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Assessing the Quality and Credibility of Publicly Available Videos on Cervical Fusion: Is YouTube a Reliable Educational Tool?

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ABSTRACT

Background: YouTube has become a popular source for patient education, though there are concerns regarding the quality and reliability of videos related to orthopaedic and neurosurgical procedures. This study aims to evaluate the credibility and educational content of videos on YouTube related to cervical fusion. Secondarily, the study aims to identify factors predictive of higher or lower quality videos.

Methods: A YouTube query using the search terms "cervical fusion" was performed, and the first 50 videos were included for analysis. Reliability was assessed using the *Journal of the American Medical Association* (*JAMA*) criteria. Educational quality was assessed using the Global Quality Score (GQS) and the Cervical Fusion Content Score (CFCS). Videos were stratified by content and source, and differences in *JAMA*, GQS, and CFCS scores were assessed. Multivariable linear regression was used to identify predictors of higher or lower *JAMA*, GQS, and CFCS scores. Statistical significance was established at $P < 0.05$.

Results: Total number of views was 6 221 816 with a mean of 124 436.32 ± 412 883.32 views per video. Physicians, academic, and medical sources had significantly higher mean *JAMA* scores ($P = 0.042$). Exercise training and nonsurgical management videos had significantly higher mean CFCS scores ($P = 0.018$). Videos by physicians ($\beta = 0.616$; $P = 0.025$) were independently associated with higher *JAMA* scores. Advertisements were significant predictors of worse CFCS ($\beta = -3.978$; $P = 0.030$), and videos by commercial sources predicted significantly lower *JAMA* scores ($\beta = -1.326$; $P = 0.006$).

Conclusions: While videos related to cervical fusion amassed a large viewership, they were poor in both quality and reliability. Videos by physicians were associated with higher reliability scores relative to other sources, whereas commercial sources and advertisements had significantly lower reliability and educational content scores. Currently, YouTube seems to be an unreliable source of information on cervical fusion for patients.

Level of Evidence: 4.

Clinical Relevance: The results of this study aid surgeons in counseling patients interested in cervical fusion, and suggest that publicly available videos regarding cervical fusion may not be an adequate tool for patient education at this time.

Cervical Spine

Keywords: cervical, fusion, patient education, video, surgery

INTRODUCTION

While physicians and health care providers have traditionally been the primary source of medical information, an increasing number of patients are turning to the Internet as a source for health care guidance. It has previously been reported that 61% of adults in the United States regularly search for health-related content, and approximately 80% of adults have turned to it at least once.[1,2] YouTube, an online open-source platform that allows users to view and upload videos, is widely regarded as the most popular Web site where users can view videos and share information.

Videos related to health care issues are becoming more popular; however, there has been concern over the quality and reliability of these videos for patient education.[3,4] Several studies have reported overall poor educational quality of videos pertaining to a variety of orthopaedic and neurosurgical conditions and procedures, including femoroacetabular impingement syndrome,[3] knee arthroplasty,[4] scolio-

sis,[5] posterior cruciate ligament injuries,[6] and others. The risk of misinformation is of particular concern to spine surgeons, as 54% of patients report researching their condition before consultation with orthopaedic or neurosurgical surgeons.[7]

Cervical spondylosis is fairly common, with approximately 50% of patients over 40 years old and 85% of patients over 65 years old having some evidence of cervical degeneration.[8,9] Though many patients remain asymptomatic,[8,10] roughly 83 per 100 000 individuals will develop cervical radiculopathy every year.[11] Cervical fusion is a commonly used surgical procedure for degenerative spine pathologies, including radiculopathy, cervical myelopathy, and degenerative disc disease. Given the high prevalence of cervical degeneration, the annual number of cervical spinal surgeries has been increasing over time.[12] As more patients are referred for surgery, it is imperative that accurate and valuable information be available for patients who are contemplating surgery.

Therefore, the current study aims to assess the educational quality and reliability of publicly available YouTube videos related to cervical fusion. Secondarily, this study aims to identify factors associated with higher and lower quality videos.

METHODS

YouTube Search

An online query was performed on the YouTube online library (https://www.youtube.com/) using the keywords "cervical fusion." The first 50 video results were recorded and assessed for use in the study using a method previously accepted in other peer-reviewed literature.[6,13] Exclusion criteria for videos included non-English videos or audio-only soundtracks. In cases where a video was excluded, the next consecutive eligible video was included for consideration.

Video Characteristics

For each video result, the following video characteristics were recorded to be analyzed: (1) title, (2) video source or uploader, (3) type of content, (4) video duration, (5) days since upload, (6) number of views, (7) view ratio (views/day), (8) number of likes, (9) number of dislikes, (10) like ratio (like*100/like + dislike), and (11) video power index (VPI; like ratio*view ratio/100). The VPI, which has been used in previous literature, is a measurement that represents video popularity.[6,13]

Table 1. The *Journal of the American Medical Association* score criteria and descriptions.

Criteria	Description
Authorship	Author and contributor credentials and affiliations are clearly stated
Attribution	Clearly lists all copyright information and includes references or sources for content
Currency	Date of post and subsequent updates to content are included
Disclosure	Conflicts of interest, funding, sponsorship, advertising, support, and video ownership are disclosed

Video Upload Sources

Video sources or uploaders were broken down into the following categories: (1) academic (authors or uploaders with research or university or college affiliations), (2) physician (independent physicians or physician groups without research or university or college affiliations), (3) nonphysicians (health professionals other than licensed medical doctors), (4) athletic trainers, (5) medical sources (content or animations from health-focused Web sites), (6) patients, and (7) commercial sources.

Video Content Categories

Video content was classified into the following categories: (1) exercise training (videos on rehabilitation and therapy post cervical fusion), (2) general information related to cervical fusion, (3) patient testimonials, (4) surgical technique, (5) nonsurgical management, and (6) advertisements.

Assessment of Video Reliability and Educational Content Quality

The *Journal of the American Medical Association* (*JAMA*) benchmark criteria were used to assess the accuracy and reliability of the video results. The *JAMA* benchmark criteria (Table 1) are a nonspecific and objective set of 4 guidelines that may be identifiable in online videos and resources. These criteria include (1) authorship, (2) attribution, (3) currency, and (4) disclosure. The observer assigns 1 point for each criterion fulfilled. Authorship criteria assesses the quality of the authors, contributors, academic affiliation, and credentials. Attribution assesses the references and sources used, as well as the copyright information. Currency evaluates the date content is posted and its use of up-to-date information. Finally, disclosure assesses any spon-

Table 2. The Global Quality Score.

Grade	Description
1	Poor quality; not useful for patient education
2	Poor quality; minimal relevant information. Limited utility to patients
3	Suboptimal quality; some useful information present, but missing key topics. Somewhat useful to patients
4	Good quality; most important topics discussed. Useful to patients
5	Excellent quality; all topics covered in a clear manner. Highly useful to patients

sorship, commercial funding, advertisements, or other potential conflicts of interest. A total score of 0 represents low accuracy and reliability, whereas a total score of 4 represents high accuracy and reliability. Though this method is not validated, it has been used previously in peer-reviewed literature as a means of assessing the reliability of online resources.[6,13,14]

To assess the overall educational content quality of the videos, we used the Global Quality Score (GQS). The GQS (Table 2) is a ranking tool ranging from poor quality (not educationally useful to patients) to excellent quality and flow (highly useful to patients). Scores range from 1 to 5 with a maximum score of 5 indicating high educational quality. Like the *JAMA* score, the GQS has not been validated, but it has been used in previous peer-reviewed literature to assess the content quality of online resources.[6,13,14]

To assess educational content quality specifically related to cervical fusion, we created the Cervical Fusion Content Score (CFCS). This 16-item tool is based on guidelines published by the American Academy of Orthopaedic Surgeons.[15] Although this is a nonvalidated tool, similar methods for assessing the educational quality of online videos using orthopaedic and neurosurgical topic-based instruments have been noted in previous peer-reviewed literature.[6,16] The CFCS criteria (Table 3) include information pertaining to (1) common patient symptoms and populations; (2) general information about cervical fusion; (3) diagnoses and evaluations warranting cervical fusion; (4) methods, risks, and benefits pertaining to cervical fusion surgeries; and (5) postoperative outcomes. The observer assigns 1 point for each criterion satisfied with a maximum possible score of 16 indicating high cervical fusion-specific educational content quality. Interrater reliability for all 3 outcome tools was assessed using intraclass correlation (ICC) analysis. For the *JAMA*, GQS, and CFCS tools, ICC values were >0.7, indicating good interrater reliability.

Table 3. Criteria assessed in the cervical fusion content score.

Patient presentation
Describes symptoms
Describes relevant patient population
General information
Defines cervical fusion
Compares cervical fusion to lumbar fusion
Explains purpose of cervical fusion
Mentions majority population affected
Diagnosis and evaluation
Mentions specific or relevant symptoms
Discusses use of imaging
Mentions red flag requiring urgent treatment
Treatment
Describes multiple surgical approaches
Describes the use of bone grafting
Describes the associated risks
Describes the associated benefits
Outcomes
Discusses postoperative outcomes
Mentions effect on range of motion
Discusses length of recovery

Statistical Methods

All statistical tests were performed using Stata version 13.1 (StataCorp LC, College Station, TX). Descriptive statistics were used to quantify video characteristics, video reliability, and quality scores. Continuous variables are presented as means ± standard deviations and ranges. Categorical variables are presented as relative frequencies with percentages. One-way analysis of variance (ANOVA) tests were used to determine if video reliability and quality differed based on video source and video content. Multivariate linear regression analyses were used to determine the influence of specific video characteristics on video reliability (*JAMA* score) and educational quality (GQS and CFCS). A P value < 0.05 was statistically significant.

RESULTS

Overall, 50 videos were analyzed, and the baseline characteristics of these videos are summarized in Table 4. The mean number of views per video was 124 436.32 ± 412 883.32. In total, the 50 included videos were viewed 6 221 816 times. The maximum number of views was 2 591 952, and the minimum number of views was 163.

The primary video content category was assessed for each video, and the results are summarized in Figure 1. The most common category represented was information about surgical technique (54%).

Table 4. Video characteristics.

Characteristic	Mean ± SD	Max	Min
Video duration (min)	10.9 ± 18.27	89.1	0.57
Views	124 436.32 ± 412 883.32	2 591 952	163
Days since upload	1733.57 ± 1085	4835	147
View ratio (views/d)	43.6 ± 107.5	536.1	0.17
Likes	232.5 ± 860.1	5600	0
Dislikes	22.7 ± 92.4	602	0
Like ratio	92 ± 15.6	100	0
Video power index	35.8 ± 101.8	470.5	0

The lowest proportion of video content was attributed to exercise training, at 2%. Video sources are summarized in Figure 2. Physicians were the most common source of video content (64%), whereas patients were categorized as the least common source (2%).

The mean *JAMA*, GQS, and CFCS scores, stratified by content and source, are summarized in Table 5. Overall, the mean *JAMA* score was 1.86, the GQS was 1.48, and the CFCS was 5.28. In terms of the video sources, videos by physicians had the highest mean *JAMA* (2.1) and CFCS (5.8) scores. ANOVA demonstrated significant between-groups interactions in the *JAMA* score ($P = 0.042$) between source categories, with physicians, academic sources, and medical sources having significantly higher mean *JAMA* scores. Analysis by content category revealed significant differences in the CFCS ($P = 0.018$), with exercise training and nonsurgical management having higher mean scores. There were no other significant associations found between video source or content classification and the VPI, *JAMA*, or GQS.

Multivariate linear regression analyses were performed to determine if independent associations existed among video characteristics, video content category, video upload source, and video reliability and educational quality scores. Videos by physicians were significantly associated with higher *JAMA* scores ($\beta = 0.616$; $P = 0.025$). In addition, videos

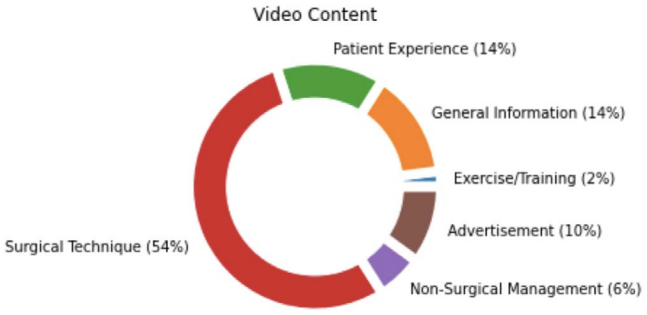

Figure 1. Videos stratification and percentage breakdowns by primary content material.

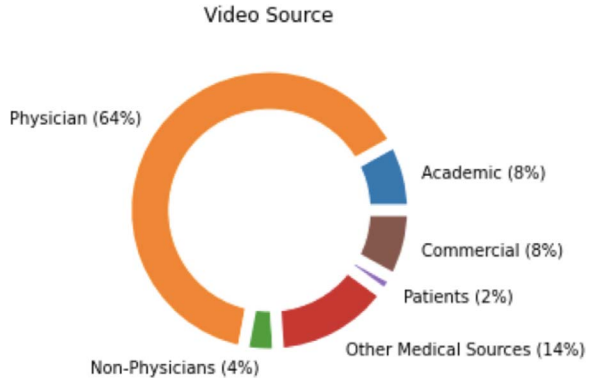

Figure 2. Video stratification and percentage breakdowns by publishing source.

classified as nonsurgical management were significant predictors of having higher *JAMA* ($\beta = 0.907$; $P = 0.050$) and CFCS ($\beta = 4.243$; $P = 0.029$) scores. Videos that were classified as advertisements were significant predictors of worse CFCS ($\beta = -3.978$; $P = 0.030$), and videos by commercial sources were associated with significantly lower *JAMA* scores ($\beta = -1.326$; $P = 0.006$).

DISCUSSION

This study sought to assess the quality and credibility of publicly available YouTube videos related to cervical fusion and video characteristics that were predictive of higher educational quality. Despite the popularity of the first 50 videos queried as denoted by total viewership, both the quality and educational content of the included videos was overall poor. Videos published by physicians were

Table 5. Quality and reliability of videos based on source and content.

Variables	*JAMA*, Mean ± SD	GQS, Mean ± SD	CFCS, Mean ± SD
Overall	1.86 ± 0.9	1.48 ± 0.7	5.28 ± 3.2
Source[a]			
Academic	1.8 ± 1.0	2.0 ± 0.8	4.3 ± 3.3
Physician	2.1 ± 0.9	1.4 ± 0.7	5.8 ± 3.5
Nonphysicians	1.0 ± 0	1.5 ± 0.7	4.5 ± 3.5
Medical sources	1.6 ± 0.5	1.6 ± 0.8	3.9 ± 1.9
Patients	1.0 ± 0	1.0 ± 0	5.0 ± 0
Commercial	1.0 ± 0	1.3 ± 0.5	5.3 ± 3.0
Content[b]			
Exercise or training	3.0 ± 0	2.0 ± 0	10.0 ± 0
General background	1.6 ± 0.8	1.4 ± 0.5	5.9 ± 3.1
Patient experience	1.6 ± 0.5	1.1 ± 0.4	6.4 ± 2.0
Surgical technique	1.8 ± 0.8	1.5 ± 0.7	4.3 ± 3.1
Nonsurgical management	3.0 ± 0	1.7 ± 0.6	10.0 ± 1.0
Advertisement	2.4 ± 1.3	1.2 ± 0.4	4.0 ± 2.9

Abbreviations: *JAMA*, *Journal of the American Medical Association*; GQS, Global Quality Score; CFCS, Cervical Fusion Content Score.
[a] *P* values for source analysis of variance (ANOVA): *JAMA* = 0.042; GQS = 0.676; CFCS = 0.765.
[b] *P* values for content ANOVA: *JAMA* = 0.055; GQS = 0.531; CFCS = 0.018.

independently associated with higher quality, while videos focusing on nonsurgical alternatives to cervical fusion were associated with higher quality and educational content. Commercial sources were associated with significantly lower quality, whereas videos intended as advertisements were associated with lower educational content, as assessed by the CFCS.

As anticipated, we observed that videos related to cervical fusion attracted many viewers. The total number of views for the videos included was 6 221 816 at the time of our analysis, with a mean of 124 436.3 views. Previous orthopaedic and neurosurgical studies that aimed to assess the popularity of YouTube videos found comparable results.[5,6,13] Kunze et al[6] recently assessed the quality of videos related to posterior cruciate ligament injuries and reported a mean of 50 477.9 views per video. Staunton et al[5] in their 2015 study reported on videos related to scoliosis and found the mean number of views to be 71 152. More recently in 2018, Ovenden et al[17] performed a similar query related to anterior cervical fusion and discectomy (ACDF), reporting a mean of 96 239 views. The high number of views in our analysis further supports the notion that cervical fusion is a popular search topic for YouTube users and may attract a large patient viewership. Moreover, it may suggest that videos related to spinal disorders and procedures are becoming more popular over time; the mean number of views per video in our study is higher than the 2 previously mentioned studies.

While these videos may be popular, the overall quality and educational content were quite poor. This again is in line with previous studies. The aforementioned study of ACDF videos by Ovenden et al[17] showed a mean *JAMA* score of 1.63. Brooks et al[18] conducted a YouTube search for videos related to lumbar discectomy and found that only 19.8% of videos were rated as "good," while 49.4% were rated as "poor or inadequate." This trend of poor quality extends to a variety of other orthopaedic procedures and conditions outside the spine, including the knee and hip.[3,4,6] Moreover, the mean CFCS, a tool we designed to assess the educational content quality for videos related to cervical fusion, was 5.28 out of a maximum of 16, reflecting a substantial lack of pertinent information across all videos regardless of source.

Overall, we observed that a majority (64%) of videos were produced by physicians. Previous studies have shown that videos produced by physicians are generally more reliable and of higher quality than videos produced by nonphysicians.[19] In our analysis, we similarly found that videos produced by physicians, academic institutions, and other medical sources had significantly higher *JAMA* scores relative to videos made by patients, nonphysicians, or commercial sources. Moreover, in our analysis, we found that videos produced by physicians were independently associated with higher quality videos. However, the educational content, as assessed by the GQS and CFCS, did not significantly differ between these groups. This suggests that, while the reliability of the videos produced by physicians and reputable medical sources may be higher, those videos are not necessarily of higher education quality or utility to patients.

On the other hand, videos produced by commercial sources were significantly associated with lower *JAMA* scores. Furthermore, videos classified as advertisements were significantly associated with lower CFCS scores. Advertisements and direct-to-consumer marketing of medical therapies and procedures may lead patients to have skewed or unrealistic outcome expectations after procedures.[20] In fact, Sherman et al[21] analyzed pretreatment expectations in patients undergoing acupuncture for low back pain. They found that patients with higher pretreatment expectations generally had higher expectations for improvement, were less likely to pursue other treatment modalities, but were not more likely to have improved outcomes after treatment. In the context of cervical fusion, surgeons should attempt to assess patients' current understanding of surgery and should establish realistic patient expectations, particularly in those patients that have done independent research before a consultation.

Interestingly, analysis by content category did demonstrate that videos related to nonsurgical alternatives to surgery were independently associated with higher *JAMA* and CFCS scores. Overall, only 6% of videos analyzed were related to nonsurgical alternatives to surgery. Therefore, the statistical significance observed is likely a function of a low sample size. If the study sample was extended to include more videos, this relationship may not be evident. Alternatively, the question of whether to undergo surgery for spinal disorders is complex, and not everyone may benefit from surgery.[22,23] There-

fore, it is possible that the nonsurgical videos needed to include a more complete discussion of the relevant disease processes and surgical considerations to justify nonsurgical treatment.

This study has several limitations. First, only the top 50 videos returned were assessed. Therefore, many videos were excluded, and our analysis may not reflect the overall quality of videos available to patients. However, the top 50 videos are potentially the most important to evaluate, as these are the most likely to be found and viewed by patients. Second, the search terms cervical fusion used in our analysis may differ from terms used by patients. For example, patients may replace "cervical" with "neck" or other terms in their search, which may alter the returned videos. However, we believe our search terminology is broad enough to include the most popular videos directly pertinent to cervical surgery and reflect most videos that patients may encounter.

CONCLUSIONS

In this study, YouTube videos related to cervical fusion were assessed for reliability and educational quality. Overall, videos related to cervical fusion were popular and amassed a large viewership. However, they were poor in both quality and reliability. Videos by physicians were more associated with higher reliability scores relative to other sources. Videos produced by commercial sources and advertisements were associated with significantly lower reliability and educational content scores. Currently, YouTube seems to be an unreliable source of information on cervical fusion for patients. Surgeons should carefully review pertinent information related to cervical fusion with patients to clarify and correct any misinformation to establish realistic surgical expectations.

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