, American Society for Surgery of the Hand; OTA, Orthopaedic Trauma Association; POSNA, Pediatric Orthopaedic Society of North America.

grade reading level, which is the average reading level of a US adult,¹⁰ and only 1 article was at or below the sixth-grade level, the level widely recommended for PEMs.¹¹ In addition, there was no statistically significant difference between articles coauthored by the various orthopedic subspecialties and those written exclusively by AAOS.

For FK readability calculations, interobserver reliability (ICC, 0.9982) and intraobserver reliability (ICC, 1) were both excellent.

Discussion

Although increasing numbers of patients are using information from the Internet to inform their healthcare decisions,¹² studies have shown that online PEMs are written at a readability level above that of the average patient.^{1,9,13} In the present study, we also found that OT-PEMs from AAOS are written at a level considerably higher than the recommended sixth-grade reading level,¹⁶ potentially impairing patient comprehension and leading to poorer health outcomes.¹⁷

The pervasiveness of too-high PEM readability levels has been found across orthopedic subspecialties.^{2,9,12,13} Following this trend, the OT articles we reviewed had a ninth-grade reading level on average, and only 1 of 115 articles was below the recommended sixth-grade level.¹⁰ The issue of too-high PEM readability levels is thus a problem both

in OT and in orthopedics in general. Accordingly, efforts to address this problem are warranted, especially as orthopedic PEM readability has not substantially improved over the past several years.¹⁸

In this study, we also tried to identify any readability differences between articles coauthored by orthopedic societies and articles that were not coauthored by orthopedic societies. We hypothesized that multidisciplinary authorship could improve PEM readability; for example, orthopedic societies could collaborate with other medical specialties (eg, family medicine) that have produced appropriately readable PEMs. One study found that the majority of PEMs from the American Academy of Family Physicians (AAFP) were written below the sixth-grade reading level because of strict organizational regulation of the production of such materials.¹⁹ By noting and adopting successful PEM development methods used by groups such as AAFP,^{19,20} we might be able to improve OT-PEM readability. However, this was not the case in our study, though our observations may have been limited by the small sample of reviewable articles.

One factor contributing to the poor readability of orthopedic PEMs is that orthopedics terminology is complex and includes words that are often difficult to translate into simpler terms without losing their meaning.¹⁰ When PEMs are written at a level that is too complex, patients cannot fully comprehend

them, which may lead to poor health literacy. This problem may be even more harmful when considering the poor literacy levels of patients at baseline. Kadakia and colleagues¹⁶ found that OT patients had poor health literacy; for example, fewer than half knew which bone they fractured. As health literacy is associated with poorer health outcomes and reduced use of healthcare services,²¹ optimizing patients' health literacy is of crucial importance to both their education and their outcomes.

Our study should be viewed in light of some important limitations. As OTA does not publish its own PEMs, we assessed only OT-related articles that were available on the AAOS website and were exclusively written by AAOS, or coauthored by AAOS and by OTA and/or another orthopedic subspecialty organization. As these articles represent only a subset of the full spectrum of OT-PEMs available on the Internet, our results may not be generalizable to the entire scope of such materials. However, as AAOS and OTA represent the most authoritative OT organizations, we think these PEMs would be among those most likely to be recommended to patients by their surgeons. In addition, although we used a well-established tool for examining readability—the FK readability scale¹⁰⁻¹³—this tool has its own inherent limitations, as FK readability grade level is calculated purely on the basis of words per sentence and total syllables per word, and does not take into account other article elements, such as images, which also provide information.^{1,10} Nevertheless, the FK scale is an inexpensive, easily accessed readability tool that provides a reproducible readability value that is easily comparable to results from earlier studies.¹⁰ The final limitation is that we excluded from the study AAOS website articles written in a language other than English. Such articles, however, are important, as a large portion of the patient population speaks English as a second language. Indeed, the readability of Spanish PEMs has been investigated—albeit using a readability measure other than the FK scale—and may be a topic pertinent to orthopedic PEMs.²²

Most of the literature on the readability of orthopedic PEMs has found their reading levels too high for the average patient to comprehend.^{1,9-12} The trend continues with our study findings regarding OT-PEMs available online from AAOS. Although the literature on the inadequacies of orthopedic PEMs is vast,^{1,9-12} more work is needed to improve the quality, accuracy, and readability of these materials. There has been some success in improving PEM readability

and producing appropriately readable materials within the medical profession,^{19,23} so we know that appropriately readable orthopedic PEMs are feasible.

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References

- Polishchuk DL, Hashem J, Sabharwal S. Readability of online patient education materials on adult reconstruction web sites. *J Arthroplasty.* 2012;27(5):716-719.
- Bluman EM, Foley RP, Chiodo CP. Readability of the patient education section of the AOFAS website. *Foot Ankle Int.* 2009;30(4):287-291.
- Hoffmann T, Russell T. Pre-admission orthopaedic occupational therapy home visits conducted using the Internet. *J Telemed Telecare.* 2008;14(2):83-87.
- Rider T, Malik M, Chevassut T. Haematology patients and the Internet—the use of on-line health information and the impact on the patient–doctor relationship. *Patient Educ Couns.* 2014;97(2):223-238.
- AlGhamdi KM, Moussa NA. Internet use by the public to search for health-related information. *Int J Med Inform.* 2012;81(6):363-373.
- Beredjikian PK, Bozentka DJ, Steinberg DR, Bernstein J. Evaluating the source and content of orthopaedic information on the Internet. The case of carpal tunnel syndrome. *J Bone Joint Surg Am.* 2000;82(11):1540-1543.
- Meena S, Palaniswamy A, Chowdhury B. Web-based information on minimally invasive total knee arthroplasty. *J Orthop Surg (Hong Kong).* 2013;21(3):305-307.
- Labovitch RS, Bozic KJ, Hansen E. An evaluation of information available on the Internet regarding minimally invasive hip arthroplasty. *J Arthroplasty.* 2006;21(1):1-5.
- Badarudeen S, Sabharwal S. Assessing readability of patient education materials: current role in orthopaedics. *Clin Orthop Relat Res.* 2010;468(10):2572-2580.
- Badarudeen S, Sabharwal S. Readability of patient education materials from the American Academy of Orthopaedic Surgeons and Pediatric Orthopaedic Society of North America web sites. *J Bone Joint Surg Am.* 2008;90(1):199-204.
- Yi PH, Ganta A, Hussein KI, Frank RM, Jawa A. Readability of arthroscopy-related patient education materials from the American Academy of Orthopaedic Surgeons and Arthroscopy Association of North America web sites. *Arthroscopy.* 2013;29(6):1108-1112.
- Ganta A, Yi PH, Hussein K, Frank RM. Readability of sports medicine-related patient education materials from the American Academy of Orthopaedic Surgeons and the American Orthopaedic Society for Sports Medicine. *Am J Orthop.* 2014;43(4):E65-E68.
- Vives M, Young L, Sabharwal S. Readability of spine-related patient education materials from subspecialty organization and spine practitioner websites. *Spine.* 2009;34(25):2826-2831.
- Strategic and Proactive Communication Branch, Division of Communication Services, Office of the Associate Director for Communication, Centers for Disease Control and Preven-

- tion, US Department of Health and Human Services. *Simply Put: A Guide for Creating Easy-to-Understand Materials*. 3rd ed. http://www.cdc.gov/healthliteracy/pdf/Simply_Put.pdf. Published July 2010. Accessed February 7, 2015.
- Wallace LS, Keenum AJ, DeVoe JE. Evaluation of consumer medical information and oral liquid measuring devices accompanying pediatric prescriptions. *Acad Pediatr*. 2010;10(4):224-227.
 - Kadakia RJ, Tsahakis JM, Issar NM, et al. Health literacy in an orthopedic trauma patient population: a cross-sectional survey of patient comprehension. *J Orthop Trauma*. 2013;27(8):467-471.
 - Peterson PN, Shetterly SM, Clarke CL, et al. Health literacy and outcomes among patients with heart failure. *JAMA*. 2011;305(16):1695-1701.
 - Feghhi DP, Agarwal N, Hansberry DR, Berberian WS, Sabharwal S. Critical review of patient education materials from the American Academy of Orthopaedic Surgeons. *Am J Orthop*. 2014;43(8):E168-E174.
 - Schoof ML, Wallace LS. Readability of American Academy of Family Physicians patient education materials. *Fam Med*. 2014;46(4):291-293.
 - Doak CC, Doak LG, Root JH. *Teaching Patients With Low Literacy Skills*. 2nd ed. Philadelphia, PA: Lippincott; 1996.
 - Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med*. 2011;155(2):97-107.
 - Berland GK, Elliott MN, Morales LS, et al. Health information on the Internet: accessibility, quality, and readability in English and Spanish. *JAMA*. 2001;285(20):2612-2621.
 - Sheppard ED, Hyde Z, Florence MN, McGwin G, Kirchner JS, Ponce BA. Improving the readability of online foot and ankle patient education materials. *Foot Ankle Int*. 2014;35(12):1282-1286.