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The Quality of Online Resources Available to Patients Regarding Cannabidiol for Symptomatic Relief of Hip or Knee Arthritis is Poor

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ABSTRACT

Introduction: This study aimed to assess the quality of online resources pertaining to cannabidiol (CBD) for the nonoperative management of hip and knee arthritis.

Methods: Websites were identified on the three most popular global search engines using terms relevant to CBD, hip or knee pain, and arthritis. Websites were scored based on a 25-point scale regarding diagnosis, evaluation, and treatment of hip and knee pathologies.

Results: The initial search yielded 287 results, and 94 websites were analyzed after meeting inclusion criteria. The average Flesch-Kincaid reading level was 48, corresponding to a college education level. Mean website score was poor at 7.46 (SD 3.51) of 25 (29.8%). Websites published by physicians had statistically higher scores (P = 0.03).

Conclusions: Many online resources regarding CBD use for hip and knee arthritis are available; however, the readability is more advanced than recommended by the National Institutes of Health. Very few resources are sponsored by physicians or professional organizations, and many are overtly sales oriented. Patients should be counseled that the information available online on this topic is generally unreliable. Surgeons and professional health organizations should play a stronger role in providing balanced resources to patients regarding CBD use for hip and knee arthritis.

Arthritis has profound health, societal, and financial implications in the United States. An estimated 52.5 million adults in the United States in 2012 had a diagnosis of arthritis, and this number is projected to increase to 72.4 million by 2040.[1] In 2013, arthritis-attributable medical costs in the United States were estimated to be $140 billion and associated lost wages to be $164 billion.[2] The hip and the knee are the two most common locations for symptomatic degenerative arthritis.[3]

Several nonoperative modalities exist that have been recommended for patients with debilitating degenerative hip and knee arthritis, including weight loss in patients with body mass index >25, low-impact aerobic exercises,

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strengthening, and neuromuscular education. The most recent practice recommendations from the American Academy of Orthopaedic Surgeons (AAOS) also note that for knee arthritis, evidence is inconclusive regarding the use of bracing treatment, transcutaneous electrical nerve stimulation, and manual therapy. AAOS guidelines also cite strong evidence against the use of acupuncture and glucosamine and chondroitin supplementation in the setting of knee arthritis.[4]

Several pharmacologic agents—such as acetaminophen, nonsteroidal anti-inflammatory drugs, and, in certain circumstances, opioids—are used to improve symptoms in degenerative arthritis, particularly hip and knee arthritis. However, none have been demonstrated to clearly delay the progression of arthritis or alter the underlying pathophysiology to reverse degenerative joint changes. Injections of corticosteroid, growth factors, or platelet-rich plasma are commonly used but per AAOS guidelines, currently have inconclusive evidence for their use in the knee. Strong evidence also exists that hyaluronic acid injections provide no notable improvement over placebo in the hip or knee.[4,5]

Many patients are unable to tolerate the aforementioned modalities or have refractory symptoms after trialing these conservative measures but may not yet wish to proceed with joint arthroplasty.[6] This common scenario often prompts a search for alternative agents to improve pain, maintain function, and increase mobility. Cannabidiol (CBD) has recently gained popularity as a therapeutic class with purported potential to improve symptoms of numerous clinical ailments. Some reports suggest that the use of CBD has become pervasive, with an estimated 64 million Americans trying CBD between January 2017 and 2019, of which 14.3% are considered to be daily users.[7] A recent survey of over 2,600 arthritis patient conducted by the arthritis foundation found that 79%of respondents reported using CBD, having used it in the past, or were considering using it. Moreover, 52% of all surveyed patients have been living with osteoarthritis for 10 or more years, and of the respondents who take CBD, 94% turn to CBD specifically for pain relief.[8]

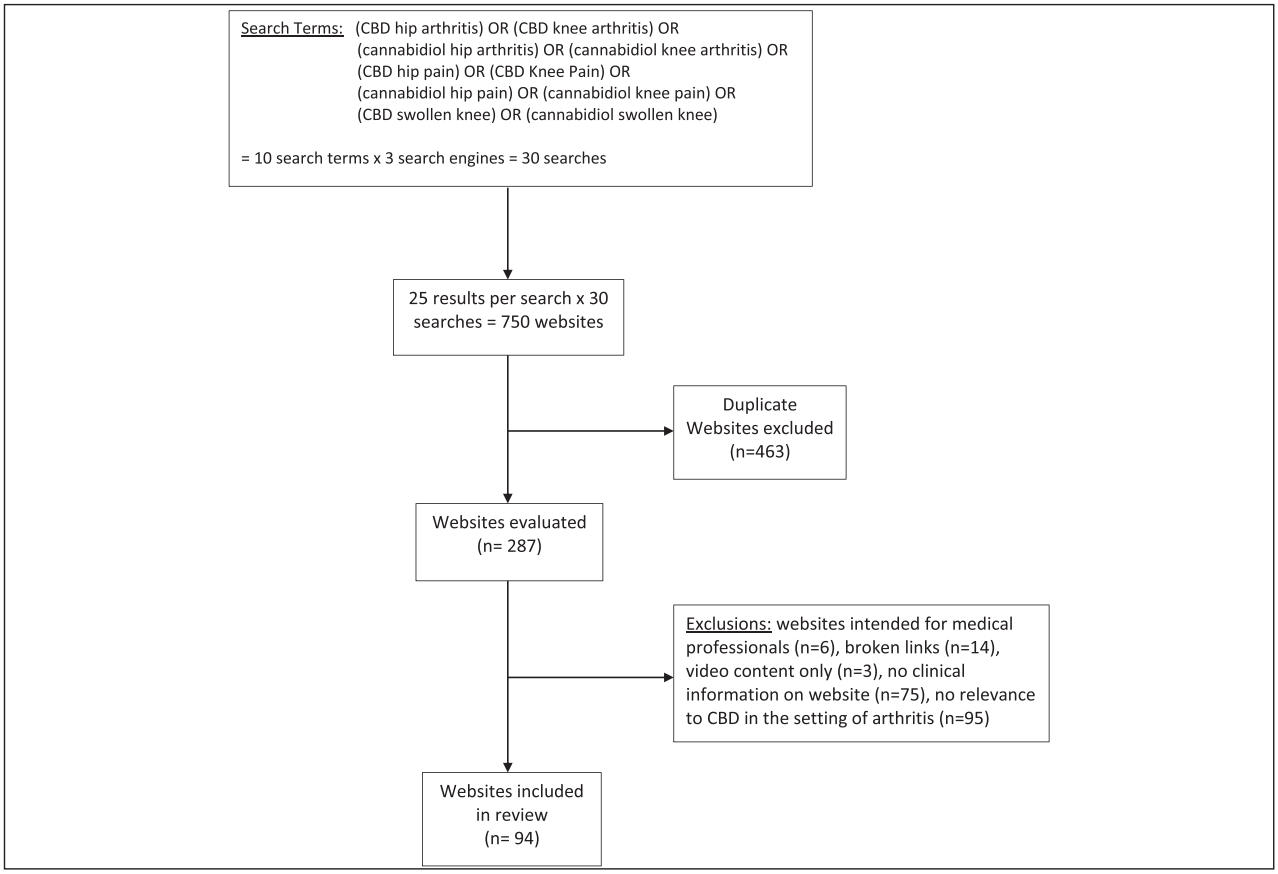
CBD is related to tetrahydrocannabinol, in which both are derived from the cannabis plant; however, unlike tetrahydrocannabinol, CBD does not carry the same psychoactive effects.[9] Indeed, one of the most appealing aspects of CBD is its relatively benign safety profile.[10] The reported benefits of CBD include decreasing inflammation, promoting intestinal motility, increasing hunger, decreasing nausea and vomiting, and, most pertinently, reducing pain.[11] However, scientific research on the potential role of CBD is far outpaced by an explosive increase in CBD access and direct to consumer online marketing and sales. Although studies exist examining the potential role of CBD in treatment of cancer, cancer-related pain, sleep disorders, inflammatory bowel disease, multiple sclerosis, and seizure disorders, to our knowledge, no previous studies exist on the self-directed use of CBD for symptom relief for degenerative arthritis of the hip or knee.[10,12-21] As the scientific community further develops its clinical understanding of CBD, a pressing need exists to also increase awareness of the unvetted information available online for patients. The purpose of this study was to evaluate and grade the quality of online resources pertaining to CBD for hip and knee arthritis. Our hypothesis was that there would be poor-quality information available on CBD and its role in management for hip and knee arthritis.

Methods

In April 2020, three separate search engines (Google, Yahoo, and Bing) were used to find online resources describing CBD for hip and knee arthritis. We used search terms that patients may use on the Internet to find information about CBD for hip and knee arthritis. These included "CBD" or "Cannabidiol" combined with "knee pain," "hip pain," "swollen knee," "knee arthritis," or "hip arthritis." This yielded 10 different search term combinations for each of the three search engines, yielding a total of 30 searches. The methodology for screening search results was consistent with that done by previous analyses regarding the quality of online resources in orthopaedics.[22] Specifically, the first 25 results were recorded from each search. Websites marked as advertisements that had paid to be populated at the top of searches were excluded. Duplicate entries were removed if they appeared on multiple search engines. Websites were excluded if they were targeting medical professionals, included only video content, provided no information about hip or knee pain or arthritis, did not mention CBD, or had a nonfunctional hyperlink (Figure 1).

The websites were further divided into the following six types: physician sponsored, hospital or heath system sponsored, medical device or sales industry sponsored, professional organization's website, news article, or other. The Flesch-Kincaid method (FK) was used to score websites for readability.[23] A scoring system was developed to quantify and evaluate how the available online resources explain diagnosis, evaluation, and treatment of hip and knee arthritis and the potential role

Figure 1



Inclusion and exclusion criteria.

for CBD as an adjunct therapy in this setting. This scoring system (Table 1) was modified from previous nonvalidated scoring systems used in the literature for similar purposes.[22,24] The scoring system had a maximum score of 25 points and was agreed on by the senior authors who are experienced with treatment of hip and knee arthritis and the potential role of CBD in this clinical setting. Of the 25 points, six were related to diagnosis and evaluation of hip and knee arthritis and 19 were related to arthritis treatment. Because multiple treatment approaches exist for early-to-moderate hip and knee arthritis, this scoring system aims to capture a myriad of possible treatment modalities. Two authors (B.A.A. and J.L.) independently graded all screened websites, awarding one point for each criterion. The two scores for each website were then averaged to obtain a final score. Interobserver reliability was established using the kappa statistic, which is most commonly used for studies measuring agreement between two or more observers. A kappa of 1 represents perfect agreement, whereas a kappa of 0 represents agreement equivalent to chance.[25] Average scores of individual article types were compared with that of other article types to compare the quality and reliability of information between article types.[22]

Statistical analysis was done using the SAS software package version 9.4 (SAS Institute). Student *t*-tests were done for continuous data, and χ^2 or Fisher exact tests were done for categorical data, as appropriate. Two-tailed *P* values <0.05 were considered statistically significant.

Results

The initial search yielded 750 websites. A total of 463 duplicates were removed and 193 websites were subsequently excluded based on the aforementioned exclusion criteria. The final group included 94 websites that discussed CBD for hip and knee arthritis (Figure 1). The interobserver reliability in website scoring between the two reviewers was excellent (kappa: 0.80, 95% confidence interval, 0.78-0.83).[25]

Review of each of these 94 websites revealed a mean website score of 7.46 (SD 3.51) of 25 (29.8%). More

Table 1. Website Scoring Rubric

Diagnosis and evaluation (6 points)
Describes in any detail the anatomy of the knee or the hip
Describes in any detail the function of knee or hip structures
Describes in any detail the pathogenies of degenerative joint disease/osteoarthritis
Differentiates osteoarthritis from other forms of arthritis or generalized inflammatory conditions
Physician may examine your hip/knee
Physician may obtain hip/knee radiographs, advanced imaging (MRI), or do other testing (serologic testing and joint aspiration) to determine underlying diagnosis
Treatment (19 points)
Conservative treatment methods for osteoarthritis of the hip and knee presented including rest and activity modification
Role of physical therapy is discussed
Weight loss
Role of anti-inflammatories and analgesics
Alternative treatments (injections, acupuncture, glucosamine, topical cream, and capsaicin)
Surgery can be used to address advanced cartilage loss (cartilage procedure or joint replacement)
Discusses medical literature on the use of CBD for knee/hip arthritis
Discusses the mechanism of action of CBD
Differentiates THC from CBD
States CBD is derived from cannabis/hemp
Acknowledges that treatment is considered controversial and that evidence base is limited
Discusses that the term "CBD" encompasses various formulations and discusses more than one CBD formulation
Discusses routes of CBD delivery (oral, topical, nasal spray, etc) and considerations for each
Mentions lack of FDA regulation for CBD
Acknowledges CBD currently is not currently a recommended treatment modality for hip and knee pain by governing medical associations
Mentions potential side effects or risks of CBD therapy
Mentions possible CBD interaction with commonly taken medications
Discusses in any detail dosing of CBD
Mention of the legality of CBD products
Total/25 points

CBD = cannabidiol, THC = tetrahydrocannabinol

specifically, the mean website scores for diagnosis and evaluation section were 1.08 (SD 1.45) of 6 (17.9%), whereas the mean website scores for treatment were 6.55 (SD 3.07) of 19 (34.5%) (Table 2). The mean FK reading level was 48.78 (SD 10.11), corresponding to a "difficult" reading level consistent with that appropriate for a college education.[23,26]

The most common source of categorized online information came from either the sales industry (38, 40.4%) or news-style articles without an explicit link to purchase CBD products (42, 44.68%). Only 4 (4.25%) of the websites were physician sponsored, and only 2 (2.13%) were from professional organizations, such as the arthritis foundation (Table 3).[27] In the heterogeneous landscape of quality online sales oriented websites, it should be highlighted that although few in number, physician-sponsored websites were the only group to have statistically significant higher scores than the other website categories (9.25, SD 0.96, $P = 0.03$).

Of websites that met inclusion criteria, 22 websites (23.4%) were found using the search term "cannabidiol," whereas 72 (76.6%) were encountered when searching "CBD." The average website scores were not significantly different between those with listing "CBD" and those with "cannabidiol" ($P = 0.382$).

Table 2. Website Performance

Factor	Mean Score	SD	% Websites
Diagnosis and evaluation			
Describes in any detail the anatomy of the knee or the hip	0.18	0.39	19.50
Describes in any detail the function of knee or hip structures	0.15	0.36	16.50
Describes in any detail the pathogenies of degenerative joint disease/osteoarthritis	0.39	0.49	37.00
Differentiates osteoarthritis from other forms of arthritis or generalized inflammatory conditions	0.28	0.45	26.50
Physician may examine your hip/knee	0.04	0.20	4.50
Physician may obtain hip/knee radiographs, advanced imaging (MRI), or do other testing (serologic testing and joint aspiration) to determine underlying diagnosis	0.03	0.18	2.50
Treatment			
Conservative treatment methods for osteoarthritis of the hip and knee presented including rest and activity modification	0.12	0.32	10.00
Role of physical therapy is discussed	0.15	0.36	13.00
Weight loss	0.13	0.34	10.50
Role of anti-inflammatories and analgesics	0.26	0.44	23.50
Alternative treatments (injections, acupuncture, glucosamine, topical cream, and capsaicin)	0.14	0.35	12.00
Surgery can be used to address advanced cartilage loss (cartilage procedure or joint replacement)	0.19	0.40	16.00
Discusses medical literature on the use of CBD for knee/hip arthritis	0.47	0.50	42.50
Discusses the mechanism of action of CBD	0.64	0.48	58.50
Differentiates THC from CBD	0.64	0.48	60.50
States CBD is derived from cannabis/hemp	0.73	0.44	72.50
Acknowledges that treatment is considered controversial and that evidence base is limited	0.33	0.47	23.50
Discusses that the term “CBD” encompasses various formulations and discusses more than one CBD formulation	0.52	0.50	47.50
Discusses routes of CBD delivery (oral, topical, nasal spray, etc) and considerations for each	0.50	0.50	46.00
Mentions lack of FDA regulation for CBD	0.28	0.45	19.50
Acknowledges that CBD currently is not currently a recommended treatment modality for hip and knee pain by governing medical associations	0.12	0.32	9.50
Mentions potential side effects or risks of CBD therapy	0.28	0.45	25.00
Mentions possible CBD interaction with commonly taken medications	0.22	0.42	20.50
Discusses in any detail dosing of CBD	0.34	0.48	34.50
Mention of the legality of CBD products	0.51	0.50	50.00

CBD = cannabidiol, THC = tetrahydrocannabinol

Table 3. Source of Website Information

Factor	No. of Articles	% of Included Articles	Score Average	SD	Total Average Score of All Other Article Types	SD	*P* Value (vs All Other Types)
News	42	44.68	8.10	3.75	7.25	3.44	0.26
Sales industry	38	40.40	7.26	3.57	7.88	3.61	0.42
Physician	4	4.25	9.25	0.96	7.56	3.65	0.03*
Hospital/health system	3	3.19	4.67	3.79	7.73	3.56	0.15
Professional organization	2	2.13	7.50	4.95	7.63	3.6	0.96
Other	5	5.32	7.00	3.16	7.67	3.62	0.69

Discussion

This study provides the first comprehensive analysis we are aware of investigating available online resources on CBD for hip and knee arthritis. We found that although a number of online resources are available for patients seeking information about CBD for hip and knee arthritis, the content presented in these resources was limited, with an average score of 7.46 (SD 3.51) of 25 (29.8%). These resources were also typically written at a reading level higher than that recommended for the general population with FK reading scores of 48.78 (SD 10.11) corresponding to a college education level. For perspective, a "fairly easy" reading ease corresponds to a FK score of 70 to 80 and an "easy" reading ease corresponds to a FK score of 80 to 90. In addition, the overwhelming majority of websites on CBD for hip and knee arthritis were not developed by physicians, hospitals, or professional medical associations but were presented as news articles or overt advertisements from sales-oriented organizations with direct links to purchase CBD. Notably, a wide range of quality exists in regard to reliable information regarding arthritis diagnosis, evaluation, and treatment on websites offering CBD products for purchase. This is highlighted by the fact that the top three highest scoring and bottom three lowest scoring websites all included links to purchase CBD products. In fact, to our knowledge, no consensus statements exist regarding CBD use by any major orthopaedic organization in the United States at this time.

As reflected in the scoring rubric presented, we think that a well-structured website designed to educate patients about CBD for hip and knee arthritis should be written at an appropriate reading level but also discuss specific relevant topics (Table 1). Inclusion of each of these topics will help inform patients by (1) explaining what to expect regarding evaluation and workup of hip and knee arthritis, (2) describe the underlying anatomy and disease pathogenesis of different types of arthritis, (3) discuss a diverse array of treatment options, (4) define CBD, (5) present a balanced assessment of the medical literature regarding CBD in this clinical setting, and (6) mention the legality of CBD products along with potential side effects and risks of use. In discussing each of these points, an online resource would serve to educate and inform patients both before and after their physician encounter.

Our findings that online information on CBD for hip and knee arthritis is generally of poor quality are in line with past studies reporting that quality and accuracy of the websites patients may use to obtain information about their health can be inadequate.[22,28,29] Given that patients are increasingly likely to look up information about health online, physicians can improve their relationship with patients by better understanding the quality of information patients access about their health before the patient-physician encounter.[30] Looking forward, given the few current CBD resources sponsored by physicians or professional medical organizations, a clear opportunity and a need exists for readily accessible, balanced, scientific, and comprehensive information on this topic. Until that time, patients should be counseled that online information about CBD for hip and knee arthritis is of heterogeneous quality and generally unreliable. Surgeons should play an increased role in providing comprehensive resources to patients and educating them on the risks and potential uses of CBD.

References

1. Hootman JM, Helmick CG, Barbour KE, Theis KA, Boring MA: Updated projected prevalence of self-reported doctor-diagnosed arthritis and arthritis-attributable activity limitation among US adults, 2015-2040. *Arthritis Rheumatol* 2016;68:1582-1587.

2. *Arthritis Cost Statistics*|*CDC*. 2019. https://www.cdc.gov/arthritis/data_statistics/cost.htm. Accessed June 30, 2019.

3. Zhang Y, Jordan JM: Epidemiology of osteoarthritis. *Clin Geriatr Med* 2010;26:355-369.

4. TREATMENT OF OSTEOARTHRITIS OF THE KNEE EVIDENCE-BASED GUIDELINE 2ND EDITION Adopted by the American Academy of Orthopaedic Surgeons Board of Directors May 18, 2013. https://aaos.org/globalassets/quality-and-practice-resources/osteoarthritis-of-the-knee/osteoarthritis-of-the-knee-2nd-editiion-clinical-practice-guideline.pdf

5. MANAGEMENT OF OSTEOARTHRITIS OF THE HIP EVIDENCE-BASED CLINICAL PRACTICE GUIDELINE Adopted by the American Academy of Orthopaedic Surgeons Board of Directors March 13, 2017. https://www5.aaos.org/uploadedFiles/PreProduction/Quality/Guidelines_and_Reviews/OA%20Hip%20CPG_6-11-19.pdf

6. Crawford DC, Miller LE, Block JE: Conservative management of symptomatic knee osteoarthritis: A flawed strategy? *Orthop Rev* 2013;5:e2.

7. Gill LL: *CBD Goes Mainstream. Consumer Reports*. https://www.consumerreports.org/cbd/cbd-goes-mainstream/. Accessed May 25, 2019.

8. Khaleghi M: New arthritis foundation guidelines on CBD use could be first of many more to come. *Altern Therap Health Med* 2020;26:8-11.

9. Johnson TP, Wislar JS: Response rates and nonresponse errors in surveys. *JAMA* 2012;307:1805-1806.

10. Johnson JR, Burnell-Nugent M, Lossignol D, Ganae-Motan ED, Potts R, Fallon MT: Multicenter, double-blind, randomized, placebo-controlled, parallel-group study of the efficacy, safety, and tolerability of THC:CBD extract and THC extract in patients with intractable cancer-related pain. *J Pain Symptom Manage* 2010;39:167-179.

11. Bakshi C, Barrett AM: Impact of recreational and medicinal marijuana on surgical patients: A review. *Am J Surg* 2019;217:783-786.

12. Kuhathasan N, Dufort A, MacKillop J, Gottschalk R, Minuzzi L, Frey BN: The use of cannabinoids for sleep: A critical review on clinical trials. *Exp Clin Psychopharmacol* 2019;27:383-401.

13. Belardo C, Iannotta M, Boccella S, et al: Oral cannabidiol prevents allodynia and neurological dysfunctions in a mouse model of mild traumatic brain injury. *Front Pharmacol* 2019;10:352.

14. Kisková T, Mungenast F, Suváková M, Jäger W, Thalhammer T: Future aspects for cannabinoids in breast cancer therapy. *Int J Mol Sci* 2019;20:1637.

15. Hoffenberg EJ, McWilliams S, Mikulich-Gilbertson S, Murphy B, Hoffenberg A, Hopfer CJ: Cannabis oil use by adolescents and young adults with inflammatory bowel disease. *J Pediatr Gastroenterol Nutr* 2019;68:348-352.

16. Mondello E, Quattrone D, Cardia L, et al: Cannabinoids and spinal cord stimulation for the treatment of failed back surgery syndrome refractory pain. *J Pain Res* 2018;11:1761-1767.

17. Lötsch J, Weyer-Menkhoff I, Tegeder I: Current evidence of cannabinoid-based analgesia obtained in preclinical and human experimental settings. *Eur J Pain* 2018;22:471-484.

18. Blake A, Wan BA, Malek L, et al: A selective review of medical cannabis in cancer pain management. *Ann Palliat Med* 2017;6:S215-S222.

19. Langford RM, Mares J, Novotna A, et al: A double-blind, randomized, placebo-controlled, parallel-group study of THC/CBD oromucosal spray in combination with the existing treatment regimen, in the relief of central neuropathic pain in patients with multiple sclerosis. *J Neurol* 2013;260:984-997.

20. Russo EB, Guy GW, Robson PJ: Cannabis, pain, and sleep: Lessons from therapeutic clinical trials of Sativex, a cannabis-based medicine. *Chem Biodivers* 2007;4:1729-1743.

21. Williamson EM, Evans FJ: Cannabinoids in clinical practice. *Drugs* 2000;60:1303-1314.

22. Nwachukwu BU, Rauck RC, Kahlenberg CA, et al: The quality of online resources available to patients interested in knee biologic therapies is poor. *HSS J* 2018;14:322-327.

23. Flesch R: A new readability yardstick. *J Appl Psychol* 1948;32:221-233.

24. Ghodasra JH, Wang D, Jayakar RG, et al: The assessment of quality, accuracy, and readability of online educational resources for platelet-rich plasma. *Arthroscopy* 2018;34:272-278.

25. Viera AJ, Garrett JM. Understanding interobserver agreement: The kappa statistic. *Fam Med* 2005;37:360-363.

26. Lerbinger O. *Corporate Communication: An International and Management Perspective*. Hoboken, NJ, John Wiley & Sons, 2018.

27. *CBD for Arthritis Pain: What You Should Know*. Accessed May 10, 2020. https://www.arthritis.org/health-wellness/healthy-living/managing-pain/pain-relief-solutions/cbd-for-arthritis-pain

28. Garcia GH, Taylor SA, Dy CJ, Christ A, Patel RM, Dines JS: Online resources for shoulder instability: What are patients reading? *J Bone Joint Surg Am* 2014;96:e177.

29. Johnson CC, Garcia GH, Liu JN, Stepan JG, Patel RM, Dines JS: Internet resources for Tommy John injuries: What are patients reading? *J Shoulder Elbow Surg* 2016;25:e386-e393.

30. Tan SSL, Goonawardene N: Internet health information seeking and the patient-physician relationship: A systematic review. *J Med Internet Res* 2017;19:e9.