Critical Review of Patient Education Materials From the American Academy of Orthopaedic Surgeons

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Abstract

We performed an expanded readability analysis to determine if the American Academy of Orthopaedic Surgeons (AAOS) had sufficiently improved its patient education materials since they were originally studied in 2007.

In March 2013, we downloaded patient education materials from the AAOS patient information website, *Your Orthopaedic Connection*. Using 10 different readability formulas, we found that the mean grade level of patient education materials on the website is 8.84. Flesch-Kincaid analysis showed a mean grade level of 9.98 (range, 6.6-12.6). Nine other readability analyses showed a mean reading level of 7.7 (range, 6.5-13.7). Although this is an improvement over the 2007 level, it is above the average national reading comprehension level.

The readability of patient education materials on the AAOS website still exceeds the average reading ability of a US adult. Revisions made over the 5 years leading up to this latest study resulted in better readability. The *Prevention & Safety* entries, written near seventh-grade level, should serve as a model for the remaining articles.

Ｏne of the goals of the American Academy of Orthopaedic Surgeons (AAOS) is to provide patient education materials in line with the readability skills of the general patient population. The mean reading grade level in the United States is estimated at about seventh grade.[1] A study completed in 2007 found that the mean grade level of patient education materials on the AAOS website was 10.43, according to Flesch-Kincaid analysis.[2]

The Internet is fast becoming a primary source of health care information. Every day, more than 8 million Americans use Internet resources to try to answer their questions about the medical conditions and symptoms they are experiencing.[3] About 80% of Americans report using an Internet resource to seek answers to health questions.[3,4] Studies have identified a correlation between "health literacy" and clinical outcomes: lower health literacy is associated with adverse patient outcomes, such as more frequent hospitalizations and emergency department visits, and higher health literacy is associated with more favorable patient outcomes.[4-6] Given these findings, it is essential to ensure that the health care information being accessed is easily comprehended.

Orthopedic conditions are among the most common conditions that cause patients to seek medical care.[6-9] Many orthopedic conditions call for surgical intervention. Controversy arises regarding nonoperative and operative treatments for certain diseases. Once a patient has been diagnosed with a particular injury or condition, it is almost instinctive to seek an immediate online source describing it. Online patient information should be composed at an appropriate reading level to prevent placing undue stress on patients and to foster healthy dialogue at office visits. Badarudeen and Sabharwal[10] found in their study that the mean grade level of patient information in the children sections of the AAOS and Pediatric Orthopaedic Society of North America (POSNA) websites was 8.9. The estimated mean national reading level is about seventh grade. The American Medical Association (AMA) and the National Institutes of Health (NIH) recommended that the readability level for patient education information be no higher than seventh grade.[11] In addition, the Centers for Disease Control and Prevention (CDC) recommended that the readability of patient education materials be between sixth grade and seventh grade.[12]

In April 2007, Sabharwal and colleagues[2] performed a readability analysis of patient education materials available on the AAOS website. The Flesch-Kincaid grade formula (FKGL), used to analyze all the listed articles, computed a mean grade level of 10.43.[2,10,13]

Using 10 different readability formulas, we performed an expanded readability analysis of all entries in the patient education library of the AAOS website to determine if any readability improvements had been made since the 2007 study.

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Materials and Methods

The "readability" of text is a metric that can be used to determine the level of reading comprehension required to understand online patient information. This metric can be measured with numerous commonly used assessments, such as the FKGL, the Flesch Reading Ease score (FRE), the Simple Measure of Gobbledygook (SMOG), the Gunning Fog Index (GFI), the New Dale-Chall formula (NDC), the Coleman-Liau Index (CLI), the New Fog Count (NFC), the Raygor readability estimate (RRE), the FORCAST formula, and the Fry readability graph (FRG).[14-19]

The AAOS website's patient education library features 6 categories of body parts: *Shoulder & Elbow, Hand & Wrist, Hip & Thigh, Knee & Lower Leg, Foot & Ankle,* and *Neck & Back.* Each has subcategories *Broken Bones & Injuries, Diseases & Conditions, Treatments & Surgeries, Prevention & Safety,* and *Patient Stories.*[20] On the website, we found a total of 260 entries; 9 were deemed unsuitable for readability analysis. *Patient Stories* entries were omitted because they contained many direct quotations from patients. Therefore, the 9 entries were not provided with the average US reading level in mind. All information was found at http://orthoinfo.aaos.org.

Each entry was copied into Microsoft Word (Microsoft, Redmond, Washington), and a readability analysis was performed with Readability Studio Professional Edition Version 2012.1 for Windows (Oleander Software, Vandalia, Ohio). Scores from the 10 readability assessments previously mentioned were calculated.

The process by which the readability scores for all patient information were calculated is best understood by example. Ten methods were used to evaluate the patient information in the *Broken Bones & Injuries* part of the *Knee & Lower Leg* section, and a mean was calculated. This was done for each section. Values were averaged to produce an overall readability level for the specific body part.

The mean grade level generated by each readability method was calculated as well. For example, RRE generated a grade level for *Broken Bones & Injuries, Diseases & Conditions,* and *Treatments & Surgeries* and calculated their mean. This was done for each readability scale, and a mean grade level of all the methods was calculated.

The mean grade level of each specific section and the mean of all readability analyses were averaged together to generate a final reading grade level for the body part. The final reading grade level for each body part was averaged to produce an overall readability level of the patient information on the AAOS website.

Results

Applying 10 different readability assessment tools produced a mean readability level of 8.84 for the patient information on the AAOS website.

The average readability score of *Broken Bones & Injuries, Diseases & Conditions, Prevention & Safety,* and *Treatment & Surgeries* was obtained. With regard to *Broken Bones & Injuries,* all 6 body part categories were above the recommended readability level of seventh grade (range, 7.78-8.56). Similarly, the patient information for all 6 body part subsets in the category of *Diseases & Conditions* was above the seventh-grade reading level (range, 8.03-9.36) (**Tables I, II**). On analysis of *Treatments & Surgeries,* all 6 body part subsets contained information above the seventh-grade reading level (range, 8.55-9.65) (**Tables I, II**). The information in *Shoulder & Elbow, Treatments & Surgeries,* had the highest aggregate reading level, 9.65 (**Table II**).

The AAOS website provided *Prevention & Safety* information on *Foot & Ankle, Hip & Thigh,* and *Neck & Back.* Readability analyses suggested that all this information is at the seventh- to eighth-grade reading level (range, 6.18-7.23) (**Tables I, II**).

NFC analysis produced a mean readability grade level of 8.18, and SMOG analysis produced a mean level of 12.37 (**Tables I, II**). FRE analysis of patient information in *Foot & Ankle* and *Neck & Back* suggested that the materials are written in *difficult* to *plain English* (**Figures 1, 2**). *Difficult* indicates easily understood by college graduates, *plain English* indicates easily understood by eighth graders, and *fairly difficult* indicates easily understood by 13- to 15-year-old students.[21] With FRE analysis, entries pertaining to *Knee & Lower Leg* and *Hip & Thigh* were described as *difficult* to *fairly difficult* (**Figures 3, 4**). Likewise, with FRE analysis, entries in *Shoulder & Elbow* and *Hand & Wrist* were *difficult* to *fairly difficult* (**Tables I, II**).

Reading-level ranges for sections in *Foot & Ankle, Hand & Wrist,* and *Hip & Thigh* were 7.14 to 8.55, 7.78 to 8.76, and 7.23 to 9.16, respectively. Reading-level ranges for sections in *Knee & Lower Leg, Neck & Back,* and *Shoulder & Elbow* were 8.23 to 9.36, 6.18 to 8.92, and 8.43 to 9.79, respectively.

Discussion

Other studies have shown that health literacy and health outcomes are related.[5,22] Better health outcomes can be achieved in part through improved health literacy. Patients with good health literacy are, in general, healthier.[5,6,22,23] According to *Health Literacy: A Manual for Clinicians,* produced by the AMA,[24] the best predictor of a person's health status is that person's health literacy. It follows that the lower a person's health literacy, the more likely the person is in poor health. Poor health literacy can lead to more frequent hospitalizations and office visits, additional testing, increased overall morbidity, and higher medical expenses.[5,6,22,23] A more health-literate patient can be more efficient during an office encounter. The patient can engage in an informed dialogue and present directed questions about his or her medical condition. This can improve the physician–patient relationship.[10] To obtain these benefits, patients must be able to access comprehensive, readable information. The Internet can be a source of this information.

Internet access and use of the Internet as a source of health information are rapidly increasing throughout the world.[10] In one study, 75% of patients who attended an orthopedic clinic had Internet access.[9,10] Numerous investigators have commented on orthopedic patients' extensive use of Internet resources with the intent to obtain medical information.[7-10,25] However, not all health information is written such that the average US adult can thoroughly understand it. In response, the AMA, US Department of Health and Human Services, and NIH set a rec-

ommended readability level for patient education information no higher than sixth grade. In addition, the CDC recommended that the readability of patient education materials be between sixth and seventh grades.[1,6]

Musculoskeletal injuries are very common. The AAOS is a leading authority for information on the pathology, treatment, and prognosis of these injuries. In another study, a readability analysis was performed on the children section of the AAOS website's patient education library.[10] It was determined that "only one of the fifty-seven available online pediatric orthopedic patient education articles available at the AAOS and POSNA web sites had the recommended readability grade level."[10] Our

Table I. *Foot & Ankle, Hand & Wrist*, and *Hip & Thigh* Grade Levels Determined by 10 Readability Scales

	Readability Scale										Mean
	CLI	NDC	FKGL	FRE	FORCAST	FRG	GFI	NFC	RRE	SMOG	
Foot & Ankle											
Broken Bones & Injuries	10.50	10	9.30	58.00	10.60	10.00	10.90	8.00	10.00	11.70	8.10
Diseases & Conditions	10.30	10	9.10	59.00	10.40	10.00	10.80	7.90	10.00	11.80	8.03
Patient Stories[a]	13.50	12	12.60	41.00	11.60	16.00	14.00	9.50	13.00	14.60	10.49
Prevention & Safety	8.90	8	8.20	68.00	9.30	8.00	10.10	8.20	8.00	10.70	7.14
Treatment & Surgeries	11.20	10	10.00	54.00	10.40	11.00	11.20	8.10	11.00	12.60	8.55
Grade level of all readability analyses	10.88	9	9.84	56.00	10.46	11.00	11.40	8.34	10.40	12.28	8.46
Grade level of each section specific to body part	—	—	—	—	—	—	—	—	—	—	8.06
Grade level of *Foot & Ankle*	—	—	—	—	—	—	—	—	—	—	8.26
Hand & Wrist											
Broken Bones & Injuries	9.80	8	8.90	61.00	10.30	9.00	10.50	7.90	10.00	11.40	7.78
Treatments & Surgeries	11.40	12	10.50	53.00	10.70	11.00	11.70	8.50	11.00	12.80	8.76
Diseases & Conditions	11.50	10	9.20	55.00	11.00	11.00	10.30	6.70	12.00	11.70	8.34
Grade level of all readability analyses	10.90	9	9.53	56.33	10.67	10.33	10.83	7.70	11.00	11.97	8.30
Grade level of each section specific to body part	—	—	—	—	—	—	—	—	—	—	8.30
Grade level of *Hand & Wrist*	—	—	—	—	—	—	—	—	—	—	8.30
Hip & Thigh											
Patient Stories[a]	10.40	10	10.00	55.00	10.40	11.00	11.80	8.70	9.00	12.60	8.39
Prevention & Safety	12.00	10	9.70	53.00	11.00	10.30	10.30	6.70	11.00	11.80	7.23
Treatments & Surgeries	11.70	10	10.80	50.00	10.70	12.00	12.70	9.40	11.00	13.30	9.16
Broken Bones & Injuries	10.90	10	9.50	56.00	10.60	10.00	11.20	8.20	11.00	11.70	8.31
Grade level of all readability analyses	11.32	11	10.14	52.80	10.70	11.00	11.68	8.40	10.60	12.50	8.64
Grade level of each section specific to body part	—	—	—	—	—	—	—	—	—	—	8.48
Grade level of *Hip & Thigh*	—	—	—	—	—	—	—	—	—	—	8.56

Abbreviations: CLI, Coleman-Liau Index; NDC, New Dale-Chall formula; FKGL, Flesch-Kincaid grade level; FRE, Flesch Reading Ease score; FORCAST (formula); FRG, Fry readability graph; GFI, Gunning Fog Index; NFC, New Fog Count; RRE, Raygor readability estimate; SMOG, Simple Measure of Gobbledygook.
[a]*Patient Stories* were analyzed by the readability scales but the values were not used to obtain averages.

study analyzed all patient education articles in the AAOS patient education section.

Of the 251 articles analyzed, *Prevention & Safety* entries on *Foot & Ankle*, *Hip & Thigh*, and *Neck & Back* were near the seventh-

Table II. *Knee & Lower Leg*, *Neck & Back*, and *Shoulder & Elbow* Grade Levels Determined by 10 Readability Scales

	Readability Scale										Mean
	CLI	NDC	FKGL	FRE	FORCAST	FRG	GFI	NFC	RRE	SMOG	
Knee & Lower Leg											
Broken Bones & Injuries	11.10	10	9.20	56.00	10.80	10.00	11.00	7.40	11.00	11.80	8.23
Diseases & Conditions	12.40	12	10.80	47.00	11.20	13.00	12.40	8.60	12.00	13.20	9.36
Patient Stories[a]	10.20	10	10.30	55.00	10.50	11.00	11.70	8.40	10.00	13.00	8.51
Treatments & Surgeries	11.40	10	10.40	53.00	10.50	11.00	12.20	8.90	11.00	13.00	8.84
Grade level of all readability analyses	11.28	11	10.18	52.75	10.75	11.25	11.83	8.33	11.00	12.75	8.74
Grade level of each section specific to body part	—	—	—	—	—	—	—	—	—	—	8.80
Grade level of Knee & Lower Leg	—	—	—	—	—	—	—	—	—	—	8.77
Neck & Back											
Broken Bones & Injuries	11.50	10	9.70	53.00	10.70	11.00	11.60	7.90	11.00	12.20	8.56
Diseases & Conditions	11.60	10	9.70	53.00	10.80	11.00	11.10	7.60	11.00	12.10	8.49
Patient Stories[a]	12.30	12	13.00	44.00	11.00	14.00	13.20	11.10	17.00	14.70	10.63
Prevention & Safety	8.20	6	6.60	75.00	9.40	7.00	8.10	6.50	7.00	9.00	6.18
Treatments & Surgeries	11.90	10	10.30	51.00	10.80	12.00	12.00	8.30	11.00	12.90	8.92
Grade level of all readability analyses	11.10	10	9.86	55.20	10.54	11.00	11.20	8.28	11.40	12.18	8.56
Grade level of each section specific to body part	—	—	—	—	—	—	—	—	—	—	8.15
Grade level of Neck & Back	—	—	—	—	—	—	—	—	—	—	8.35
Shoulder & Elbow											
Broken Bones & Injuries	11.00	10	9.70	54.00	11.00	11.00	10.90	7.80	11.00	11.90	8.43
Diseases & Conditions	11.80	10	9.80	52.00	11.20	11.00	10.90	7.30	12.00	12.00	8.60
Treatment & Surgeries	12.50	10	11.50	46.00	11.10	13.00	12.60	9.10	13.00	13.70	9.65
Grade level of all readability analyses	11.77	10	10.33	50.67	11.10	11.67	11.47	8.07	12.00	12.53	9.79
Grade level of each section specific to body part	—	—	—	—	—	—	—	—	—	—	9.12
Grade level of Shoulder & Elbow	—	—	—	—	—	—	—	—	—	—	9.46

Abbreviations: CLI, Coleman-Liau Index; NDC, New Dale-Chall formula; FKGL, Flesch-Kincaid grade level; FRE, Flesch Reading Ease score; FORCAST (formula); FRG, Fry readability graph; GFI, Gunning Fog Index; NFC, New Fog Count; RRE, Raygor readability estimate; SMOG, Simple Measure of Gobbledygook.
[a]*Patient Stories* were analyzed by the readability scales but the values were not used to obtain averages.
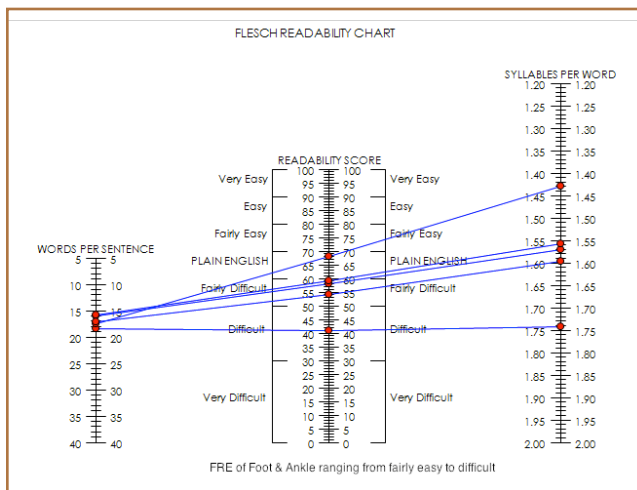
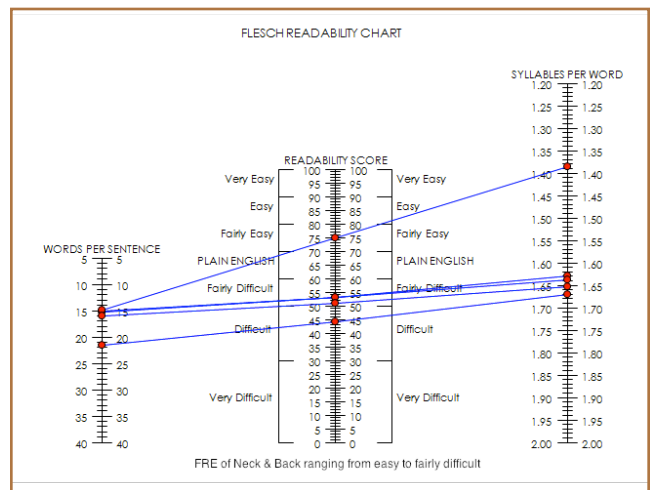Figure 1. *Foot & Ankle* Flesch Reading Ease (FRE) scores, from *fairly easy* to *difficult*.

Figure 2. *Neck & Back* Flesch Reading Ease (FRE) scores, from *easy* to *fairly difficult*.
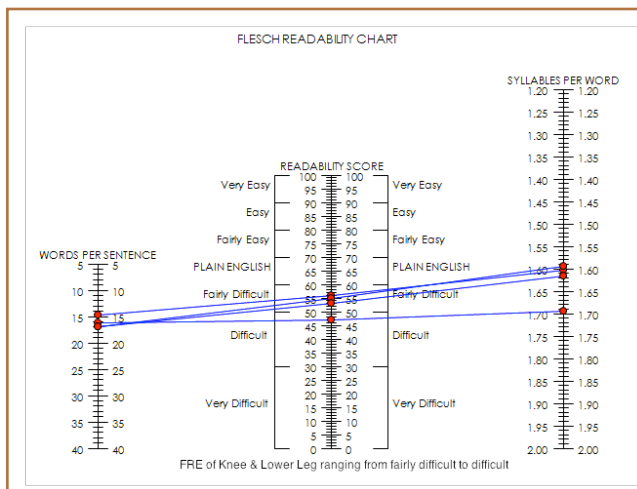

Figure 3. *Knee & Lower Leg* Flesch Reading Ease (FRE) scores, from *fairly difficult* to *difficult*.
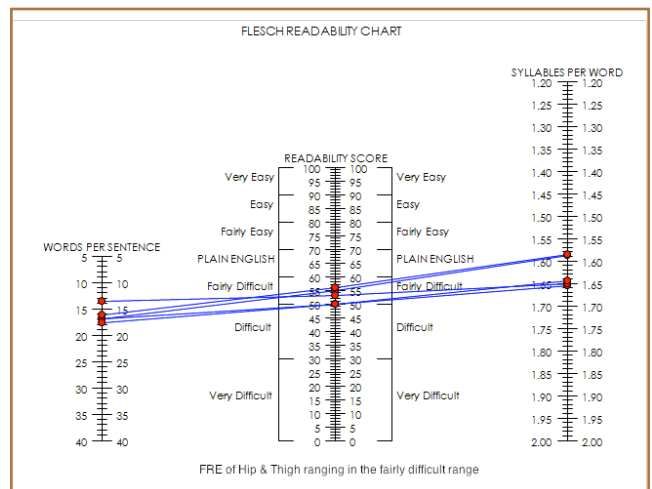

Figure 4. *Hip & Thigh* Flesch Reading Ease (FRE) scores, in *fairly difficult* range.

grade reading level, in line with the CDC recommendation. Of these, *Neck & Back* entries were written at the lowest level, 6.18. This provides evidence that complex medical information can be condensed and rephrased to be understood by the average US adult. The writing style used in these entries should serve as a template for other patient education articles on the AAOS website. Although the mean reading level (8.84) of AAOS patient information exceeds recommendations, it is certainly within striking distance of the maximum seventh-grade reading level. It is possible that even marginal editing of the text in the provided articles would result in a reading level below seventh grade.

Not all readability analyses generated the same results. NFC analysis generated the lowest grade level, SMOG analysis the highest. Further NFC analysis led to the finding that 28.6% of entries were near seventh-grade reading level. NFC calculates a

document's grade level based on sentence length and number of words containing 3 or more syllables. In addition, numerals and proper nouns are counted as easy words, regardless of their syllable count.[26] It is conceivable that the information in the AAOS patient education library had a significant amount of sentence structure of this type.

SMOG generally produces higher scores because it attempts to predict 100% comprehension. Most other formulas predict 50% to 75% comprehension. The SMOG readability formula calculates a document's grade level based on sentence length and number of complex words.[17] Thus, the high grade level resulting from SMOG in this study may be attributable to the test methodology, combined with the high grade level of the writing.

This study reaffirms that the majority of patient information on the AAOS website is above the US adult's average reading

level. It is possible that the articles included in this study make up only a small portion of the literature on orthopedic diseases and conditions. However, this sample of articles is suitable for analysis and representative of the whole, as many orthopedic surgeons refer their patients to the AAOS website or to similar information portals.[10] Our study results suggest that the majority of orthopedic patient information on the AAOS website may be too difficult for the average US adult to understand. However, improvement is possible. The 2007 analysis found a mean readability grade level of 10.43, and our analysis found a current FKGL of 9.98 (range, 6.6-11.5), with the other 9 readability scales producing a mean grade level of 7.7 (range, 6.5-13.7). Both metrics suggest that the patient information on the AAOS website has been modified to a lower grade level, suggesting an improvement in readability.

This study had its limitations. First, the impact that diagrams and tables have on text readability was not accounted for. Second, there was no assessment of interobserver or intraobserver variability. FKGL has been applied to AAOS patient education materials in past studies, but the other 9 readability tools have not.

The AAOS website made liberal use of images and tables in its materials. Although the impact of these elements was not evaluated, there are guidelines for their use in patient education.[11,21,27] Suggestions include placing images near relevant text; adding succinct captions; highlighting, bolding, or underlining relevant text; and using a simple color scheme. In addition, pictures and diagrams should not include too much information; each should be directed at a specific topic.[27,28] Short movie clips can be included at the end of each section to further support and clarify relevant text.[29] Another possible modification for increased readability is to shorten sentences. Most analyses take into account sentence length when determining the grade level of text. Last, bullet points may be used to provide shortened versions of long sentences.

Although the average US adult can read at seventh-grade level, we do not know if the patients who access the AAOS website fall within this average. The 10 readability analyses performed in this study compute a grade level based on text and numerals, not illustrations and diagrams. The AAOS website used many illustrations and diagrams in its articles, thus resulting in another limitation to this study.

In 2000, the AAOS online patient education library was launched with the goal of strengthening patient–physician relationships.[10] It is encouraging that the *Prevention & Safety* information is written at the average US adult reading level. The result is that the maximum number of patients can comprehend this information and possibly avoid the ailments described in the text. The AAOS should use these sections as a model for constructing other patient information sections. If a patient visits the AAOS website for information about his or her orthopedic injury and the information is written at a low grade level, the patient may become well-informed about the condition, make efficient use of the office visit, reduce medical expenses, and improve his or her prognosis.

Toward these goals, patient information on the AAOS web-

site should be written at the seventh-grade reading level so that it may inform as many patients as possible. This website is an excellent source of orthopedic information. Minor editing and incorporation of the suggestions included in this article can help adjust all patient information to the seventh-grade level.

Conclusion

A more favorable patient outcome is associated with good understanding of a medical condition. Orthopedic diseases and conditions can be complex, involving many surgical interventions. The controversy surrounding treatment regimens and complex procedures and anatomy may be difficult to convey to patients. Previous studies have shown that the AAOS provides a majority of its patient education materials above the average US adult's reading level. In recent years, however, this information has been lowered to a grade level of 8.84. Nevertheless, to ensure better patient understanding of orthopedic conditions, the style of the AAOS *Prevention & Safety* articles should be followed when writing these materials.

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This paper will be judged for the Resident Writer's Award.