Readability and Reliability of Online Information Regarding Patellar Instability

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ABSTRACT

BACKGROUND: Assessment of readability and reliability of online resources for orthopedic patients is an area of growing interest, but there is currently limited reporting on this topic for patellar instability (PI) and medial patellofemoral ligament reconstruction (MPFLR).

METHODS: Utilizing the Searchresponse.io dataset, we analyzed inquiries related to PI and MPFLR. Readability and reliability were assessed using the Automated Reading Index, Flesch Reading Ease, and the JAMA benchmark criteria.

RESULTS: Analysis of 363 frequently asked questions from 130 unique websites revealed a predominant interest in fact-based information. Readability assessments indicated that the average grade level of the resources was significantly higher than the 6th grade level and reliability varied between resources.

CONCLUSION: Although the internet is an easily accessible resource, we demonstrate that PI and MPFLR resources are written at a significantly higher reading level than is recommended, and there is inconsistent reliability amongst resources with medical practice websites demonstrating the lowest reliability.

KEYWORDS: patellar instability, patella, medial patellofemoral ligament, MPFL reconstruction

INTRODUCTION

The internet is a readily available and easily accessible resource which people have progressively utilized for advice on matters of health and wellness.[1] As many as 72% of adults in the United States have utilized the internet to investigate overall health issues, whereas in orthopedics 65% of patients have used the internet to learn about their condition.[1,2] Given the pervasive accessibility of information in today's world, it is crucial to understand how patients seek information regarding their health concerns and whether or not that information is accurate and comprehensible. According to the National Center for Educational Statistics, 21% of American adults have low-literacy skills, with 54% of adults possessing literacy below the sixth-grade level.[3,4] While information may be available to those who seek it, patient miscomprehension of health resources can negate the positive impact of its availability. Prior literature has investigated the readability of online resources frequently accessed by patients in various orthopedic pathologies, including anterior cruciate ligament injury and common spinal pathology.[5,6] Previous studies have shown significant variation in the readability of materials with many requiring a higher reading level than would be comprehensible to the general American population.[6-10] By understanding patients' most frequent concerns and the readability and reliability of available resources, physicians may be able to better educate their patients.

Patellar instability (PI) refers to a spectrum of pathology related to the displacement of the patella from its anatomic position within the trochlear groove of the distal femur.[11] It may refer to either patellar subluxation, in which the patella shifts from its position within the groove, or patellar dislocation, in which the patella entirely displaces out of the trochlear groove.[11–13] PI is experienced by 50–77 out of 100,000 Americans, making it a common area of interest online for patients who may seek to further understand their patellar instability.[11,13] The medial patellofemoral ligament (MPFL) is a critical structure for patellar stability in the first 30 degrees of knee flexion, is often compromised in the setting of PI, and is commonly reconstructed for patients meeting operative indications.[14,15] Currently, there is limited research into the readability and reliability of online resources regarding patellar instability.[10]

The aim of this study is to elucidate the topics of greatest interest to patients and thoroughly assess the overall readability and reliability of online resources related to and MPFLR. We hypothesize that patients will be most interested in information about the pathophysiology and treatment options for patellar instability and that resources will exceed the recommended 6th grade reading level.

METHODS

Searchresponse.io is a commercially available dataset that compiles over 150 million Google's People Also Ask (PAA) questions for over 200 million keywords.[16] Since Google can offer different PAA questions for search terms over time, an advantage of using the Searchresponse.io dataset is that it compiles PAA questions for search terms over time and

ranks them by popularity. For PI, PAA questions, popularity, and associated websites were queried using the search terms "patellar subluxation", "knee subluxation", and "patellar dislocation", "knee dislocation", and "patellar instability". For MPFL, the search terms were "MPFL reconstruction" and "Medial Patellofemoral Ligament Reconstruction".

For both PI and MPFL, questions were first categorized using the Rothwell classification system, which categorizes questions as fact, policy, or value questions and has been previously implemented in similar investigations on topics ranging from rotator cuff repairs to cruciate ligament injuries.[17–20] For PI, questions were further subcategorized into one of 10 topics relevant to questions about medical conditions: diagnosis, billing/cost, curability, recovery, pathophysiology, condition definition, evaluation of symptoms, complications/morbidity, management of risks, and treatment (**Table 1**). MPFL questions were subcategorized into one of the eleven following groups relevant to questions about medical procedures: specific activities and restriction, recovery, technical details, billing/cost, condition details, indications, management of risks/complications, pain, evaluation of symptoms, evaluation of intervention, and longevity (**Table 2**). Questions were categorized by two evaluators with another evaluator serving to resolve discrepancies.

Websites were categorized into one of five domain groups: academic, medical practice, commercial, government, and social media (**Table 3**). Website reliability was assessed using

the JAMA benchmark criteria, which rates websites on a scale of 0–4, with one point assigned based on presence of four aspects: authorship, attribution, currency, and disclosure. Website readability was assessed using previously used readability formulas: Automated Reading Index (ARI), Flesch

Table 1. Question Classification System for patellar instability

Category	Description
Fact	
Diagnosis	Patellar Instability Diagnosis
Cost	Cost of treatment including questions about insurance coverage/cost
Curability	Question about whether patellar instability is treatable
Recovery	Specific questions about recovery length or milestones
Pathophysiology	Questions about what causes patellar instability or how it happened
Condition Definition	What is patellar instability or questions asking if it is part of or related to another condition
Value	
Evaluation of Symptoms	Questions asking about patellar instability symptoms or if certain symptoms suggest patellar instability
Complications/ Morbidity	What are the complications of patellar instability or what can happen if left untreated
Policy	
Management of Risks	Management of risks and limitations associated with patellar instability
Treatment	Questions about treatment options, indications, and success

Table 2. Question Classification System for medial patellofemoral ligament reconstruction

Category	Description
Fact	
Specific Activities & Restrictions	Ability/Inability to perform a specific activities or actions after surgery
Recovery	Specific questions regarding recovery
Technical details	Specific questions about surgical procedure
Billing/Cost	Cost of surgery including questions about insurance coverage/cost
Condition details	Specific questions about the condition process
Policy	
Indications	Surgical indications, timing of surgery, who is a good candidate
Management of R/C	Management of risks/complications during and after surgery
Value	
Pain	Pertains to duration, severity, and management of pain
Evaluation of Symptoms	Evaluation of symptoms related to MPFLR
Evaluation of Intervention	Evaluation of procedure/alternatives to procedure/not doing anything, as well as successfulness or invasiveness

Table 3. Website Categorization

Website Categorization	
Commercial	Commercial organization that positions itself as a source of health information, includes medical device and pharmaceutical companies Example: WebMD, Everyday Health
Academic	Institution with a clear academic mandate, including universities, academic medical centers, academic societies, and journals. Example: AAOS, Mayo Clinic, HSS
Medical Practice	Local hospital or orthopedic practice without an academic affiliation, includes single surgeon websites Example: New York Orthopedics
Government	Websites ending in .gov or maintained by a national government Example: Medline, PubMed
Social Media	Websites maintained by nonmedical organizations primarily designed for information sharing between internet users. Includes health blogs, internet forums, and support groups Example: fitpro.com, silversneakers.com

Reading Ease (FRE), Gunning Fog Index (GFI), Flesch-Kincaid Grade Level, Coleman-Liau Index, Simple Measure of Gobbledygook (SMOG), and Linear Write Formula (LWF).[6,8] Reading formula scores of websites was calculated using a readability calculator.[21] Websites were excluded from the readability analysis if a readability calculation was not possible; for example, if the website was video based.

Statistical significance was set at p<0.05 a priori. All statistical analyses were conducted in Python using the Pandas, statsmodels, NumPy, and Plotly packages. The Python program was written in Visual Studio Code (Microsoft Corporation, Redmond, WA). Analysis of variance in readability and JAMA benchmark scores was calculated using one-way ANOVA. Analysis of average readability was also assessed using one-sample t-tests.

RESULTS

Patellar Instability Question Types

One hundred and five (105) unique websites were used to identify 271 of the most frequently asked questions related to PI were analyzed. The most popular questions were "How do you fix patellar instability?", "How do you test for patellar instability?", and "What does knee subluxation feel like?" (**Table 4**). Based on the Rothwell classification, most PI questions were fact-based (63%), while policy and value related questions accounted for 27% and 10% of the questions, respectively. PI questions were primarily subcategorized as condition definition, pathophysiology, and treatment-related categories. Condition definition questions were mostly answered by academic websites, pathophysiology questions were mostly answered by government and academic websites, and most treatment questions were answered by commercial websites.

Table 4. Most frequently asked questions by patients about patellar instability and medial patellofemoral ligament reconstruction

Ten Most Frequently Asked Patellar Instability/MPFLR Related Questions	Popularity
Patellar Instability	
How do you fix patellar instability?	126
How do you test for patellar instability?	125
What does knee subluxation feel like?	120
What is the best brace for patellar dislocation?	98
How long is recovery from patellar dislocation surgery?	81
MPFLR	
Is MPFLR major surgery?	101
Is MPFLR painful?	87
How long does it take to recover from MPFLR?	72
How successful is MPFLR surgery?	39
How long do you wear a brace after MPFLR?	36

Patellar Instability Readability and Reliability

PI websites answering billing/cost and pathophysiology questions had the highest average grade level readability (13.7 and 12.7), while questions asking about PI recovery and to evaluate PI symptoms had the lowest average grade level readability (9 and 8.9). There was a significant difference in average grade level readability and readability based on all the individual tests based on question subcategory. Websites answering diagnosis and treatment related questions had the highest average JAMA benchmark score (3.1 and 3), and there was a significant difference in mean JAMA benchmark scores based on question subcategory. For each question subcategory, the websites answering those questions had a significantly higher average grade level readability than the AMA recommended 6th grade reading level.

Of the 105 unique websites, commercial, government, and academic domains accounted for 27.5%, 26.4%, and 24.2% of the websites respectively. The mean JAMA benchmark score for all websites was 2.7 (SD: 1.3), and there was a significant difference in mean JAMA score by website category (p<0.01). Medical practice sites had the lowest average JAMA score (1.4) and government websites had the highest JAMA score (3.6). The mean grade level readability for all websites was 11.5 (SD: 3.8) and there was a significant difference in average grade level readability by website category (p<0.01). There was also a significant difference in mean values for each individual readability test by website category except for the CLI test.

MPFLR Question Types

Twenty-five (25) unique websites answered the 93 most commonly asked MPFLR questions. The most popular questions were "Is MPFL reconstruction major surgery?", "Is MPFL reconstruction painful?", and "How long does it take to recover from MPFL reconstruction?". For MPLFR, 77% of the questions were fact-based, and there was only one policy-related question. Questions about technical details and specific activities and restrictions accounted for 37% and 17% of the MPFLR commonly asked questions, respectively (**Table 5**). Technical details questions were primarily answered by academic websites, and questions about specific activities and restrictions were answered mostly by medical practice websites.

MPFLR Readability and Reliability

The average grade level readability for all websites was 12.4 (SD: 3.6). The mean grade level readability was highest for the commercial (17) sites and lowest for the medical practice sites (10). The average grade level readability was highest for websites answering questions related to billing/cost and evaluation of MPFLR (14.8 and 14.6), and websites answering specific activities and restriction questions had the lowest mean grade level readability (9.7). There is a significant difference in average grade level readability based on MPFLR

Table 5. Distribution, Credibility, and Readability for PI Websites by Website Type

Category	Percent of Total Websites	JAMA Score	Average Grade Level Readability	ARI	GFI	FKGL	CLI	SMOG	LWF	FRE Reading Score
Commercial	28%	3.2	12	11.5	15	11.2	12.4	10.6	11.3	44
Government	26%	3.6	14.2	13.8	17.5	13.3	13.8	12.6	14.4	34.2
Academic	24%	2.4	12.6	12.1	15.8	11.7	13	11.1	11.7	40.5
Medical practice	19%	1.4	10.9	10.5	13.3	10	11	9.6	11.2	54.4
Social media	3%	2.2	21.8	23.3	25.7	21	14.4	17.8	28.6	13.7
P-Value	—	<0.01	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01

Automated Reading Index (ARI); Gunning Fog Index (GFI); Flesch-Kincaid Grade Level (FKGL); Coleman-Liau Index (CLI); Simple Measure of Gobbledygook (SMOG); Linsear Write Formula (LWF); Flesch Reading Ease (FRE)

Table 6. Distribution, Credibility, and Readability for MPFLR Websites by Website Type

Category	Percent of Total Websites	JAMA Score	Average Grade Level Readability	ARI	GF	FKGL	CLI	SMOG	LWF	FRE Reading Score
Medical practice	36%	1.3	10	9.6	12.5	9	10.9	9.2	9.1	56.8
Academic	28%	3.3	13.6	13.8	16.7	12.4	13.7	12	13.1	39.9
Government	28%	3.7	14.5	14.7	17.8	12.9	15.5	12.7	13.5	34.4
Commercial	8%	3.5	17	17.5	20.3	15.7	16.2	14.6	17.8	23.5

Automated Reading Index (ARI); Gunning Fog Index (GFI); Flesch-Kincaid Grade Level (FKGL); Coleman-Liau Index (CLI); Simple Measure of Gobbledygook (SMOG); Linsear Write Formula (LWF); Flesch Reading Ease (FRE)

question type (p<0.01). For all question subcategories except for Billing/Cost and Indications, average grade level readability was significantly greater than the AMA recommended 6th grade reading level (p<0.01).

Of the 25 unique websites, medical practice sites accounted for 36% of the websites, and commercial websites only accounted for 10% (**Table 6**). Websites answering billing/cost questions had the highest mean JAMA benchmark score (4) and websites answering indications and pain related questions had the lowest mean JAMA benchmark score (1). Medical practice sites also had the lowest mean JAMA benchmark score (1.7) and government sites had the highest mean JAMA benchmark score (3.7). Academic, government, and medical practice sites had an average grade level readability significantly greater than the recommended 6th grade reading level (p<0.01).

DISCUSSION

The current study used 130 unique websites to evaluate 363 frequently asked questions by patients for PI and MPFLR. The results demonstrate that patient's researching both PI and MPFLR were most interested in fact-based information which comprised 63% and 77% of questions, respectively. Commercial websites were the most frequently used source for PI questions (28%), whereas medical practice sites were the most frequently used for MPFLR questions (36%). Readability evaluations for all question types pertaining to both

PI and MPFLR demonstrated average grade reading levels than were greater than the recommended 6th grade level regardless of website type. Additionally, the results demonstrated substantial variability in reliability of information based on both topic and source. Although government-based websites having the highest reliability scores for both PI and MPFLR, these website types made up <30% of resources used for both conditions. These findings underscore the existing disparity between the information patients are seeking and the quality of resources that are currently available for PI and MPFLR.

What Do Patients Want to Know About PI and MPFLR?

The most asked question by patients regarding PI was, "How do you fix patellar instability?" and the most commonly asked question for MPFLR was, "Is MPFLR major surgery?" These questions were reflective of the overall trend for patient questions, which centered on a desire to understand the pathophysiology of their condition, the treatment options available, technical details of surgery, limitations following surgery, and the outcome they can expect. These results are consistent with previous investigations into topics of interest to patients for a various orthopedic conditions.[9,10,18,22] It is important for physicians to understand these trends to best educate their patients, particularly in regard to indications for conservative and operative management after primary dislocation events. Although MPFLR has been associated with lower rates of instability, it is less clear

that surgery leads improved functional outcomes.[23] Given that nearly 80% of patient MPFLR inquiries were related to technical details of surgery, post-operative pain, activity specific restrictions, and the recovery process, it is imperative that physicians clearly communicate the potential risks and benefits of electing for surgical management of PI. By setting expectations for return-to-activity restrictions, physicians cannot only establish rapport with their patients but also serve as the primary source of information and education in place of online resources. It is important to note that while we cannot ascertain whether queries for the current study occurred before or after consultation with an orthopedic surgeon, the results offer guidance for surgeons in their efforts to educate patients on the symptoms, diagnosis, and treatment of PI.

Readability and Reliability of PI and MPFLR Resources

Readability evaluations for all question types pertaining to both PI and MPFLR demonstrated significantly higher grade reading levels than the recommended 6th grade level, regardless of website type. These results are in agreement with much of the available literature within orthopedics, and are further supported by the consistency of these findings across multiple readability scores provides. Prior investigations have found that readability of not only online resources, but also those provided by academic institutions to patients far surpass suggested reading levels. These findings have demonstrated in both the pediatric and adult populations and include nearly all orthopedic subspecialties.[6,9,22,24-27] In the only other study investigating the topic of patellar instability, the authors found the average reading level for online information on patellar instability to be at the 10th grade level.[10] The contrast between these reading levels can be illustrated using one of the most frequently asked questions from the current study. An example of 6th grade level response to how testing for patellar instability is tested would be, "To check for patellar instability, a doctor moves your kneecap from side to side to see if it moves too much or hurts. They might also use X-rays or MRI to look inside your knee for any problems." On the other hand, a 10th grade level response would be, "To test for patellar instability, a doctor will perform a physical examination where the kneecap is moved side to side to assess for excess motion or discomfort. They may also use the apprehension test and imaging studies such as X-rays or MRI to identify any underlying structural issues." While both responses convey the same information, the discrepancy in complexity highlights the fact that adhering to the 6th grade reading level may make this information more accessible to a broader audience.

The findings presented in this study build upon previous reports on the problematic nature of online resources readability for the general public.[5,6,8,10] In the current study, PI websites had an average grade level of 11.3. Billing/cost and pathophysiology questions had the highest average grade level readability (13.7 and 12.7), while questions about PI recovery and to evaluate PI symptoms had the lowest average grade level readability (9 and 8.9). The average grade level readability for all MPFLR websites was 12.4 with the mean grade level readability being highest for the commercial sites (17) and lowest for the medical practice sites (10). It is perhaps not surprising that websites with more technical topics, such as pathophysiology and billing, are less comprehensible to the general public. However, this supports the notion that technical topics must be presented in more simplistic terms both online and in clinic so that the general public can understand the information.

While the importance of readability cannot be overstated, ensuring reliability of information available to patients is also paramount. The JAMA benchmark score was originally proposed in 1997 and assesses websites for authorship, attribution, disclosure, and currency.[28] Authorship entails that the details of any authors or contributors, along with their credentials and affiliations, and attribution requires that references and sources for all content be clearly outlined. Disclosure requires website ownership to be prominently and fully disclosed, including any potential conflicts of interest. Currency ensures that content is dated both at the time of initial upload and at any subsequent updating. Given its streamlined approach to evaluating transparency and reliability, it is considered the most widely used assessment tool.[29]

Regarding reliability of PI and MPFLR resources, the mean JAMA benchmark score for PI websites based upon question category was 2.49 and 2.56 based upon website category. For MPFLR, the mean JAMA benchmark scores were 2.24 and 2.95 for question category and website category, respectively. Medical practice sites had the lowest average JAMA score (PI: 1.4/MPFLR: 1.3) and government websites had the highest JAMA score (PI: 3.6/MPFLR: 3.7) for both PI and MPFLR. While the mean JAMA benchmark scores are comparable to those found for other orthopedic pathologies, the low reliability scores on medical practices sites represents a concerning trend in the orthopedic literature.[9,24,30-32] Ideally, the information provided to patients directly from their surgeon's websites should be reflective of what is discussed in clinic and therefore represent the most reliable information available. These findings suggest that there is substantial variability in the reliability of websites that patients will reference in order to learn more about their health conditions and highlight the need for major improvements to the reliability of resources provided by medical practice sites.

Limitations

This study is not without limitations. The study design presents an inherent limitation as the most frequently asked questions on Google may change over time. Therefore, while this study enables a static snapshot of patient interest,

it may not reflect what information patients are most interested in at any given time. Additionally, it is possible that questions may have fallen into multiple categories, which has the potential to create overlap or difficulty with categorization. Finally, although the JAMA benchmark scoring system provides a straightforward approach to assessing reliability, it may not provide as comprehensive of an analysis as more sophisticated models such as the DISCERN score. For this reason, it has been suggested that the JAMA score may be a better measure of resource transparency rather than reliability.[5]

CONCLUSION

Although the internet is an easily accessible resource for patients to investigate their health concerns, concerns exist regarding the readability and reliability of information available to patients. The results of the current study demonstrate that online resources for PI and MPFLR are written at a significantly higher level than the reading level of the average patient in the United States, and there is inconsistent reliability amongst website types with medical practice sites demonstrating the lowest reliability. Taken together, these results underscore the need for understanding the type of information patients are seeking and striving to improve the online material provided by medical practices.

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