Original Article

Patients With Shoulder Labral Tears Search the Internet to Understand Their Diagnoses and Treatment Options

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Purpose: To analyze the most frequently searched questions associated with shoulder labral pathology and to evaluate the source-type availability and quality. **Methods:** Common shoulder labral pathology-related search terms were entered into Google, and the suggested frequently asked questions were compiled and categorized. In addition, suggested sources were recorded, categorized, and scored for quality of information using JAMA *(The Journal of the American Medical Association)* benchmark criteria. Statistical analysis was performed to compare the types of questions and their associated sources, as well as the quality of sources. **Results:** In this study, 513 questions and 170 sources were identified and categorized. The most popular topics were diagnosis/evaluation (21.5%) and indications/management (21.1%.). The most common website types were academic (27.9%), commercial (25.2%), and medical practice (22.5%). Multiple statistically significant associations were found between specific question categories and their associated source types. The average JAMA quality score for all sources was 1.56, and medical websites had significantly lower quality scores than nonmedical sites (1.05 vs 2.12, $P < .001$). **Conclusions:** Patients searching the internet for information regarding shoulder labral pathology often look for facts regarding the diagnosis and management of their conditions. They use various source types to better understand their conditions, with government sources being of the highest quality, whereas medical sites showed statistically lower quality. Across the spectrum of questions, the quality of readily available resources varies substantially. **Clinical Relevance:** The use of online resources in health care is expanding. It is important to understand the most commonly asked questions and the quality of information available to patients.

Shoulder instability events, particularly dislocations, are a frequent reason for emergency department visits, with a recent estimate of 23.9 dislocations per 100,000 person-years, a number that increases in high-risk populations such as younger male individuals and high-level athletes.[1] Other labral pathology unrelated to instability, such as SLAP tears, is highly prevalent, having been documented in up to 26% of shoulder arthroscopies for any diagnosis.[2] When treatment decisions are being made, it is important for physicians to tailor treatment approaches based on not only the pathology but individual patient differences in activities performed and overall demand. The decision to operate must follow careful discussion between the patient and surgeon regarding patient expectations, functional goals, and education about procedure specifics.

Patients often consult internet resources, such as Google's search engine (Alphabet, Mountain View, CA), to better educate themselves about surgery before and after discussions with their physicians. Google uses a machine learning search such as RankBrain and Bidirectional Encoder Representations From Transformers (BERT) to match content to a user's search and, theoretically, improve the available content based on a user's information needs.[3,4] Although this is intended to provide the most relevant and helpful information, prior studies have called into question the reliability of the information readily available to patients,[5] with more than two-thirds of patients using unreliable sources.[6] When counseling patients about treatment options, physicians should be aware of what questions

Table 1. Definitions of Rothwell Classification and Other Descriptive Categories

	Description
Rothwell classification	
Fact	Asks whether something is true and to what extent; objective information (e.g., Is shoulder surgery covered by insurance?)
Policy	Asks whether a specific course of action should be taken to solve a problem (e.g., What exercise is good for a labral tear?)
Value	Asks for evaluation of an idea, object, or event (e.g., How painful is arthroscopic shoulder surgery?)
Question classification by topic	
Fact	
Activities/restrictions	Questions on ability to perform activity/action with labral tear or after shoulder surgery or any restrictions thereof
Timeline of recovery	Specific questions regarding length of time for recovery milestones
Technical details	Questions regarding surgical procedure, including types of implants
Cost	Questions on cost of surgery and/or rehabilitation postoperatively
Anatomy/function	Specific questions regarding structure and function of shoulder joint, as well as types of injuries that can affect labrum
Diagnosis	Questions regarding how one knows he or she has shoulder injury
Policy	
Indications/management	Questions on surgical indications and timing of surgery
Risks/complications	Questions regarding management of risks/complications during and after surgery
Value	
Pain	Questions pertaining to duration, severity, and management of pain
Longevity	Specific questions regarding longevity of labral tear or labral repair
Evaluation of surgery	Questions on evaluating successfulness or invasiveness of shoulder arthroscopy
Injury comparison	Questions on comparison to other injuries regarding severity and so on.
Website categorization	
Academic	Institution with clear academic mandate, including universities, academic medical centers, and academic societies (e.g., AAOS, Mayo Clinic, and HSS)
Commercial	Commercial organization that positions itself as source of health information, including medical device and pharmaceutical companies (e.g., WebMD and Everyday Health)
Government	Website ending in .gov or maintained by national government (e.g., MEDLINE and PubMed).
Medical practice	Local hospital or orthopaedic practice without academic affiliation (e.g., Michigan Orthopedics)
Single-surgeon personal	Website built and maintained by individual surgeon (e.g., EdwinSu.com and DrRMarx.com), excluding biography pages on institutional websites
Social media	Website maintained by nonmedical organizations primarily designed for information sharing between internet users (e.g., fitpro.com and silversneakers.com), including health blogs, internet forums, and support groups

AAOS, American Academy of Orthopaedic Surgeons; HSS, Hospital for Special Surgery.

patients commonly ask and the quality of resources they are seeking.

Given the wide availability of quality and reliability of information available, many patients will bring a spectrum of background information, concerns, and questions into a discussion of the surgical treatment of their shoulder labral pathology. By better understanding what questions patients are commonly asking and the resources available, surgeons can better tailor discussions and develop education materials. The purposes of this study were to analyze the most frequently searched questions associated with shoulder labral pathology and to evaluate the source-type availability and quality. We hypothesized that questions would vary in type and source used and that source type would vary in availability and quality.

Methods

The following search terms were entered into Google Web Search (www.google.com) using a clean-installed Google Chrome browser: "shoulder labrum," "labral tear," "shoulder dislocation," "labral repair," "labrum surgery," and "SLAP repair." A clean-installed browser was used to minimize the effect of personalized search algorithms used by Google Search. The list of frequently associated questions was refreshed for each search term until approximately 100 questions were generated. We chose 100 questions based on the precedent set in the existing literature.[7,8] A freely available data mining extension (Scraper, version 1.7) was used to extract each question and its associated webpage to a database.

Two reviewers (N.O.A. and M.C.) first categorized the questions according to the Rothwell classification

Table 2. JAMA Benchmark Criteria

Criteria	Description
Authorship	Clearly identifiable authors and contributors with affiliations and relevant credentials present
Attribution	References and sources clearly listed with any copyright information disclosed
Currency	Clearly identifiable posting date of any content, as well as date of any revisions
Disclosure	Website ownership clearly disclosed, along with any sponsorship, advertising, underwriting, and financial support

JAMA, *The Journal of the American Medical Association.*

system,[9,10] summarized in Table 1. Questions were then further classified into 1 of 15 topics relevant to labral injuries of the shoulder and their repair: specific activities, restrictions, timeline of recovery, technical details, cost, anatomy/function, diagnosis, policy, indications/management, risk/complications, pain, longevity, evaluation of surgery, injury comparison, and other. Descriptions of each of these topics are found in Table 1.

As previously reported in the literature, websites were categorized by source into the following groups: commercial, academic, medical practice, single-surgeon personal, government, social media, and other.[11-13] Definitions and examples are listed in Table 1. In accordance with previous literature, JAMA *(The Journal of the American Medical Association)* benchmark criteria were used to measure website quality. JAMA benchmark criteria rate websites based on authorship, attribution, currency, and disclosure. One point is assigned for the presence of each component, and the points are totaled to yield a final JAMA score ranging from 0 to 4 (Table 2).[14] This instrument has been used in multiple studies to investigate the quality of online health information.[7,15-17] After the initial classification, discrepancies between the 2 reviewers were resolved by a third party (M.G.).

Statistical Analysis

Continuous variables were expressed as means and standard deviations, whereas categorical variables were expressed as absolute and relative frequencies. Descriptive analyses and Pearson χ^2 tests were used to evaluate nominal data. JAMA benchmark criteria were evaluated using 2-tailed independent t tests. Multivariate analysis was used to evaluate associations between types of questions and types of sources. The level of statistical significance was set at $P < .05$. All data analysis was performed using SPSS software (version 21; IBM, Armonk, NY).

Results

A total of 1,446 questions were generated from the initial search. After duplicates were removed, 513 unique questions associated with 170 websites were extracted and categorized. Inter-rater reliability for website categorization was 99.2%. The top 11 most frequently asked questions regarding shoulder labral injuries are presented in Table 3.

Most questions fell into the fact category (55.3%) using the Rothwell classification system (Fig 1A). The most popular topics were diagnosis/evaluation (21.5%), indications/management (21.1%), activities/restrictions (12.3%), and evaluation of pain (12.7%) (Fig 1B). The most common types of websites searched were academic (27.9%), followed by commercial (25.2%) and medical practice (22.5%) (Fig 2A). Of the 3 websites classified as "other" types, 1 was Wikipedia (Wikimedia Foundation, San Francisco, CA) and the other 2 were affiliated with a newspaper. These websites were all associated with questions in the fact category regarding diagnosis/evaluation of shoulder pain.

The distribution of website sources stratified by question topics is summarized in Figure 2B. Fact, policy, and value questions were relatively evenly distributed across website sources, with the exception of academic sources, which had a higher percentage of value questions ($P = .03$) and a lower percentage of policy questions ($P = .03$). Among the question topics, commercial websites were more commonly associated with questions regarding pain (40%, $P = .003$), cost (100%, $P = .002$), and evaluation of surgery (50%, $P = .03$) and were significantly less commonly associated with technical details (11.1%, $P = .02$) and longevity (0%, $P = .03$). Government websites were more commonly related to questions regarding diagnosis/evaluation (5.5%, $P < .001$). Among medical websites, academic sources were more commonly associated with questions regarding anatomy/function (46.9%, $P = .01$), diagnosis/evaluation (40.9%, $P < .001$), and longevity (78.6%, $P < .001$). Medical practice websites were more commonly associated with timeline of recovery (43.5%, $P = .01$), risks/complications (60.0%, $P = .04$), and injury comparison (42.1%, $P = .04$). Finally, single-surgeon personal sites were significantly more associated with activities/restrictions (19.0%, $P = .03$),

Table 3. Top 11 Most Frequently Asked Questions Regarding Shoulder Labral Injuries and Labral Repair

1. How long does shoulder labral tear surgery take?
2. Is shoulder labrum surgery considered major surgery?
3. What happens if a shoulder labral tear goes untreated?
4. Can the anchors come out after shoulder surgery?
5. Can a shoulder labral tear heal on its own/without surgery?
6. Will a cortisone shot help a torn shoulder labrum?
7. Is arthroscopic shoulder/shoulder labral surgery worth it?
8. Can you live with a torn shoulder labrum?
9. Can a torn shoulder labrum get worse?
10. How do you sleep with a torn labrum?
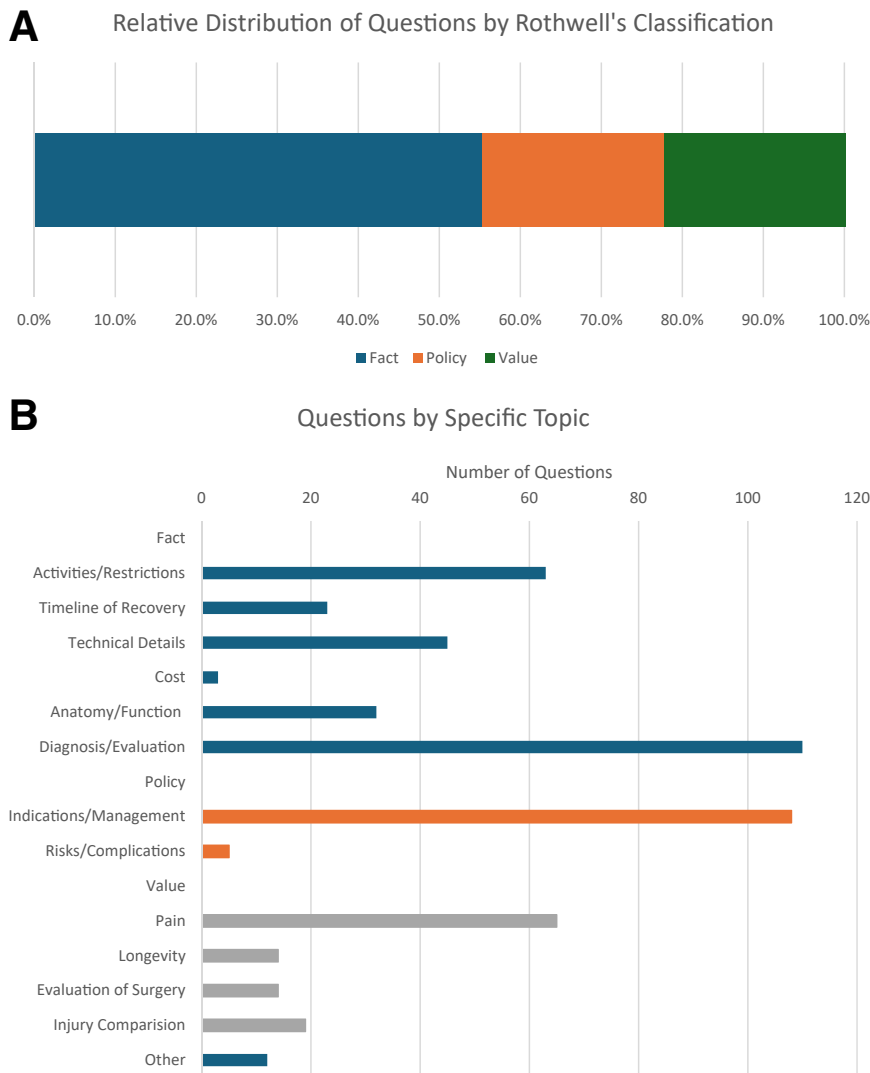11. Where do you feel pain from a torn labrum?

A   Relative Distribution of Questions by Rothwell's Classification

■ Fact   ■ Policy   ■ Value

B   Questions by Specific Topic

Fig 1. Relative distribution of questions by Rothwell classification and by topic. (A) Percentage of questions belonging to fact, value, or policy classifications. (B) Number of questions in each topic category.

timeline of recovery (30.4%, $P = .002$), and technical details (22.2%, $P = .01$). Academic websites were significantly less associated with questions regarding activities/restrictions (3.2%, $P < .001$) and indications for surgery (19.4%, $P = .03$), medical practice sources answered significantly fewer questions regarding pain (10.8%, $P = .02$), and single-surgeon personal websites were considerably less likely to answer questions about anatomy/function of the shoulder (0%, $P = .04$) or diagnosis/evaluation of shoulder pain (2.7%, $P = .002$). Finally, social media sources were significantly associated with activities/restrictions (25.4%, $P < .001$).

The average JAMA score was 1.56 ± 1.31 (Table 4). Government websites, including PubMed, had the highest JAMA score, at 3.92. Whereas medical websites (i.e., academic, medical practice, and single-surgeon personal) accounted for 61.3% of sources, they had lower JAMA scores than nonmedical websites (i.e., social media and commercial) (1.05 vs 2.12, $P < .001$).

Discussion

In this study, we found that the most-searched items regarding shoulder labral pathology related to the diagnosis and management of these conditions, followed by activity restrictions and related pain. Question classifications (fact, policy, and value) were evenly distributed among website groups. However, academic sites had a higher percentage of value questions and a lower percentage of policy questions. Significant associations were found between specific question topics and different types of sources, but overall, no single source type served as a predominant resource for all or most question types. Regarding the quality of sources, government sites were found to have the highest JAMA score, followed by social media, commercial, academic, single-surgeon personal, and finally, medical practice.

Labral pathology is a commonly occurring problem requiring significant discussion between patients and their surgeons before pursuing surgical treatment.
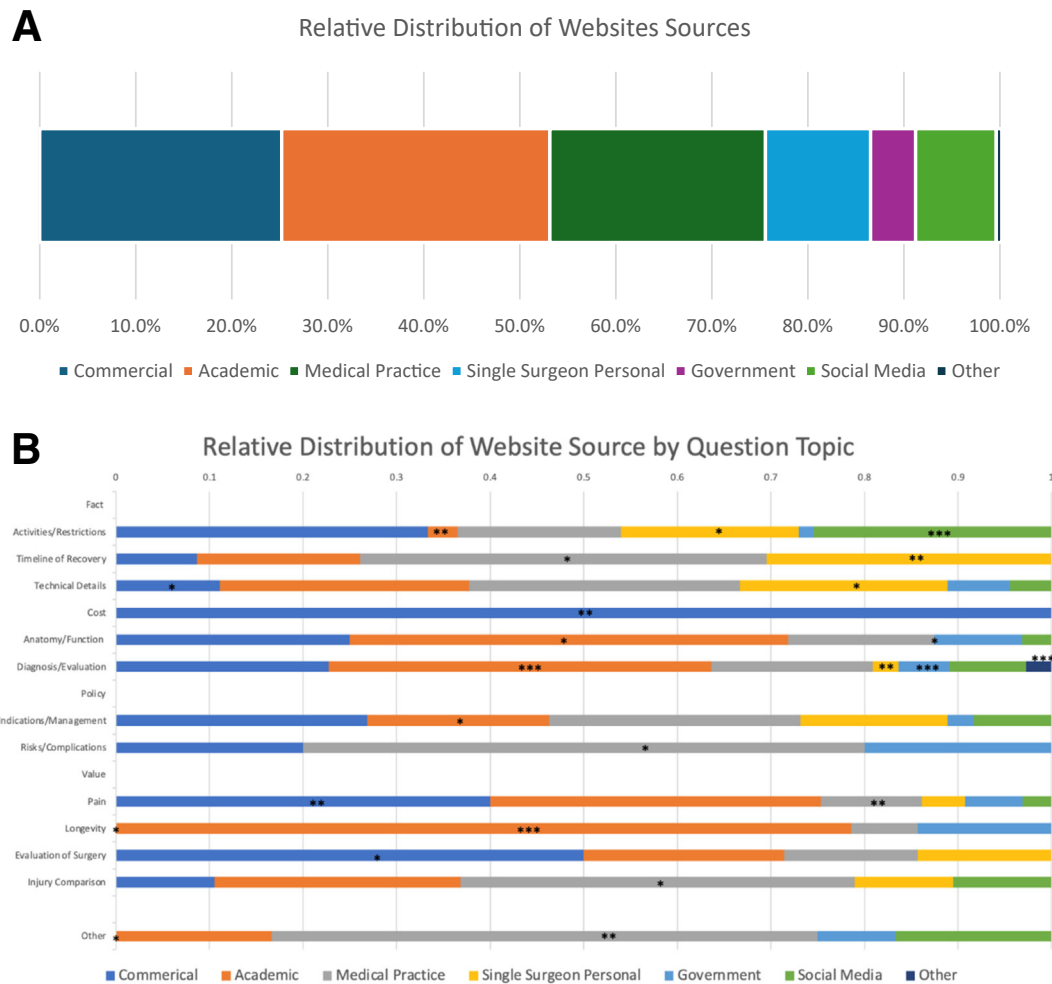
A

B

Fig 2. Relative distribution of websites. (A) Percentage of websites belonging to 7 groups. (B) Percentage of questions in each website category. Regarding statistically significant sections (via Pearson χ^2 test), $P < .05$ is designated by 1 asterisk; $P < .01$, 2 asterisks; and $P < .001$, 3 asterisks.

Studies have shown a high prevalence of labral tears on magnetic resonance imaging, even in asymptomatic individuals, which may make it difficult to confidently

Table 4. Distribution of Website Categories for Shoulder Labral Injuries With JAMA Benchmark Score

	JAMA Score, Mean (SD)	n	%
Total websites	1.56 (1.31)	370	
Website classification			
Commercial	2.12 (1.23)	129	25.2
Academic	1.40 (1.27)	143	27.9
Social media	2.14 (0.73)	43	8.4
Medical practice	0.68 (0.81)	115	22.5
Single-surgeon personal	0.95 (0.85)	56	10.9
Government	3.92 (0.28)	24	4.7
Other*	2.67 (0.47)	3	0.6

JAMA, *The Journal of the American Medical Association*; SD, standard deviation.

*Website sources in this category were associated with Wikipedia (n = 1) and a newspaper (n = 2).

attribute a patient's symptoms to a labral tear even when one is identified.[18] Once identified, further discussion is required to determine appropriate treatment. Davis et al.[19] looked at the trend in SLAP tear repair and found that repair of SLAP tears decreased from 82% of interventions for this issue to just over 20% in a 14-year period, even within a single institution. Dessaur and Magarey[20] found in a systematic review that no single clinical test was able to accurately determine the presence of a SLAP lesion with sufficient sensitivity or specificity. In another systematic review, Kibler and Sciascia[21] found that even in publications specifically focused on surgical repair of SLAP lesions, over half of included studies did not report surgical indications. Given the difficulties in diagnosing labral pathology, lack of consensus on precise surgical indications, and changing trends in surgical repair, it is unsurprising that patients turn to available internet resources to better understand their conditions and treatment options. This also helps to elucidate why most of the questions

identified in this study were categorized as fact and policy questions.

Better understanding specific areas of confusion and what information the average patient is seeking can help surgeons tailor their conversations to meet the needs of their patient populations better. This can allow for more efficient appointments, help to align the conversational goals between patients and their physicians, and help physicians better prepare for the specific topics and questions that may arise. The 2 most prevalent questions found regarding labral surgery asked about the duration of the surgical procedure and whether it would be considered "major surgery"—questions likely best answered by the performing surgeon. Understanding these common concerns can help surgeons to better guide their discussions with patients in the presurgical time frame. The third most prevalent question asks about the consequences of an untreated tear. Given the previously discussed ambiguity in diagnosis and treatment protocols for labral tears, this is again an opportunity for a surgeon to have a personalized and specific discussion of the available options with his or her patient, rather than the patient relying on generalized or low-quality online information.

The quality of information available raises major concerns, with our study reporting that single-surgeon and medical practice websites scored the lowest for quality of information via JAMA scores. Previous orthopaedic research on patient searches related to arthroplasty and sports medicine has also identified these sources as lower quality,[5,8] suggesting that this issue is not restricted to questions on labral pathology. Schwartzberg et al.[18] performed a systematic review of studies of online resources in sports medicine. They found that across multiple topics in the sports medicine literature, search engines tended to preferentially return low-quality resources in response to patient questions. Shen et al.[8] found similar results relating to joint replacement, with more than half of the resources provided by search engines coming from sources other than academic or government entities and almost one-fifth coming from social media. With exponential growth in internet-based content, medical practice has been influenced by the information reported on the internet, with earlier research in orthopaedic surgery identifying issues with both quality and readability.[22] A study by the American Academy of Orthopaedic Surgeons and American Orthopaedic Society for Sports Medicine on sports medicine-related patient education resources found that most were written at higher-than-recommended reading level, which may make it difficult for average patients and especially patients with low health literacy to glean important information from these resources.[23] Accuracy and completeness are essential to improving the quality of available information. However, if resources are not presented in an accessible and understandable manner, orthopaedic providers risk losing patients to other available sources, regardless of their quality.

Although research suggests that online patient information is a current area of weakness in orthopaedics, it simultaneously proposes an opportunity for improving the field. Studies on the influence of internet information on the doctor-patient relationship have shown that the availability of high-quality online information can empower patients to be more informed and engaged in care. This, in turn, can help to improve their relationships with their physicians. In contrast, contradictory information between what a physician is discussing and what a patient has read online may compromise a patient's trust and, ultimately, the physician-patient relationship owing to perceived inconsistencies.[24,25] Future study in this area is needed to better characterize how information found by patients online informs their decision making, as well as their conversations with their physicians. Further benefits to improving this information have been well documented, with studies showing that quality internet-based information can be a time- and cost-effective way to improve patient knowledge and satisfaction. A systematic review of internet-based patient education by Dekkers et al.[26] found that Web-based education increased patients' knowledge and satisfaction compared with traditional education initiatives. By targeting the most frequently asked patient questions with Web-based educational tools such as those identified in this study, orthopaedic providers have the opportunity to reap these same benefits for their specific patient populations. These findings point to the importance of surgeons not only generating or improving their personal online resources for patients but also advocating for the improvement of such resources from their institutions and societies. As more and more patients look to internet resources for their medical information, providing high-quality information will become increasingly beneficial to both patients and providers.

Limitations

There are a variety of limitations inherent to our study design. One limitation of this study derives from the attempt to categorize patient questions into discrete subjects or topics. As discussed earlier, the decision-making process around shoulder labral surgery is complex, and limiting the data to predefined categories may fail to fully capture or may otherwise mischaracterize either the intent of the question or the type of source providing the information. Additionally, this study did not obtain these questions from patients directly; rather, Google searches were used as a proxy to identify these common concerns. Furthermore, this study used a clean-installed browser to prevent the

influence of algorithm personalization. However, in real-world patient searches, results and sources may be influenced by the user's past behavior, including frequently used source types, prior questions, or social media use. Given each individual's history and activity level, specific questions and answers may change on a case-by-case basis. Each of these could further change over time as individual behavior, algorithms, policies, and knowledge in the field advance, therefore limiting the generalizability to all patient searches. Additionally, our study was limited in its ability to assess the quality of the sources. Although the JAMA score is useful for assessing source quality, it lacks granular detail and cannot substitute for an individual and critical assessment of the source. Finally, we were unable to comment on the readability of resources associated with common questions.

Conclusions

Patients searching the internet for information regarding shoulder labral pathology often look for facts regarding the diagnosis and management of their conditions. They use various source types to better understand their conditions, with government sources being of the highest quality, whereas medical sites showed statistically lower quality. Across the spectrum of questions, the quality of readily available resources varies substantially.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: J.P.C. reports that administrative support, article publishing charges, equipment, drugs or supplies, statistical analysis, travel, and writing assistance were provided by Henry Ford Health System and receives non-financial support from Henry Ford Health System. S.J.M. reports board membership with American Academy of Orthopaedic Surgeons, American Orthopaedic Association, American Shoulder and Elbow Surgeons, and *Journal of Shoulder and Elbow Surgery*; reports a consulting or advisory relationship with Arthrex, DePuy Synthes, and Exactech; and receives non-financial support from Exactech and Smith & Nephew. T.S.L. reports a consulting or advisory relationship with Smith & Nephew and Enovis. All other authors (G.G., M.J.A., M.A.G., M.G., N.O.A., M.C., B.P.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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