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Quality and Reliability Evaluation of Online Videos on Carpal Tunnel Syndrome: A YouTube Video-based Study

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3 1 **Title:** Quality and Reliability Evaluation of Online Videos on Carpal Tunnel Syndrome: A YouTube Video-
4 based Study
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3 **20 Abstract**

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5 **21 Objectives:** With the increasing popularity of searches for medical information on YouTube, the availability of
6
7 **22** videos concerning carpal tunnel syndrome is increasing. In previous quality-evaluating studies in the orthopedic
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9 **23** field, YouTube video accuracy and quality were low. This study aimed to evaluate the quality and reliability of
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11 **24** YouTube videos on carpal tunnel syndrome.

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13 **25 Setting and Participants:** No participants were included.

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15 **26 Primary and secondary outcome measures:** We searched YouTube using the keywords “carpal tunnel
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17 **27** syndrome” and “carpal tunnel release” and evaluated the first 55 retrieved videos. We summarized the video
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19 **28** characteristics including Video Power Index (VPI), which was designed to evaluate video popularity based on
20
21 **29** the number of likes and views. We categorized them based on source and content. Video quality and reliability
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23 **30** were evaluated using the Journal of the American Medical Association (JAMA) benchmark criteria, Global
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25 **31** Quality Score (GQS), and carpal tunnel syndrome-specific score.

26
27 **32 Results:** The mean JAMA scores, GQS, and carpal tunnel syndrome-specific score were 2.13, 2.69, and 5.0,
28
29 **33** respectively. The most common source of video was from allied health workers, and academically sourced
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31 **34** videos had the highest JAMA score and GQS. These three scores evaluating video quality and reliability were
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33 **35** significantly correlated with each other. However, the VPI was not significantly correlated with video quality
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35 **36** and reliability represented by the three scores. Multiple linear regression analysis showed that a higher JAMA
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37 **37** score was associated with a higher likes ratio, and a higher GQS was associated with a longer video running time
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39 **38** and greater number of comments. However, a higher VPI was not associated with higher video quality or
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41 **39** reliability.

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42 **40 Conclusions:** YouTube videos on carpal tunnel syndrome have low quality and reliability. Video popularity was
43
44 **41** not significantly correlated with quality or reliability. Our findings suggest that expert groups should provide and
45
46 **42** promote high-quality video content to YouTube users and patients.

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48 **43 Keywords:** Carpal tunnel syndrome, Carpal tunnel release, YouTube, Video quality
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3 44 **Strengths and limitations of this study**

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5 45 1. The strength of our study is that we investigated various characteristics including number of views, number
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7 46 of likes, Video Power Index (VPI), and video source (uploader) in the YouTube videos about carpal tunnel
8
9 47 syndrome.
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11 48 2. The strength of our study is that reliability and quality of YouTube videos about carpal tunnel syndrome
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13 49 were investigated three scoring systems including the Journal of the American Medical Association (JAMA)
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15 50 benchmark criteria, Global Quality Score (GQS), and CTS-specific score (CTS-SS). Three scores were
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17 51 independently assessed a second time by the two raters 30 days after the first measurement. Intra- and inter-
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19 52 observer agreements were determined using intraclass correlation coefficients.
- 20
21 53 3. The strength of our study is that a multiple linear regression analysis was performed to identify video
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23 54 characteristics affecting reliability and quality of YouTube videos.
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25 55 4. The limitation of our study is that YouTube video metrics such as the number of likes and views are
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27 56 constantly updated; therefore, these study data are accurate only on the date of the search.
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57 **Background**

58 With the Internet penetration rate exceeding 50% worldwide [1], searches for health information on the
59 Internet have become common. According to recent studies, 80% of Internet users searched for health
60 information online [2], and up to 30% of orthopedic patients searched online for disease information [3].
61 Furthermore, well-designed videos of disease information positively affect treatment outcomes by improving
62 patient comprehension [4, 5]. However, most online information is not regulated, resulting in the spread of
63 inaccurate and low-quality data among patients [6–10]. Therefore, physicians should properly evaluate such
64 information and help patients receive accurate information and appropriate treatment.

65 YouTube, which has over 1 billion users watching over 1 billion hours of videos each day, is a source of
66 representative video-based educational content [11]. Although some high-quality orthopedic content is uploaded
67 by qualified experts on YouTube, most of the related content is uploaded by unqualified individuals, providing
68 patients inaccurate and erroneous information. In previous quality-evaluating studies in the orthopedic field,
69 YouTube video accuracy and quality were low [1, 10, 12–14].

70 According to previous studies that investigated the quality of carpal tunnel syndrome (CTS) information
71 provided by Internet search engines [15–17], the quality of online information has improved over the past decade
72 but remains low. These studies reported that there was significant scope for improvement. In contrast, recent
73 studies [18, 19] reported that most YouTube videos and websites that provide information on CTS can reinforce
74 misconceptions. Two quality-evaluating studies on CTS information available on YouTube [20, 21] focused on
75 video quality and reliability, and neither examined the relationship between characteristics such as video
76 popularity and quality.

77 The current study aimed to (1) evaluate the quality and reliability of YouTube videos concerning CTS, (2)
78 investigate the video characteristics, sources and contents, and (3) determine the relationship between video
79 characteristics and quality.

81 **Methods**

82 *Patient and Public Involvement*

83 No patient involved.

85 *YouTube Search Design and Study Setting*

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3 86 The YouTube online library (<https://www.youtube.com>) was searched on April 1, 2021, using the terms
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5 87 “carpal tunnel syndrome” and “carpal tunnel release.” The first 50 videos retrieved based on each keyword and
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7 88 sorted by “view count” for a total of 100 videos were selected for review. Of them, 45 were excluded
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9 89 (duplicates, 39; non-English, 3; information on cubital tunnel syndrome, 2; soundtrack with no mention of carpal
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11 90 tunnel, 1). Thus, 55 YouTube videos found using the keywords “carpal tunnel syndrome” and “carpal tunnel
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13 91 release” were analyzed (Figure 1).

14 92 Data on the following video characteristics were collected from each YouTube video: (1) title, (2) channel
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16 93 name, (3) number of subscribers, (4) video running time, (5) number of views, (6) number of comments, (7)
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18 94 video source/uploader, (8) content type, (9) days since upload, (10) view ratio (*number of views/days since*
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20 95 *upload*), (11) number of likes, (12) number of dislikes, (13) likes ratio ($Likes \times 100 / [Likes + Dislikes]$), and
21
22 96 (14) Video Power Index (VPI). The VPI was calculated using the following formula: $like\ ratio \times view\ ratio / 100$.
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24 97 This value is an index designed to evaluate video popularity based on the number of likes and views [1].

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26 98 Video sources/uploaders were categorized as follows [1, 10]: (1) academic (uploaders affiliated with
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28 99 universities or research groups), (2) physicians (individual physicians or physician groups not affiliated to a
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30 100 university or research institute), (3) non-physicians (allied health workers such as alternative medical providers,
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32 101 physiotherapists, occupational therapists), (4) trainers, (5) medical sources (animations or related content from
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34 102 health websites), (6) patients, and (7) commercial. Contents were categorized as follows: (1) exercise training,
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36 103 (2) disease information, (3) patient experience, (4) surgical technique, (5) nonsurgical management such as
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38 104 chiropractic treatment, and (6) advertisement.

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40 106 ***Evaluation of Video Quality and Reliability***

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43 107 The quality and reliability of YouTube videos were assessed using three scoring systems: The Journal of
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45 108 the American Medical Association (JAMA) benchmark criteria, Global Quality Score (GQS), and CTS-specific
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47 109 score (CTS-SS). The JAMA criteria enable a nonspecific assessment of content reliability and include four
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49 110 criteria (Table 1) [22]. Each criterion is assigned 1 point for a maximum total of 4 points. A score of 0 indicates
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51 111 low video reliability and accuracy, whereas a score of 4 indicates high video reliability and accuracy. The GQS
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53 112 [1, 10, 23] consists of five grades and provides a nonspecific assessment of health-related website quality (Table
54
55 113 2). The total GQS ranges from 1 to 5, with a higher score indicating better educational quality. To better evaluate
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57 114 quality and accuracy of YouTube videos concerning CTS, we employed the new CTS-SS, which consists of 20
58
59 115 items. We generated this scoring system based on recent review articles [24–26] and guidelines published by the
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3 116 American Academy of Orthopedic Surgeons [27], which were considered reasonable in previous studies [9, 10].
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5 117 The CTS-SS evaluates information on (1) patient symptoms and population, (2) carpal tunnel anatomy, (3) CTS
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7 118 diagnosis and evaluation, (4) treatment options, and (5) postoperative care and course (Table 3). One point was
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9 119 given for each of the 20 items for a total maximum of 20 points. Higher scores indicated higher CTS-specific
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11 120 educational value.

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14 122 ***Intra-observer Reliability and Inter-observer Agreement Assessment***

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16 123 All three scoring systems (JAMA, GQS, CTS-SS) were independently assessed a second time by the two
17
18 124 raters 30 days after the first measurement. Intra- and inter-observer agreements were determined using intraclass
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20 125 correlation coefficients (ICCs). ICCs for absolute agreement with a single measurement were used to identify
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22 126 intra-observer reliability with two-way mixed-effects analysis of variance models. ICCs for absolute agreement
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24 127 with a single rater were used to identify inter-observer agreement using two-way random-effects analysis of
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26 128 variance models. A guideline [28] for evaluating ICC values was adopted: excellent (>0.90), good (0.75–0.90),
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28 129 moderate (0.50–0.75), and poor (< 0.50). In cases of disagreement, all authors re-evaluated the video in question
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30 130 until consensus was reached.

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33 132 ***Statistical Analysis***

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35 133 Continuous variables are presented as mean \pm standard deviation. Differences in the JAMA score, GQS,
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37 134 CTS-SS, and VPI according to (1) video upload source and (2) category of video contents were evaluated by
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39 135 one-way analysis of variance tests (for normally distributed data) and Kruskal-Wallis tests (for non-normally
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41 136 distributed data) followed by post hoc tests using the Bonferroni method. A Spearman correlation analysis was
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43 137 used to assess the correlation between scores and between video characteristics and scores. A multiple linear
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45 138 regression analysis was performed to identify video characteristics affecting the JAMA score, GQS, CTS-SS,
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47 139 and VPI. All reported P-values were two-sided, and those <.05 were considered statistically significant.

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50 141 **Results**

51 142 ***Video Characteristics and Quality Scores***

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53 143 The mean JAMA score, GQS, and CTS-SS were 2.13, 2.69, and 5.0, respectively, indicating low reliability
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55 144 and educational quality (Table 4). Non-physician video sources accounted for the largest share (29.09%), while
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57 145 commercial sources accounted for the lowest share (5.45%) (Figure 2). Disease-specific information accounted
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3 146 for the largest share (32.73%), while patient experience accounted for the smallest share (3.64%) (Figure 3). The
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5 147 video title, YouTube channel name, JAMA score, GQS, CTS-SS, and VPI of the top 55 videos are listed in order
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7 148 of the number of views in Figure 4.
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10 150 *Differences in Video Reliability and Quality by Source and Content*

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12 151 The JAMA score ($p < .0001$) and GQS ($p = .0004$) differed significantly among the seven groups of video
13
14 152 sources, with videos from academic and physician sources having the highest mean JAMA scores and GQS
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16 153 (Table 5). The JAMA score ($p = .0077$) and GQS ($p = .0018$) differed significantly among the six groups of video
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18 154 content, with videos about surgical technique and disease-specific information having the highest mean JAMA
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20 155 scores and GQS. However, the CTS-SS and VPI did not differ significantly between the groups based on video
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22 156 sources and contents.
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25 158 *Factors Affecting Video Quality and Popularity*

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27
28 159 JAMA, GQS, and CTS-SS significantly correlated with each other (JAMA score vs. GQS, $p < .001$; JAMA
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30 160 score vs. CTS-SS, $p = .001$; GQS vs. CTS-SS, $p < .001$). However, the VPI was not significantly correlated with
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32 161 the three scores. Multiple linear regression analysis showed that a higher JAMA score was associated with a
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34 162 higher likes ratio of an academic or physician upload source compared to a patient upload source (Table 6). A
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36 163 higher GQS was associated with a longer video running time; greater number of comments; and higher
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38 164 probability of academic, physician, non-physician, medical information, and commercial upload source than of
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40 165 patient upload source. A higher CTS-SS was more associated with academic, physician, medical information,
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42 166 and commercial upload sources than patient upload sources. However, a higher VPI was not associated with
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44 167 higher video quality or reliability scores.
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46 168

47 169 *Intra-observer Reliability and Inter-observer Agreement Assessment*

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49 170 The intra-observer reliability of the two raters was excellent for the JAMA score, GQS, and CTS-SS. The
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51 171 inter-observer agreement between raters was good for the JAMA score (ICC, 0.881; 95% confidence interval
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53 172 [95% CI], 0.804–0.929), good for the GQS (ICC, 0.881; 95% CI, 0.804–0.929), and excellent for the CTS-SS
54
55 173 (ICC, 0.941; 95% CI, 0.898–0.966).
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57 174

58 175 **Discussion**

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3 176 This study demonstrated that the reliability and quality of YouTube videos concerning CTS were low. This
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5 177 result was consistent with that of other previously conducted YouTube video quality evaluation studies [1, 10,
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7 178 13, 20, 21, 29–31]. Mert et al. [20] evaluated the quality of CTS videos on YouTube and reported that the video
8
9 179 reliability and quality were low. They presented no significant relationship between video characteristics,
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11 180 reliability, and quality evaluation scoring systems. Radonjic et al. [21] also evaluated CTS videos on YouTube
12
13 181 and showed low reliability and quality and found that videos uploaded by physicians had significantly higher
14
15 182 reliability and quality evaluation scores than those uploaded by non-physicians. Goyal et al. [18] reported that
16
17 183 YouTube videos of CTS have low information quality. They determined that the potential reinforcement of
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19 184 misconceptions is prevalent in YouTube videos on CTS.

20 185 Although the overall reliability and educational quality of YouTube videos were low, those of videos from
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22 186 academic and physician uploaders or about surgical techniques and disease-specific information were
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24 187 significantly higher than those of other video sources and contents. This is because the main purpose of these
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26 188 video sources and contents is to educate doctors, medical students, and patients. In contrast, the CTS-SS did not
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28 189 differ significantly among the video sources and contents because YouTube videos focus on specific topics, such
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30 190 as symptoms and surgical technique or rehabilitation after surgical treatment, and deliver the content within a
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32 191 short running time. Additionally, some specific channels, such as the “Bob & Brad” channel, posted videos in
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34 192 four series about CTS and release. Casual YouTube viewers cannot obtain sufficient content on CTS and release
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36 193 in only one or two posted videos, but an entire series can provide most of the content. YouTube uploaders
37
38 194 usually post short videos of less than 10 minutes to maximize the number of views and user interest; thus, they
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40 195 split the content into several videos.

41 196 In this study, video popularity showed no significant correlation with reliability or quality. Popular videos
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43 197 that casual YouTube users and patients frequently watch do not have good quality and reliability. Interestingly,
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45 198 YouTube videos of expert groups that are expected to have high reliability and quality, such as the American
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47 199 Academy of Orthopedic Surgeons or Federation of European Societies for Surgery of the Hand, were not
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49 200 included in the top 55 videos. A manual search identified only about 1,600 views for the carpal tunnel release
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51 201 video uploaded to the American Academy of Orthopedic Surgeons YouTube channel
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53 202 (<https://www.youtube.com/watch?v=eemuH5UYElo>). Additionally, the Federation of European Societies for
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55 203 Surgery of the Hand and British Society for Surgery of the Hand channels have no CTS-related videos and only
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57 204 154 and 575 subscribers, respectively. It is necessary to promote an expert group’s YouTube videos and
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3 205 channels and try to provide accurate medical information by uploading a high-quality video and exposing it to
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5 206 casual YouTube users and patients.

6
7 207 In a previous study on the meniscus [10], video dislikes were described as predictors of YouTube video
8
9 208 reliability, but this was not the case in this study. The independent predictor of the JAMA score in this study was
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11 209 the likes ratio. Furthermore, independent predictors of GQS were video running time and number of comments,
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13 210 suggesting that videos with a longer running time and greater number of comments are independently and
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15 211 significantly associated with a higher GQS. The longer the video running time, the greater the amount of
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17 212 information it contains; therefore, its educational quality also increases. For GQS, a greater number of comments
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19 213 contains more useful information for users who watched the video. Regarding the CTS-SS, compared to patient
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21 214 upload sources, academic, physician, medical, and commercial upload sources are associated with a higher CTS-
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23 215 SS. However, unlike the JAMA score and GQS, CTS-SS showed no significant association with video
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25 216 characteristics except for video source.

26 217 Our study has several limitations. First, we searched the top 50 videos for “carpal tunnel syndrome” and
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28 218 “carpal tunnel release” on YouTube in the order of popularity. This search strategy missed certain videos with
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30 219 low views or hits but with potentially high quality. Although our search strategy could miss high-quality videos
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32 220 that are less “popular,” this strategy is the actual method by which casual You Tube users obtain information.
33
34 221 Second, YouTube video metrics such as the number of likes and views are constantly updated; therefore, these
35
36 222 study data are accurate only on the date of the search. Third, the assessment scoring systems that we used (the
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38 223 JAMA score, GQS, and CTS-SS) are subjective and unvalidated. We tried to resolve this subjectivity and
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40 224 invalidity of scoring systems by having two independent authors perform each evaluation twice. Fourth, one
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42 225 video entitled “Podcast: See a live surgery for carpal tunnel syndrome” with the highest number of views
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44 226 (66.5%), so the average views and VPI values tended to increase. However, this predominance was buffered by
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46 227 analysis of the 55 videos.

47 228

49 229 **Conclusions**

51 230 This study demonstrated that YouTube videos of CTS showed low reliability and quality. Video quality is
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53 231 significantly associated with content and upload source. Video popularity was not correlated with video
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55 232 reliability or quality, which suggests that a good content quality does not guarantee video popularity. The impact
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57 233 of videos on patient care cannot be underestimated. To ensure the spread of accurate information, it is necessary

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234 to YouTube videos published by expert groups and strive to provide high-quality video materials that can assist
235 with patient diagnosis and treatment.

For peer review only

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3 236 **Declarations**

4
5 237 **Ethics approval and consent to participate:** No human participants included, but ethical approval for this study
6
7 238 was obtained from Korea University Guro Hospital institutional review board. (Registration number:
8
9 239 2021GR0314)

10 240 **Consent for publication:** Not applicable

11
12 241 **Availability of data and materials:** All data generated or analysed during this study are included in this
13
14 242 published article

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16 243 **Competing interests:** The authors declare that they have no competing interests

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25
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27
28 249 analysis, writing of initial draft; J.W.Park - contributed interpretation of data and critically revised manuscript;
29
30 250 Y. Won - contributed to the acquisition and analysis of the data; Y. Kwon - contributed to interpretation of data,
31
32 251 statistical analysis; J.I. Lee - supervised the study and critically revised manuscript. All authors read and
33
34 252 approved the final manuscript.

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TABLE 1. JAMA Benchmark Criteria [22]

| Criterion | Description |
|------------------|--|
| Authorship | Author and contributor credentials and their affiliations should be provided |
| Attribution | All copyright information should be clearly listed, and references and sources for content should be stated |
| Currency | The initial date of posted content and dates of subsequent updates to content should be provided |
| Disclosure | Conflicts of interest, funding, sponsorship, advertising, support, and video ownership should be fully disclosed |

JAMA, Journal of the American Medical Association

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4 **TABLE 2. GQS Criteria** [1, 10, 23]
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| 6 Grade | 7 Description of Quality |
|------------------------------|---|
| 8 1 | Poor quality and unlikely to be useful for patient education |
| 9 2 | Poor quality and of limited use for patients because some information is present |
| 10 3 | Suboptimal quality and flow; somewhat useful for patients; important topics are missing; some |
| 11 information is present | |
| 12 4 | Good quality and flow; useful for patients because most important topics are covered |
| 13 5 | Excellent quality and flow; highly useful for patients |
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| 21 GQS, Global Quality Score | |
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TABLE 3. CTS-SS for Video Content

 Patient presentation

Describes symptoms

Describes patient population

Information about carpal tunnel syndrome

Describes carpal tunnel anatomy and/or function

Mentions caused by nerve compression

Describes risk factors (e.g., diabetes, hypothyroidism, pregnancy, repetitive use)

Diagnosis and evaluation

Mentions physical examination and findings

Discusses electrophysiological tests

Discusses additional diagnostic tests (e.g., ultrasound, MRI)

Mentions patient-centered measures (e.g., the Boston Carpal Tunnel Syndrome Questionnaire)

Discusses differential diagnosis (e.g., cervical radiculopathy)

Treatment

Describes nonsurgical treatment

Mentions laser therapy

Mentions pharmacotherapy

Mentions musculoskeletal manipulation and/or splinting

Describes surgical treatment

Mentions open carpal tunnel release

Mentions endoscopic carpal tunnel release

Postoperative care

Describes complications and outcomes

Mentions need for postoperative physical therapy

Outlines return-to-function timeline

334 CTS-SS, carpal tunnel syndrome–specific score; MRI, magnetic resonance imaging

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336 **TABLE 4. Characteristics of 55 YouTube videos about carpal tunnel syndrome**

| Variable | Value |
|------------------------------|-----------------------|
| Number of subscribers | 742,791.7 ± 1,183,968 |
| Video running time (seconds) | 400.71 ± 271.91 |
| Number of views | 1,559,722 ± 7,629,661 |
| Number of days since upload | 2,450.27 ± 1,250.96 |
| Number of comments | 316.75 ± 332.4 |
| Number of likes | 5,184.51 ± 4804.72 |
| Number of dislikes | 242.8 ± 421.93 |
| View ratio | 478.77 ± 1,506.85 |
| Like ratio | 92.81 ± 7.39 |
| VPI | 382.9 ± 910.34 |
| JAMA scores | 2.13 ± 0.94 |
| GQS | 2.69 ± 1.17 |
| CTS-SS | 5.0 ± 3.29 |

Data are presented as mean ± standard deviation.

CTS-SS, carpal tunnel syndrome-specific score; GQS, Global Quality Score; JAMA, Journal of the American Medical Association; VPI, Video Power Index

Formulas: View ratio, *number of views/days since upload*; Like ratio, *number of likes* × 100/ [*number of likes* + *number of dislikes*]; VPI, *like ratio* × *view ratio*/100.

TABLE 5. Mean Quality and Reliability Scores per Video Source and Video Content Variable

| Grouping Variable | JAMA Score | GQS | CTS-SS | VPI |
|--|--|--------------------------------------|-------------|-------------------|
| Video source | | | | |
| Academic | 3.38 ± 0.74 | 3.63 ± 1.06 | 6.12 ± 5.0 | 1077.92 ± 2324.16 |
| Physician | 2.7 ± 0.82 | 3.5 ± 1.18 | 6.4 ± 3.24 | 156.50 ± 79.12 |
| Non-physician | 2.0 ± 0.52 | 2.43 ± 0.73 | 4.13 ± 2.28 | 314.65 ± 204.90 |
| Trainer | 1.25 ± 0.5 | 1.5 ± 0.58 | 3.0 ± 2.31 | 243.20 ± 157.61 |
| Medical | 1.7 ± 0.82 | 2.7 ± 1.25 | 5.6 ± 3.41 | 371.63 ± 370.09 |
| Patient | 1.25 ± 0.5 | 1.25 ± 0.5 | 2.25 ± 0.5 | 172.21 ± 127.05 |
| Commercial | 1.33 ± 0.58 | 2.33 ± 0.58 | 6.33 ± 3.06 | 152.93 ± 122.48 |
| P value ^a | <.0001 | .0004 | .1306 | .4234 |
| Significant difference in post hoc analysis ^c | Academic vs. non-physician, trainer, medical, patient, commercial; | Academic vs. trainer, patient; | | |
| | Physician vs. trainer, medical, patient, commercial | Physician vs. trainer, patient | | |
| Video content | | | | |
| Exercise training | 1.73 ± 0.79 | 1.91 ± 0.83 | 3.09 ± 1.97 | 344.15 ± 266.65 |
| Disease-specific | 2.33 ± 0.84 | 3.17 ± 1.04 | 6.22 ± 3.54 | 227.41 ± 161.24 |
| Patient experience | 1.5 ± 0.71 | 1.5 ± 0.71 | 2.5 ± 0.71 | 133.82 ± 109.52 |
| Surgical technique | 2.83 ± 1.11 | 3.42 ± 1.16 | 5.92 ± 3.65 | 724.92 ± 1917.21 |
| Nonsurgical | 1.63 ± 0.52 | 2.13 ± 1.13 | 4.13 ± 2.64 | 396.44 ± 367.10 |
| Advertisement | 1.5 ± 0.58 | 2.25 ± 0.5 | 5.0 ± 3.65 | 260.57 ± 237.37 |
| P value ^b | .0077 | .0018 | .0897 | .3493 |
| Significant difference | Surgical technique vs. exercise training, | Disease-specific, surgical technique | | |

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5 analysis^c
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8 339 Data are presented as mean ± standard deviation.
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10 340 ^aFor the video source group, significant differences were seen in JAMA score and GQS.
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12 341 ^bFor the video content group, significant differences were seen in JAMA score and GQS.
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14 342 ^cPost hoc tests were performed using Bonferroni's method.
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16 343 CTS-SS, carpal tunnel syndrome-specific score; GQS, global quality score; JAMA, Journal of the American
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18 344 Medical Association; VPI, Video Power Index.
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TABLE 6. Multiple linear regression analysis of correlations between video characteristics and the VPI, JAMA score, GQS, and CTS-SS

| Variable | 95% CI | Standardized β | <i>P</i> value |
|--|-------------------|----------------------|----------------|
| VPI ($R^2 = 0.997$) | | | |
| Days since upload | (-0.058 to -0.02) | -0.053 | <.001 |
| View ratio | (0.576 to 0.614) | 0.985 | <.001 |
| Number of likes | (6.808 to 21.428) | 0.075 | <.001 |
| JAMA score ($R^2 = 0.626$) | | | |
| Like ratio | (0.001 to 0.107) | 0.424 | .045 |
| Video source | | | |
| Academic | (1.164 to 3.088) | 0.801 | <.001 |
| Physician | (0.239 to 2.136) | 0.49 | .015 |
| GQS ($R^2 = 0.561$) | | | |
| Video running time | (0 to 0.002) | 0.252 | .044 |
| Number of comments | (0 to 0.003) | 0.461 | .029 |
| Video source | | | |
| Academic | (1.735 to 4.315) | 0.921 | <.001 |
| Physician | (1.193 to 3.736) | 0.821 | <.001 |
| Non-physician | (0.337 to 2.856) | 0.626 | .014 |
| Medical | (0.661 to 3.094) | 0.625 | .003 |
| Commercial | (0.32 to 3.429) | 0.368 | .019 |
| CTS-SS ($R^2 = 0.356$) | | | |
| Video source | | | |
| Academic | (1.825 to 10.624) | 0.673 | .007 |
| Physician | (0.838 to 9.51) | 0.612 | .021 |
| Medical | (0.828 to 9.128) | 0.589 | .02 |

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3 Commercial (1.13 to 11.731) 0.448 .019
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5 CI, confidence interval; CTS-SS, carpal tunnel syndrome-specific score; GQS, Global Quality Score; JAMA,
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7 Journal of the American Medical Association; VPI, Video Power Index
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For peer review only

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3 346 **FIGURE LEGENDS**

4
5 347 Figure 1. Search methodology for carpal tunnel syndrome–related YouTube videos

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7 348 Figure 2. Categorical distribution of video source

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9 349 Figure 3. Categorical distribution of video content

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11 350 Figure 4. Data-bar visualization of the top 55 carpal tunnel syndrome and release videos with the highest number

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For peer review only

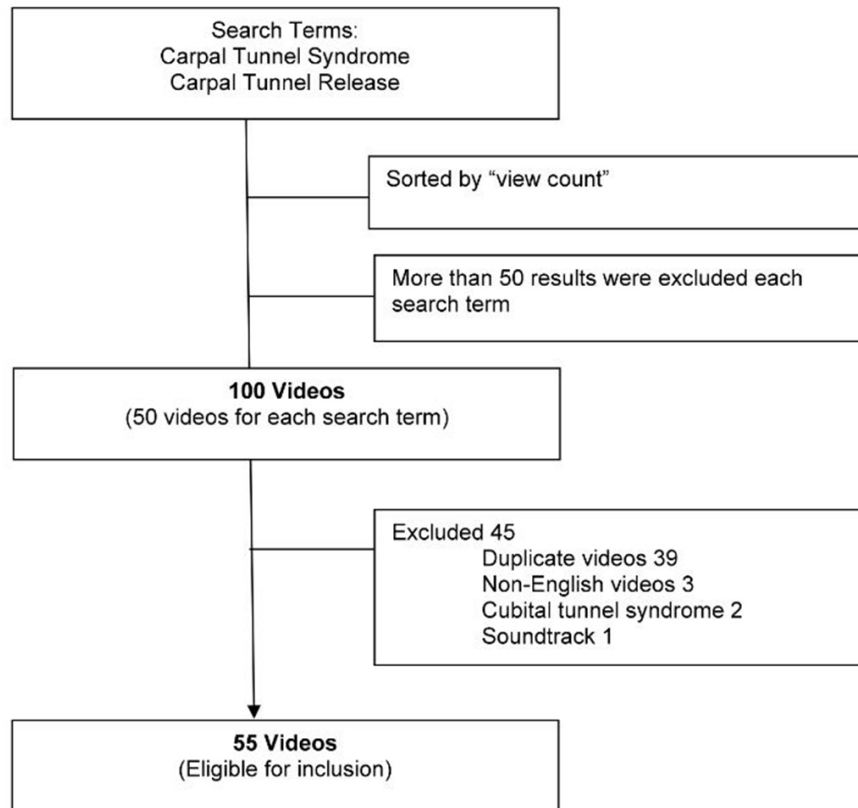


Figure 1. Search methodology for carpal tunnel syndrome-related YouTube videos

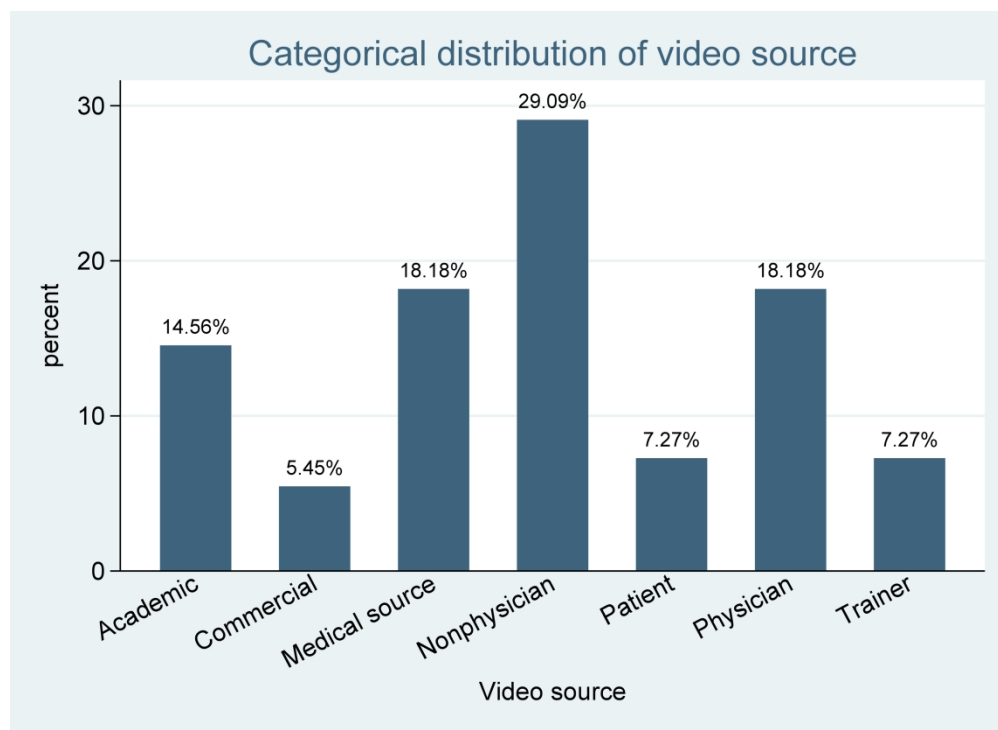


Figure 2. Categorical distribution of video source

139x101mm (600 x 600 DPI)

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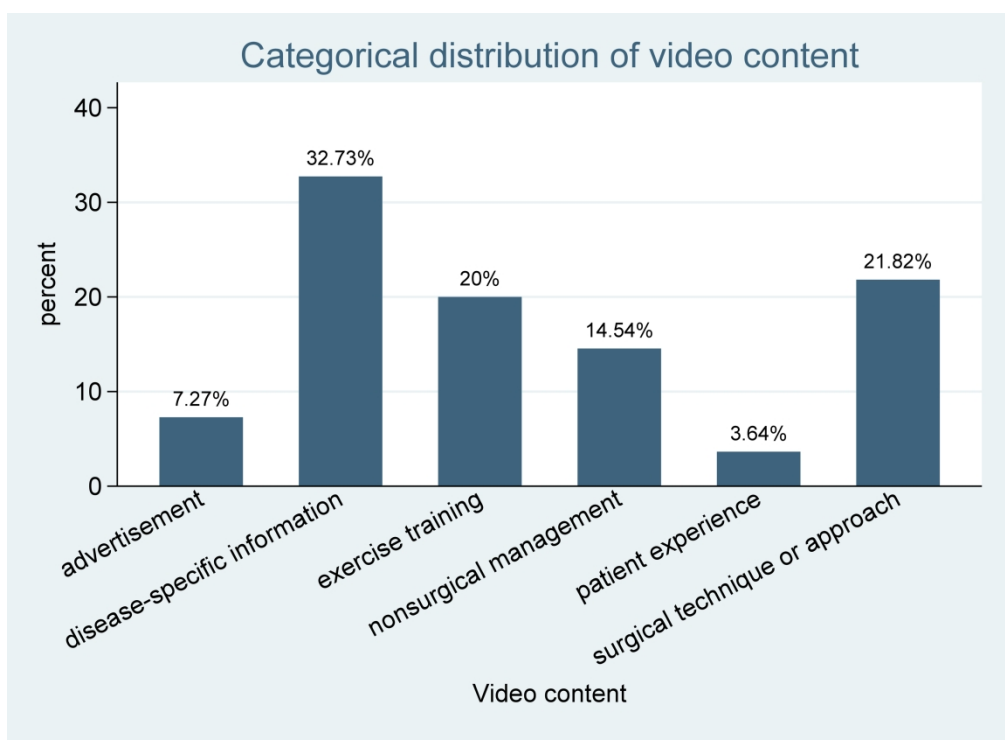


Figure 3. Categorical distribution of video content

139x101mm (600 x 600 DPI)

| title | Channel name | number of views | JAMA | QOS | CTS-SS | VPI |
|---|------------------------------|-----------------|------|-----|--------|---------|
| Podcast: See a live surgery for carpal tunnel syndrome | BroadcastMed Network | 5709920 | 3 | 3 | 4 | 679604 |
| Surgery Video: Carpal Tunnel - MedStar Union Memorial | MedStar Health | 2127961 | 5 | 13 | | 543.02 |
| exercises for tendinitis (tenosynovitis) and carpal tunnel (cps) | David Kuckhermann | 1563369 | 1 | 2 | | 334.16 |
| How to Get Natural Carpal Tunnel Relief in 24 Hours; Dr. Josh Axe | Dr. Josh Axe | 1420119 | 2 | 2 | 1 | 583.48 |
| KT Tape: Carpal Tunnel | KT Tape | 1261508 | 2 | 2 | | 292.10 |
| Carpal Tunnel Syndrome Nucleus Health | Nucleus Medical Media | 1255913 | 2 | 3 | 11 | 561.22 |
| Top 3 Exercises for Carpal Tunnel Syndrome | Madden Physical Therapy | 1170278 | 2 | 3 | 7 | 353.02 |
| Worried About Carpal Tunnel? Try 3 Simple Stretches | Cleveland Clinic | 1010182 | 3 | 3 | 2 | 743.23 |
| 5 Best Carpal Tunnel Syndrome Stretches & Exercises; Ask Doctor Jo | AskDoctorJo | 984499 | 2 | 3 | 5 | 903.17 |
| Self Acupressure for Carpal Tunnel Syndrome | LoseTheBackPain | 920535 | 2 | 2 | 3 | 251.95 |
| Live Surgery Open Carpal Tunnel Release Surgery.m4v | Dr Thomas McClellan | 845922 | 3 | 5 | 12 | 231.64 |
| Clinical Anatomy - Hand, Wrist (palmar aspect/flexors) | Armando Hasudungan | 785187 | 3 | 3 | 4 | 583.18 |
| Carpal Tunnel Self Massage Fix | HM Massage | 765715 | 1 | 2 | 5 | 455.18 |
| Carpal Tunnel Syndrome Exercises | TheProactiveAthlete | 743628 | 2 | 2 | 5 | 233.77 |
| Carpal Tunnel Surgery | CinamonToastKen | 742263 | 1 | 3 | 8 | 321.70 |
| Carpal Tunnel Treatment - Relief Without Surgery | JTconley | 685754 | 1 | 3 | 9 | 105.21 |
| Carpal Tunnel in Esports, explained in 5 minutes | Blitz Esports LoL | 628351 | 2 | 3 | 9 | 442.70 |
| Carpal Tunnel Syndrome | WorkSafeBC | 507525 | 1 | 2 | 5 | 103.20 |
| Carpal Tunnel Surgery | TheSurgerySquad | 506665 | 3 | 4 | 8 | 142.40 |
| Carpal Tunnel Exercises using Stress Ball | Carpal Tunnel Gadgets | 496320 | 1 | 1 | 1 | 195.56 |
| Phalen's Test Carpal Tunnel Syndrome | Physiotutors | 495784 | 2 | 2 | 2 | 252.45 |
| Tinel Sign: Wrist Carpal Tunnel Syndrome | Physiotutors | 489572 | 2 | 2 | 1 | 250.92 |
| Wrist Exercises for Tendinitis: Carpal Tunnel Syndrome | Road | 484034 | 2 | 2 | 3 | 211.27 |
| Avoid RSI injury in just 2 minutes a day! | Bob & Brad | 479295 | 3 | 3 | 6 | 302.68 |
| Carpal Tunnel? Avoid Surgery with 3 Step Self-Treatment Program | Carpal Tunnel Gadgets | 427646 | 1 | 1 | 1 | 1258.50 |
| Hand Massage for Carpal Tunnel Syndrome | ZHealthPerformance | 425661 | 1 | 2 | 3 | 161.13 |
| Carpal Tunnel Relief Exercises | Dr Levi Harrison | 395583 | 3 | 4 | 8 | 211.36 |
| Is It Carpal Tunnel Syndrome OR Tendinitis? | Yoga with Cassandra | 389307 | 1 | 1 | 1 | 208.95 |
| Yoga for Wrists & Fingers - Yoga for Wrist Cramps & Carpal Tunnel | nabil ebrahim | 384096 | 5 | 5 | 15 | 181.35 |
| Carpal Tunnel Syndrome - Everything You Need To Know; Dr. Nabil Ebraheim | Dr Joseph Cipriano DC | 367604 | 2 | 3 | 6 | 356.01 |
| *HUGE* Carpal Tunnel Syndrome RELEASE with CHIROPRACTIC Adjustment | Bob & Brad | 330687 | 2 | 1 | 2 | 219.11 |
| Best Sleeping Position for Shoulder, Arm, & Wrist Pain - also Carpal Tunnel Syndrome | Vitality Massage | 317351 | 1 | 1 | 2 | 87.04 |
| Massage for Carpal Tunnel Syndrome - STOP Wrist Pain Fast! | motivationaldoc | 289205 | 2 | 3 | 6 | 220.23 |
| Carpal Tunnel Self-Correction Adjustment - Dr. Alan Mandell, D.C. | Bob & Brad | 284951 | 2 | 4 | 9 | 182.39 |
| What They Don't Tell You About Carpal Tunnel Syndrome! Stretches & Treatments | RMCrayne | 284688 | 2 | 3 | 3 | 82.76 |
| Carpal Tunnel Syndrome Provocative Tests & Physical Exam | EkhartYoga | 281636 | 1 | 1 | 1 | 74.91 |
| Yoga Exercises for Carpal Tunnel Syndrome | Mr. Jeremy Read Hand Surgeon | 276853 | 2 | 3 | 3 | 94.44 |
| Carpal tunnel release | Adam J. Story, DC | 276144 | 1 | 2 | 6 | 196.22 |
| Carpal Tunnel Fix - DIY No brace! | nabil ebrahim | 260763 | 4 | 4 | 5 | 78.41 |
| Carpal Tunnel Injection - Everything You Need To Know - Dr. Nabil Ebraheim | John Mahoney | 254070 | 1 | 1 | 2 | 40.78 |
| Carpal Tunnel Release for carpal tunnel syndrome, by John Mahoney, M.D. more at www.DoctorMahoney.com | motivationaldoc | 246712 | 3 | 4 | 7 | 230.45 |
| How to Determine if You Really Have Carpal Tunnel Syndrome - Dr Mandell, DC | motivationaldoc | 242162 | 3 | 5 | 11 | 225.27 |
| Carpal Tunnel Syndrome: Fast Natural Relief in Minutes - Dr Alan Mandell, DC | Jedediah Jones | 226138 | 3 | 3 | 4 | 96.37 |
| Hand Exam For Carpal Tunnel Syndrome | nandapillai | 225022 | 3 | 3 | 4 | 40.59 |
| Carpal Tunnel Syndrome Operation | PreOp.com Patient Engagement | 222895 | 2 | 3 | 6 | 68.29 |
| Carpal Tunnel Syndrome Repair Surgery - PreOp® Patient Education Medical HD | Patient Education | 220636 | 2 | 2 | 2 | 166.91 |
| Carpal Tunnel Release Surgical Procedure Part I | MediCape | 219562 | 2 | 3 | 5 | 361.31 |
| Forearm Anatomy: Help Relieve Carpal Tunnel Syndrome | Massage Therapeutics | 210471 | 1 | 2 | 3 | 39.52 |
| 3D CGI medical video carpal tunnel syndrome | 3dmusclepep | 203590 | 2 | 4 | 6 | 169.30 |
| Carpal Tunnel Release - Teaching Video | Malek Racy | 199659 | 3 | 3 | 5 | 45.13 |
| Recognizing Thumb Muscle Atrophy - Carpal Tunnel Syndrome | handarmdoc | 193791 | 3 | 2 | 3 | 95.94 |
| Top 3 Exercises to Perform AFTER Carpal Tunnel Surgery (Release) | Bob & Brad | 183613 | 1 | 1 | 2 | 56.38 |
| One month after carpal tunnel surgery | JoeCubicte | 180793 | 1 | 2 | 7 | 61.50 |
| Early symptoms and warning signs of carpal tunnel syndrome | Carpalix | 179735 | 2 | 2 | 4 | 481.82 |
| 5 Exercises to PREVENT and ALLEVIATE Carpal Tunnel | Rehab and Revive | 179707 | 2 | 4 | 4 | 73.79 |
| Carpal Tunnel Release - Dr. Jon Hernandez | Coordinated Health | | | | | |

Figure 4. Data-bar visualization of the top 55 carpal tunnel syndrome and release videos with the highest number of views

99x91mm (600 x 600 DPI)

BMJ Open

Quality and Reliability Evaluation of Online Videos on Carpal Tunnel Syndrome: A YouTube Video-based Study

| | |
|---------------------------------|--|
| Journal: | <i>BMJ Open</i> |
| Manuscript ID | bmjopen-2021-059239.R1 |
| Article Type: | Original research |
| Date Submitted by the Author: | 10-Feb-2022 |
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| Primary Subject Heading: | Public health |
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2
3 1 **Title:** Quality and Reliability Evaluation of Online Videos on Carpal Tunnel Syndrome: A YouTube Video-
4 based Study
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3 **18 Abstract**

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5 **19 Objectives:** With the increasing popularity of searches for medical information on YouTube, the availability of
6
7 **20** videos concerning carpal tunnel syndrome (CTS) is increasing. In previous quality-evaluating studies in the
8
9 **21** orthopedic field, video accuracy and quality were low. This study aimed to evaluate the quality and reliability of
10
11 **22** YouTube videos on CTS.

12
13 **23 Setting and Participants:** No participants were included.

14
15 **24 Primary and secondary outcome measures:** We searched YouTube on April 1, 2021, using the keywords
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17 **25** “carpal tunnel syndrome” and “carpal tunnel release” and evaluated the first 55 retrieved videos. We
18
19 **26** summarized the video characteristics including Video Power Index (VPI), which was designed to evaluate video
20
21 **27** popularity based on the number of likes and views. We categorized them based on source and content. Video
22
23 **28** quality and reliability were evaluated using the Journal of the American Medical Association (JAMA)
24
25 **29** benchmark criteria, Global Quality Score (GQS), and carpal tunnel syndrome-specific score (CTS-ss) .

26
27 **30 Results:** The mean (range; minimum to maximum) of JAMA scores, GQS, and CTS-ss were 2.13 (1 to 4), 2.69
28
29 **31** (1 to 5), and 5.0 (1 to 15), respectively. The most common source of video was from allied health workers, and
30
31 **32** academically sourced videos had the highest JAMA score and GQS. Three scores were significantly correlated
32
33 **33** with each other. Multiple linear regression analysis showed that a higher JAMA score was associated with a
34
35 **34** higher likes ratio, and a higher GQS was associated with a longer video running time and greater number of
36
37 **35** comments. However, a higher VPI was not associated with higher video quality or reliability represented by the
38
39 **36** three scores.

40
41 **37 Conclusions:** YouTube videos on CTS have low quality and reliability. Video popularity was not significantly
42
43 **38** correlated with quality or reliability. Our findings suggest that expert groups should provide and promote high-
44
45 **39** quality video content to YouTube users and patients.

46
47 **40 Keywords:** Carpal tunnel syndrome, Carpal tunnel release, YouTube, Video quality
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3 41 **Strengths and limitations of this study**
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- 5 42 1. Various characteristics including number of views, number of likes, Video Power Index, and video uploader
6
7 43 in the YouTube videos about carpal tunnel syndrome were investigated.
8
9 44 2. The reliability and quality of videos were investigated using three scoring systems: JAMA benchmark
10
11 45 criteria, GQS, and CTS-SS.
12
13 46 3. Although these scoring systems are subjective and unvalidated, the scoring systems were independently
14
15 47 assessed twice by the two raters, which showed intra- and inter-observer agreements determined by
16
17 48 intraclass correlation coefficients.
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19 49 4. A multiple linear regression analysis was performed to identify video characteristics affecting the reliability
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21 50 and quality of videos.
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51 **Background**

52 With the Internet penetration rate exceeding 50% worldwide [1], searches for health information on the
53 Internet have become common. According to recent studies, 80% of Internet users searched for health
54 information online [2], and up to 30% of orthopedic patients searched online for disease information [3].
55 Furthermore, well-designed videos of disease information positively affect treatment outcomes by improving
56 patient comprehension [4, 5]. However, most online information is not regulated, resulting in the spread of
57 inaccurate and low-quality data among patients [6–10]. Therefore, physicians should properly evaluate such
58 information and help patients receive accurate information and appropriate treatment.

59 YouTube, which has over 1 billion users watching over 1 billion hours of videos each day, is a source of
60 representative video-based educational content [11]. Although some high-quality orthopedic content is uploaded
61 by qualified experts on YouTube, most of the related content is uploaded by unqualified individuals, providing
62 patients inaccurate and erroneous information. In previous quality-evaluating studies in the orthopedic field,
63 YouTube video accuracy and quality were low [1, 10, 12–14].

64 According to previous studies that investigated the quality of carpal tunnel syndrome (CTS) information
65 provided by Internet search engines [15–17], the quality of online information has improved over the past decade
66 but remains low. These studies reported that there was significant scope for improvement. In contrast, recent
67 studies [18, 19] reported that most YouTube videos and websites that provide information on CTS can reinforce
68 misconceptions. Two quality-evaluating studies on CTS information available on YouTube [20, 21] focused on
69 video quality and reliability, and neither examined the relationship between characteristics such as video
70 popularity and quality.

71 The current study aimed to (1) evaluate the quality and reliability of YouTube videos concerning CTS, (2)
72 investigate the video characteristics, sources and contents, and (3) determine the relationship between video
73 characteristics and quality.

75 **Methods**

76 *Patient and Public Involvement*

77 No patient involved.

79 *YouTube Search Design and Study Setting*

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2
3 80 The YouTube online library (<https://www.youtube.com>) was searched on April 1, 2021, using the terms
4
5 81 “carpal tunnel syndrome” and “carpal tunnel release.” The first 50 videos retrieved based on each keyword and
6
7 82 sorted by “view count” for a total of 100 videos were selected for review. Of them, 45 were excluded
8
9 83 (duplicates, 39; non-English, 3; information on cubital tunnel syndrome, 2; soundtrack with no mention of carpal
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11 84 tunnel, 1). Thus, 55 YouTube videos found using the keywords “carpal tunnel syndrome” and “carpal tunnel
12
13 85 release” were analyzed (Figure 1). The URLs of each video are listed in supplementary table 1.

14
15 86 Data on the following video characteristics were collected from each YouTube video: (1) title, (2) channel
16
17 87 name, (3) number of subscribers, (4) video running time, (5) number of views, (6) number of comments, (7)
18
19 88 video source/uploader, (8) content type, (9) days since upload, (10) view ratio (*number of views/days since*
20
21 89 *upload*), (11) number of likes, (12) number of dislikes, (13) likes ratio ($Likes \times 100 / [Likes + Dislikes]$), and
22
23 90 (14) Video Power Index (VPI). The VPI was calculated using the following formula: $like\ ratio \times view\ ratio / 100$.
24
25 91 This value is an index designed to evaluate video popularity based on the number of likes and views [1].

26
27 92 Video sources/uploaders were categorized as follows [1, 10]: (1) academic (uploaders affiliated with
28
29 93 universities or research groups), (2) physicians (individual physicians or physician groups not affiliated to a
30
31 94 university or research institute), (3) non-physicians (allied health workers such as alternative medical providers,
32
33 95 physiotherapists, occupational therapists), (4) trainers, (5) medical sources (animations or related content from
34
35 96 health websites), (6) patients, and (7) commercial. Contents were categorized as follows: (1) exercise training,
36
37 97 (2) disease information, (3) patient experience, (4) surgical technique, (5) nonsurgical management such as
38
39 98 chiropractic treatment, and (6) advertisement.

39 99

41 100 ***Evaluation of Video Quality and Reliability***

43 101 The quality and reliability of YouTube videos were assessed using three scoring systems: The Journal of
44
45 102 the American Medical Association (JAMA) benchmark criteria, Global Quality Score (GQS), and CTS-specific
46
47 103 score (CTS-SS). The JAMA criteria enable a nonspecific assessment of content reliability and include four
48
49 104 criteria (Table 1) [22]. Each criterion is assigned 1 point for a maximum total of 4 points. A score of 0 indicates
50
51 105 low video reliability and accuracy, whereas a score of 4 indicates high video reliability and accuracy. The GQS
52
53 106 [1, 10, 23] consists of five grades and provides a nonspecific assessment of health-related website quality (Table
54
55 107 2). The total GQS ranges from 1 to 5, with a higher score indicating better educational quality. To better evaluate
56
57 108 quality and accuracy of YouTube videos concerning CTS, we employed the new CTS-SS, which consists of 20
58
59 109 items. We generated this scoring system based on recent review articles [24–26] and guidelines published by the
60

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2
3 110 American Academy of Orthopedic Surgeons [27], which were considered reasonable in previous studies [9, 10].
4
5 111 The CTS-SS evaluates information on (1) patient symptoms and population, (2) carpal tunnel anatomy, (3) CTS
6
7 112 diagnosis and evaluation, (4) treatment options, and (5) postoperative care and course (Table 3). One point was
8
9 113 given for each of the 20 items for a total maximum of 20 points. Higher scores indicated higher CTS-specific
10
11 114 educational value.
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13 115

14
15 **TABLE 1. JAMA Benchmark Criteria [22]**
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| 17 Criterion | 18 Description |
|---------------------|---|
| 19 Authorship | 20 Author and contributor credentials and their affiliations should be provided |
| 21 Attribution | 22 All copyright information should be clearly listed, and references and sources for content 23 should be stated |
| 24 Currency | 25 The initial date of posted content and dates of subsequent updates to content should be provided |
| 26 Disclosure | 27 Conflicts of interest, funding, sponsorship, advertising, support, and video ownership should be 28 fully disclosed 29 |

30
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32 JAMA, Journal of the American Medical Association
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38 **TABLE 2. GQS Criteria [1, 10, 23]**
39

| 40 Grade | 41 Description of Quality |
|-----------------|---|
| 42 1 | 43 Poor quality, information missing, technique misleading; unlikely to be useful for patient education |
| 44 2 | 45 Generally sparse quality, some information provided but majority lacking, technique poor; limited use 46 for patients |
| 47 3 | 48 Moderate quality, important information provided but some lacking, technique mostly adequate; 49 somewhat useful for patients |
| 50 4 | 51 Good quality, majority of information provided but some information lacking, technique adequate; 52 useful for patients because most important topics are covered |
| 53 5 | 54 Excellent quality, full information provided, technique adequate; highly useful for patients 55 56 57 58 59 60 |

GQS, Global Quality Score

117

TABLE 3. CTS-SS for Video Content

Patient presentation

Describes symptoms (e.g., nocturnal paraesthesia, loss of sensation, thenar muscle atrophy)

Describes patient population, especially high prevalence in older women

Information about carpal tunnel syndrome

Describes carpal tunnel anatomy and/or function

Mentions caused by nerve compression

Describes risk factors (e.g., diabetes, hypothyroidism, pregnancy, repetitive use)

Diagnosis and evaluation

Mentions physical examination and findings (e.g., Tinel's sign and Phalen's manoeuvre)

Discusses electrophysiological tests

Discusses additional diagnostic tests (e.g., ultrasound, MRI)

Mentions patient-centered measures (e.g., the Boston Carpal Tunnel Syndrome Questionnaire)

Discusses differential diagnosis (e.g., cervical radiculopathy)

Treatment

Describes nonsurgical treatment, especially changes in habits

Mentions that laser therapy is one of the non-surgical options

Mentions pharmacotherapy (e.g., local corticosteroid injection, NSAIDs)

Mentions musculoskeletal manipulation and/or splinting

Describes surgical treatment that is the most effective treatment

Mentions open carpal tunnel release

Mentions endoscopic carpal tunnel release

Postoperative care

Describes complications and outcomes (e.g., CRPS, scar tenderness, reoperation)

Mentions need for postoperative physical therapy

Outlines return-to-function timeline

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2
3 118 CTS-SS, carpal tunnel syndrome-specific score; MRI, magnetic resonance imaging; NSAIDs, non-steroidal
4
5 119 anti-inflammatory drugs; CRPS, complex regional pain syndrome

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8 9 121 *Intra-observer Reliability and Inter-observer Agreement Assessment*

10 122 All three scoring systems (JAMA, GQS, CTS-SS) were independently assessed twice, 30 days apart, by the
11
12 123 two raters consisting with one orthopedic surgeon (D.K.) and one family medicine doctor (Y.K.). Intra- and
13
14 124 inter-observer agreements were determined using intraclass correlation coefficients (ICCs). ICCs for absolute
15
16 125 agreement with a single measurement were used to identify intra-observer reliability with two-way mixed-effects
17
18 126 analysis of variance models. ICCs for absolute agreement with a single rater were used to identify inter-observer
19
20 127 agreement using two-way random-effects analysis of variance models. A guideline [28] for evaluating ICC
21
22 128 values was adopted: excellent (>0.90), good (0.75–0.90), moderate (0.50–0.75), and poor (< 0.50). In cases of
23
24 129 disagreement, all authors re-evaluated the video in question until consensus was reached.

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27 28 131 *Statistical Analysis*

29
30 132 Continuous variables are presented as mean \pm standard deviation. Differences in the JAMA score, GQS,
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32 133 CTS-SS, and VPI according to (1) video upload source and (2) category of video contents were evaluated by
33
34 134 one-way analysis of variance tests (for normally distributed data) and Kruskal-Wallis tests (for non-normally
35
36 135 distributed data) followed by post hoc tests using the Bonferroni method. A Spearman correlation analysis was
37
38 136 used to assess the correlation between scores and between video characteristics and scores. A multiple linear
39
40 137 regression analysis was performed to identify video characteristics affecting the JAMA score, GQS, CTS-SS,
41
42 138 and VPI. All reported P-values were two-sided, and those <.05 were considered statistically significant.

43
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45 140 **Results**

46 47 141 *Video Characteristics and Quality Scores*

48
49 142 The mean JAMA score, GQS, and CTS-SS were 2.13, 2.69, and 5.0, respectively, indicating low reliability
50
51 143 and educational quality (Table 4). Raw scores of JAMA score and CTS-SS are shown in supplementary table 2.
52
53 144 Non-physician video sources accounted for the largest share (29.09%), while commercial sources accounted for
54
55 145 the lowest share (5.45%) (Figure 2). Disease-specific information accounted for the largest share (32.73%),
56
57 146 while patient experience accounted for the smallest share (3.64%) (Figure 3). The video title, YouTube channel

147 name, JAMA score, GQS, CTS-SS, and VPI of the top 55 videos are listed in order of the number of views in
 148 Figure 4.

150 **TABLE 4. Characteristics of 55 YouTube videos about carpal tunnel syndrome**

| Variable | Value |
|------------------------------|-----------------------|
| Number of subscribers | 742,791.7 ± 1,183,968 |
| Video running time (seconds) | 400.71 ± 271.91 |
| Number of views | 1,559,722 ± 7,629,661 |
| Number of days since upload | 2,450.27 ± 1,250.96 |
| Number of comments | 316.75 ± 332.4 |
| Number of likes | 5,184.51 ± 4804.72 |
| Number of dislikes | 242.8 ± 421.93 |
| View ratio | 478.77 ± 1,506.85 |
| Like ratio | 92.81 ± 7.39 |
| VPI | 382.9 ± 910.34 |
| JAMA scores | 2.13 ± 0.94 |
| GQS | 2.69 ± 1.17 |
| CTS-SS | 5.0 ± 3.29 |

Data are presented as mean ± standard deviation.

CTS-SS, carpal tunnel syndrome–specific score; GQS, Global Quality Score; JAMA,

Journal of the American Medical Association; VPI, Video Power Index

Formulas: View ratio, *number of views/days since upload*; Like ratio, *number of likes* ×

100/[number of likes + number of dislikes]; VPI, *like ratio* × *view ratio/100*.

172 ***Differences in Video Reliability and Quality by Source and Content***

173 The JAMA score ($p < .0001$) and GQS ($p = .0004$) differed significantly among the seven groups of video
 174 sources, with videos from academic and physician sources having the highest mean JAMA scores and GQS
 175 (Table 5). The JAMA score ($p = .0077$) and GQS ($p = .0018$) differed significantly among the six groups of video
 176 content, with videos about surgical technique and disease-specific information having the highest mean JAMA

177 scores and GQS. However, the CTS-SS and VPI did not differ significantly between the groups based on video
 178 sources and contents.
 179

TABLE 5. Mean Quality and Reliability Scores per Video Source and Video Content Variable

| Grouping Variable | JAMA Score | GQS | CTS-SS | VPI |
|--|--|--------------------------------|--------------------------------|-------------------|
| Video source | | | | |
| Academic | 3.38 ± 0.74 | 3.63 ± 1.06 | 6.12 ± 5.0 | 1077.92 ± 2324.16 |
| Physician | 2.7 ± 0.82 | 3.5 ± 1.18 | 6.4 ± 3.24 | 156.50 ± 79.12 |
| Non-physician | 2.0 ± 0.52 | 2.43 ± 0.73 | 4.13 ± 2.28 | 314.65 ± 204.90 |
| Trainer | 1.25 ± 0.5 | 1.5 ± 0.58 | 3.0 ± 2.31 | 243.20 ± 157.61 |
| Medical | 1.7 ± 0.82 | 2.7 ± 1.25 | 5.6 ± 3.41 | 371.63 ± 370.09 |
| Patient | 1.25 ± 0.5 | 1.25 ± 0.5 | 2.25 ± 0.5 | 172.21 ± 127.05 |
| Commercial | 1.33 ± 0.58 | 2.33 ± 0.58 | 6.33 ± 3.06 | 152.93 ± 122.48 |
| P value ^a | <.0001 | .0004 | .1306 | .4234 |
| Significant difference in post hoc analysis ^c | Academic vs. non-physician, trainer, medical, patient, commercial; | Academic vs. trainer, patient; | Physician vs. trainer, patient | |
| | Physician vs. trainer, medical, patient, commercial | | | |
| Video content | | | | |
| Exercise training | 1.73 ± 0.79 | 1.91 ± 0.83 | 3.09 ± 1.97 | 344.15 ± 266.65 |
| Disease-specific | 2.33 ± 0.84 | 3.17 ± 1.04 | 6.22 ± 3.54 | 227.41 ± 161.24 |
| Patient experience | 1.5 ± 0.71 | 1.5 ± 0.71 | 2.5 ± 0.71 | 133.82 ± 109.52 |
| Surgical technique | 2.83 ± 1.11 | 3.42 ± 1.16 | 5.92 ± 3.65 | 724.92 ± 1917.21 |
| Nonsurgical | 1.63 ± 0.52 | 2.13 ± 1.13 | 4.13 ± 2.64 | 396.44 ± 367.10 |
| Advertisement | 1.5 ± 0.58 | 2.25 ± 0.5 | 5.0 ± 3.65 | 260.57 ± 237.37 |

| | | | | |
|--|---|--|-------|-------|
| P value ^b | .0077 | .0018 | .0897 | .3493 |
| Significant difference in post hoc analysis ^c | Surgical technique vs. exercise training, nonsurgical | Disease-specific, surgical technique vs. exercise training | | |

180 Data are presented as mean ± standard deviation.

181 ^aFor the video source group, significant differences were seen in JAMA score and GQS.

182 ^bFor the video content group, significant differences were seen in JAMA score and GQS.

183 ^cPost hoc tests were performed using Bonferroni's method.

184 CTS-SS, carpal tunnel syndrome-specific score; GQS, global quality score; JAMA, Journal of the American
185 Medical Association; VPI, Video Power Index.

186

187 *Factors Affecting Video Quality and Popularity*

188 JAMA, GQS, and CTS-SS significantly correlated with each other (JAMA score vs. GQS, $p < .001$; JAMA
189 score vs. CTS-SS, $p = .001$; GQS vs. CTS-SS, $p < .001$). However, the VPI was not significantly correlated with
190 the three scores. Multiple linear regression analysis showed that a higher JAMA score was associated with a
191 higher likes ratio of an academic or physician upload source compared to a patient upload source (Table 6). A
192 higher GQS was associated with a longer video running time; greater number of comments; and higher
193 probability of academic, physician, non-physician, medical information, and commercial upload source than of
194 patient upload source. A higher CTS-SS was more associated with academic, physician, medical information,
195 and commercial upload sources than patient upload sources. However, a higher VPI was not associated with
196 higher video quality or reliability scores.

197

TABLE 6. Multiple linear regression analysis of correlations between video characteristics and the VPI, JAMA score, GQS, and CTS-SS

| Variable | Unstandardized beta (B) | 95% CI | Standardized β | P value |
|-----------------------|-------------------------|-------------------|----------------------|---------|
| VPI ($R^2 = 0.997$) | | | | |
| Days since upload | -0.039 | (-0.058 to -0.02) | -0.053 | <.001 |
| View ratio | 0.595 | (0.576 to 0.614) | 0.985 | <.001 |

| | | | | | |
|----|--------------------------|--------|-------------------|-------|-------|
| 1 | | | | | |
| 2 | | | | | |
| 3 | Number of likes | 14.118 | (6.808 to 21.428) | 0.075 | <.001 |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | JAMA score ($R^2 =$ | | | | |
| 8 | 0.626) | | | | |
| 9 | | | | | |
| 10 | Like ratio | 0.054 | (0.001 to 0.107) | 0.424 | .045 |
| 11 | | | | | |
| 12 | Video source | | | | |
| 13 | | | | | |
| 14 | Academic | 2.126 | (1.164 to 3.088) | 0.801 | <.001 |
| 15 | | | | | |
| 16 | Physician | 1.187 | (0.239 to 2.136) | 0.49 | .015 |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | GQS ($R^2 = 0.561$) | | | | |
| 21 | | | | | |
| 22 | Video running time | 0.001 | (0 to 0.002) | 0.252 | .044 |
| 23 | | | | | |
| 24 | Number of comments | 0.002 | (0 to 0.003) | 0.461 | .029 |
| 25 | | | | | |
| 26 | Video source | | | | |
| 27 | | | | | |
| 28 | Academic | 3.025 | (1.735 to 4.315) | 0.921 | <.001 |
| 29 | | | | | |
| 30 | Physician | 2.465 | (1.193 to 3.736) | 0.821 | <.001 |
| 31 | | | | | |
| 32 | Non-physician | 1.596 | (0.337 to 2.856) | 0.626 | .014 |
| 33 | | | | | |
| 34 | Medical | 1.878 | (0.661 to 3.094) | 0.625 | .003 |
| 35 | | | | | |
| 36 | Commercial | 1.874 | (0.32 to 3.429) | 0.368 | .019 |
| 37 | | | | | |
| 38 | | | | | |
| 39 | CTS-SS ($R^2 = 0.356$) | | | | |
| 40 | | | | | |
| 41 | Video source | | | | |
| 42 | | | | | |
| 43 | Academic | 6.225 | (1.825 to 10.624) | 0.673 | .007 |
| 44 | | | | | |
| 45 | Physician | 5.174 | (0.838 to 9.51) | 0.612 | .021 |
| 46 | | | | | |
| 47 | Medical | 4.978 | (0.828 to 9.128) | 0.589 | .02 |
| 48 | | | | | |
| 49 | Commercial | 6.430 | (1.13 to 11.731) | 0.448 | .019 |

CI, confidence interval; CTS-SS, carpal tunnel syndrome-specific score; GQS, Global Quality Score; JAMA, Journal of the American Medical Association; VPI, Video Power Index

198

199 ***Intra-observer Reliability and Inter-observer Agreement Assessment***

1
2
3 200 The intra-observer reliability of the two raters was excellent for the JAMA score, GQS, and CTS-SS. The
4
5 201 inter-observer agreement between raters was good for the JAMA score (ICC, 0.881; 95% confidence interval
6
7 202 [95% CI], 0.804–0.929), good for the GQS (ICC, 0.881; 95% CI, 0.804–0.929), and excellent for the CTS-SS
8
9 203 (ICC, 0.941; 95% CI, 0.898–0.966).

10 204

11
12
13 205 **Discussion**

14 206 This study demonstrated that the reliability and quality of YouTube videos concerning CTS were low. This
15
16 207 result was consistent with that of other previously conducted YouTube video quality evaluation studies [1, 10,
17
18 208 13, 20, 21, 29–31]. Mert et al. [20] evaluated the quality of CTS videos on YouTube and reported that the video
19
20 209 reliability and quality were low. They presented no significant relationship between video characteristics,
21
22 210 reliability, and quality evaluation scoring systems. Radonjic et al. [21] also evaluated CTS videos on YouTube
23
24 211 and showed low reliability and quality and found that videos uploaded by physicians had significantly higher
25
26 212 reliability and quality evaluation scores than those uploaded by non-physicians. Goyal et al. [18] reported that
27
28 213 YouTube videos of CTS have low information quality. They determined that the potential reinforcement of
29
30 214 misconceptions is prevalent in YouTube videos on CTS.

31
32 215 Although the overall reliability and educational quality of YouTube videos were low, those of videos from
33
34 216 academic and physician uploaders or about surgical techniques and disease-specific information were
35
36 217 significantly higher than those of other video sources and contents. This is because the main purpose of these
37
38 218 video sources and contents is to educate doctors, medical students, and patients. In contrast, the CTS-SS did not
39
40 219 differ significantly among the video sources and contents because YouTube videos focus on specific topics, such
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42 220 as symptoms and surgical technique or rehabilitation after surgical treatment, and deliver the content within a
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44 221 short running time. Additionally, some specific channels, such as the “Bob & Brad” channel, posted videos in
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46 222 four series about CTS and release. Casual YouTube viewers cannot obtain sufficient content on CTS and release
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48 223 in only one or two posted videos, but an entire series can provide most of the content. YouTube uploaders
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50 224 usually post short videos of less than 10 minutes to maximize the number of views and user interest; thus, they
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52 225 split the content into several videos.

53 226 Most of the videos had low reliability and educational quality, but some videos had useful practicality and
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55 227 educational information. The "Carpal Tunnel Syndrome - Everything You Need To Know - Dr. Nabil Ebraheim"
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57 228 video of the "nabil ebraheim" channel explains the overall symptoms, anatomy, and risk factors of CTS. In the
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59 229 "Surgery Video: Carpal Tunnel - MedStar Union Memorial" video of the "MedStar Health" channel, the surgical

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3 230 procedure and method of endoscopic carpal tunnel release were shown in detail. The "How to Determine if You
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5 231 Really Have Carpal Tunnel Syndrome - Dr Mandell, DC" video of the "motivationaldoc" channel shows the
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7 232 physical examination required for CTS diagnosis.

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9 233 In this study, video popularity showed no significant correlation with reliability or quality. Popular videos
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11 234 that casual YouTube users and patients frequently watch do not have good quality and reliability. Interestingly,
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13 235 YouTube videos of expert groups that are expected to have high reliability and quality, such as the American
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15 236 Academy of Orthopedic Surgeons or Federation of European Societies for Surgery of the Hand, were not
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17 237 included in the top 55 videos. A manual search identified only about 1,600 views for the carpal tunnel release
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19 238 video uploaded to the American Academy of Orthopedic Surgeons YouTube channel
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21 239 (<https://www.youtube.com/watch?v=eemuH5UYElo>). Additionally, the Federation of European Societies for
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23 240 Surgery of the Hand and British Society for Surgery of the Hand channels have no CTS-related videos and only
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25 241 154 and 575 subscribers, respectively. It is necessary to promote an expert group's YouTube videos and
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27 242 channels and try to provide accurate medical information by uploading a high-quality video and exposing it to
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29 243 casual YouTube users and patients.

30 244 In a previous study on the meniscus [10], video dislikes were described as predictors of YouTube video
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32 245 reliability, but this was not the case in this study. The independent predictor of the JAMA score in this study was
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34 246 the likes ratio. Furthermore, independent predictors of GQS were video running time and number of comments,
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36 247 suggesting that videos with a longer running time and greater number of comments are independently and
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38 248 significantly associated with a higher GQS. The longer the video running time, the greater the amount of
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40 249 information it contains; therefore, its educational quality also increases. For GQS, a greater number of comments
41
42 250 contains more useful information for users who watched the video. Regarding the CTS-SS, compared to patient
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44 251 upload sources, academic, physician, medical, and commercial upload sources are associated with a higher CTS-
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46 252 SS. However, unlike the JAMA score and GQS, CTS-SS showed no significant association with video
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48 253 characteristics except for video source.

49 254 Our study has several limitations. First, we searched the top 50 videos for "carpal tunnel syndrome" and
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51 255 "carpal tunnel release" on YouTube in the order of popularity. This search strategy missed certain videos with
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53 256 low views or hits but with potentially high quality. Although our search strategy could miss high-quality videos
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55 257 that are less "popular," this strategy is the actual method by which casual YouTube users obtain information.
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57 258 Second, YouTube video metrics such as the number of likes and views are constantly updated; therefore, these
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59 259 study data are accurate only on the date of the search. Third, the assessment scoring systems that we used (the
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3 260 JAMA score, GQS, and CTS-SS) are subjective and unvalidated. Because the JAMA Benchmark criteria were
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5 261 developed to assess medical information on the internet website rather than video information, the criteria may
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7 262 not fit YouTube videos. The CTS-SS includes many contents of carpal tunnel syndrome, but almost YouTube
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9 263 videos have a short duration of about 10 minutes or less. Thus, it tends to be difficult to present all checklist of
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11 264 CTS-SS in short videos. Because some criteria in the JAMA benchmark criteria and CTS-SS was unsatisfied in
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13 265 most of videos, total score may be mainly influenced by some criteria, thus all criteria have not an equal weight.
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15 266 Nevertheless, we have no choice but to use these scoring systems due to lack of validated scoring system for
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17 267 evaluating the quality and reliability of medical information in YouTube videos. The excellent inter-observer
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19 268 and intra-observer reliability were confirmed using intraclass correlation coefficients to redeem these
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21 269 shortcomings. In addition, the GQS may be highly subjective, thus we tried to resolve the subjectivity by having
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23 270 two independent authors perform each evaluation twice. Fourth, one video entitled “Podcast: See a live surgery
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25 271 for carpal tunnel syndrome” has the dominant number of views (66.5%), so the average views and VPI values
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27 272 tended to increase. We tried to buffer this dominance by analyzing 55 videos.
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274 **Conclusions**

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32 275 This study demonstrated that YouTube videos of CTS showed low reliability and quality. Video quality is
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34 276 significantly associated with content and upload source. Video popularity was not correlated with video
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36 277 reliability or quality, which suggests that a good content quality does not guarantee video popularity. The impact
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38 278 of videos on patient care cannot be underestimated. To ensure the spread of accurate information, it is necessary
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40 279 to YouTube videos published by expert groups and strive to provide high-quality video materials that can assist
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42 280 with patient diagnosis and treatment.
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3 281 **Declarations**

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5 282 **Ethics approval and consent to participate:** No human participants included, but ethical approval for this study
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7 283 was obtained from Korea University Guro Hospital institutional review board. (Registration number:
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9 284 2021GR0314)

10 285 **Consent for publication:** Not applicable

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12 286 **Availability of data and materials:** All data generated or analysed during this study are included in this
13
14 287 published article

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16 288 **Competing interests:** The authors declare that they have no competing interests

17
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19
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21
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23
24 292 analysis, writing of initial draft; J.W. Park - contributed interpretation of data and critically revised manuscript;
25
26 293 Y. Won - contributed to the acquisition and analysis of the data; Y. Kwon - contributed to interpretation of data,
27
28 294 statistical analysis; J.I. Lee - supervised the study and critically revised manuscript. All authors read and
29
30 295 approved the final manuscript.

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374 **FIGURE LEGENDS**

375 Figure 1. Search methodology for carpal tunnel syndrome–related YouTube videos

376 Figure 2. Categorical distribution of video source

377 Figure 3. Categorical distribution of video content

378 Figure 4. Data-bar visualization of the top 55 carpal tunnel syndrome and release videos with the highest number
379 of views

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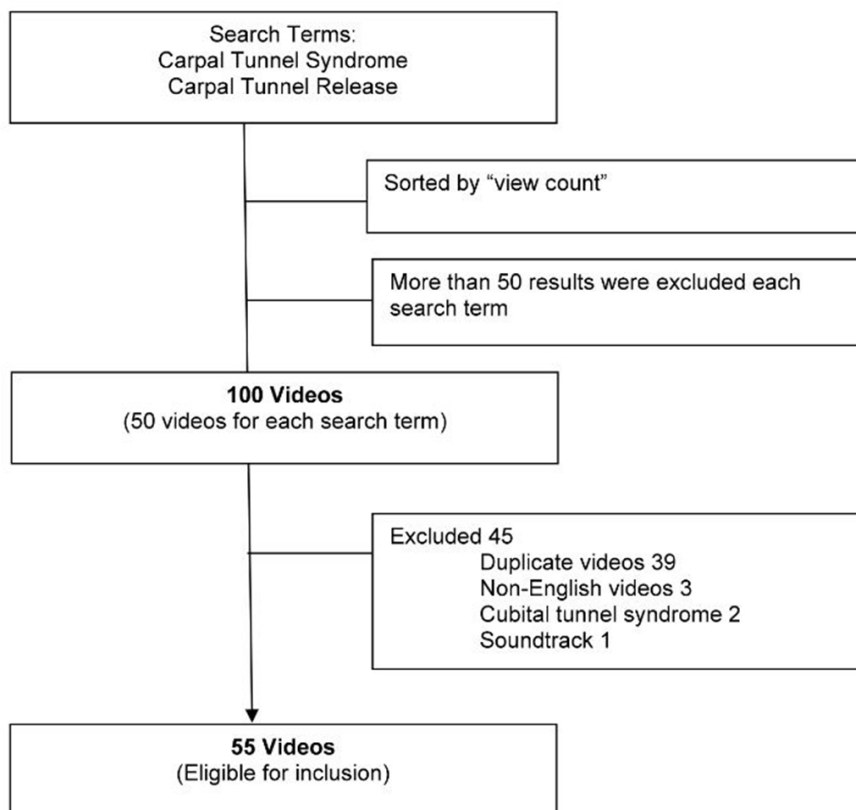


Figure 1. Search methodology for carpal tunnel syndrome-related YouTube videos

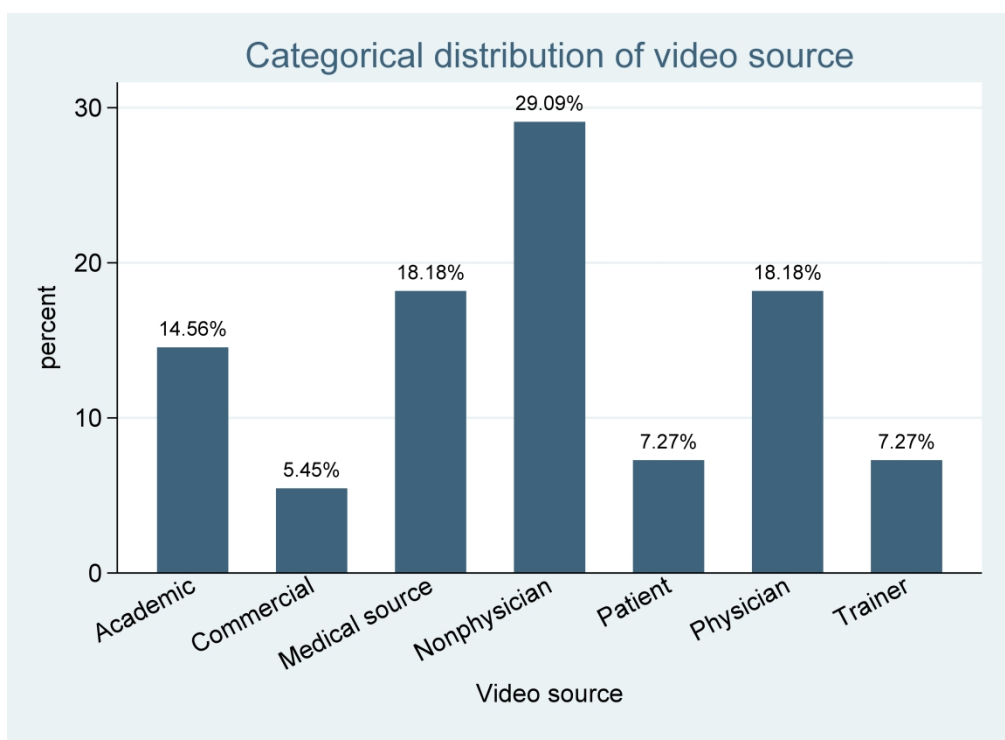


Figure 2. Categorical distribution of video source

139x101mm (1000 x 1000 DPI)

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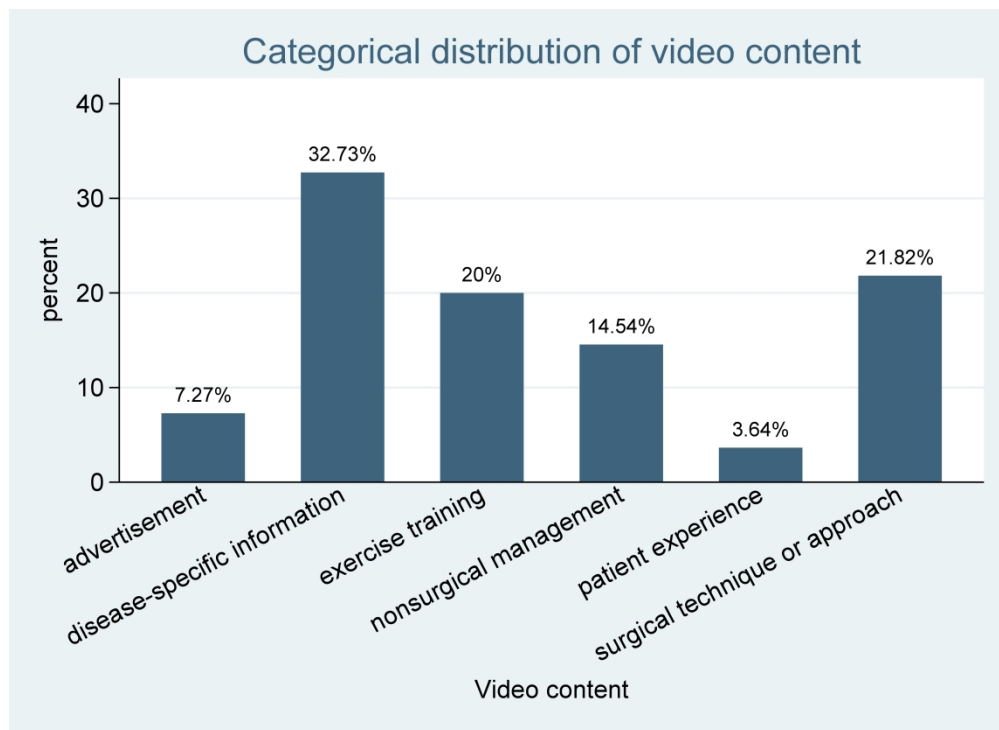


Figure 3. Categorical distribution of video content

139x101mm (1000 x 1000 DPI)

| title | Channel name | number of views | JAMA | QOS | CTS-SS | VPI |
|---|------------------------------|-----------------|------|-----|--------|---------|
| Podcast: See a live surgery for carpal tunnel syndrome | BroadcastMed Network | 5703920 | 3 | 3 | 4 | 679604 |
| Surgery Video: Carpal Tunnel - MedStar Union Memorial | MedStar Health | 2127961 | 5 | 13 | | 543.02 |
| exercises for tendinitis (tenosynovitis) and carpal tunnel (cps) | David Kuckhermann | 1563369 | 1 | 1 | 2 | 334.16 |
| How to Get Natural Carpal Tunnel Relief in 24 Hours; Dr. Josh Axe | Dr. Josh Axe | 1420119 | 2 | 2 | 1 | 583.48 |
| KT Tape: Carpal Tunnel | KT Tape | 1261508 | 2 | 2 | 3 | 292.10 |
| Carpal Tunnel Syndrome Nucleus Health | Nucleus Medical Media | 1255913 | 2 | 8 | 11 | 561.22 |
| Top 3 Exercises for Carpal Tunnel Syndrome | Madden Physical Therapy | 1170278 | 2 | 3 | 7 | 353.02 |
| Worried About Carpal Tunnel? Try 3 Simple Stretches | Cleveland Clinic | 1010182 | 3 | 3 | 2 | 743.23 |
| 5 Best Carpal Tunnel Syndrome Stretches & Exercises; Ask Doctor Jo | AskDoctorJo | 984499 | 2 | 3 | 5 | 903.17 |
| Self Acupressure for Carpal Tunnel Syndrome | LoseTheBackPain | 920535 | 2 | 2 | 3 | 251.95 |
| Live Surgery Open Carpal Tunnel Release Surgery.m4v | Dr Thomas McClellan | 845922 | 3 | 5 | 12 | 231.64 |
| Clinical Anatomy - Hand, Wrist (palmar aspect/flexors) | Armando Hasudungan | 785187 | 3 | 3 | 4 | 583.18 |
| Carpal Tunnel Self Massage Fix | HM Massage | 765715 | 1 | 2 | 5 | 455.18 |
| Carpal Tunnel Syndrome Exercises | TheProactiveAthlete | 743628 | 2 | 2 | 5 | 233.77 |
| Carpal Tunnel Surgery | ClinamonToastKen | 742263 | 1 | 3 | 8 | 321.70 |
| Carpal Tunnel Treatment - Relief Without Surgery | J7conley | 685754 | 1 | 3 | 9 | 105.21 |
| Carpal Tunnel in Esports, explained in 5 minutes | Blitz Esports LoL | 628351 | 2 | 3 | 9 | 442.70 |
| Carpal Tunnel Syndrome | WorkSafeBC | 507525 | 1 | 2 | 5 | 103.20 |
| Carpal Tunnel Surgery | TheSurgerySquad | 506665 | 3 | 4 | 8 | 142.40 |
| Carpal Tunnel Exercises using Stress Ball | Carpal Tunnel Gadgets | 496320 | 1 | 1 | 1 | 195.56 |
| Phalen's Test Carpal Tunnel Syndrome | Physiotutors | 495784 | 2 | 2 | 2 | 252.45 |
| Tinel Sign: Wrist Carpal Tunnel Syndrome | Physiotutors | 489572 | 2 | 2 | 1 | 250.92 |
| Wrist Exercises for Tendinitis Carpal Tunnel Syndrome | Road | 484034 | 2 | 2 | 3 | 211.27 |
| Avoid RSI injury in just 2 minutes a day! | Road | 484034 | 2 | 2 | 3 | 211.27 |
| Carpal Tunnel? Avoid Surgery with 3 Step Self-Treatment Program | Bob & Brad | 479295 | 3 | 3 | 6 | 302.68 |
| Hand Massage for Carpal Tunnel Syndrome | Carpal Tunnel Gadgets | 427646 | 1 | 1 | 1 | 1258.50 |
| Carpal Tunnel Relief Exercises | ZHealthPerformance | 425661 | 1 | 2 | 3 | 161.13 |
| Is It Carpal Tunnel Syndrome OR Tendinitis? | Dr Levi Harrison | 395583 | 3 | 4 | 8 | 211.36 |
| Yoga for Wrists & Fingers - Yoga for Wrist Cramps & Carpal Tunnel | Yoga with Cassandra | 389307 | 1 | 1 | 1 | 208.95 |
| Carpal Tunnel Syndrome - Everything You Need To Know; Dr. Nabil Ebraheim | nabil ebraheim | 384096 | 3 | 3 | 15 | 181.35 |
| *HUGE* Carpal Tunnel Syndrome RELEASE with CHIROPRACTIC Adjustment | Dr Joseph Cipriano DC | 387604 | 2 | 3 | 6 | 356.01 |
| Best Sleeping Position for Shoulder, Arm, & Wrist Pain- also Carpal Tunnel Syndrome | Bob & Brad | 330687 | 2 | 1 | 2 | 219.11 |
| Massage for Carpal Tunnel Syndrome - STOP Wrist Pain Fast! | Vitality Massage | 317351 | 1 | 1 | 2 | 87.04 |
| Carpal Tunnel Self-Correction Adjustment - Dr. Alan Mandell, D.C. | motivationaldoc | 289205 | 2 | 3 | 6 | 220.23 |
| What They Don't Tell You About Carpal Tunnel Syndrome! Stretches & Treatments | Bob & Brad | 284951 | 2 | 4 | 9 | 182.39 |
| Carpal Tunnel Syndrome Provocative Tests & Physical Exam | RMCrayne | 284688 | 2 | 3 | 3 | 82.76 |
| Yoga Exercises for Carpal Tunnel Syndrome | EkhartYoga | 281636 | 1 | 1 | 1 | 74.91 |
| Carpal tunnel release | Mr Jeremy Read Hand Surgeon | 278553 | 2 | 3 | 3 | 94.44 |
| Carpal Tunnel Fix - DIY No brace!! | Adam J. Story, DC | 276144 | 1 | 2 | 6 | 196.22 |
| Carpal Tunnel Injection - Everything You Need To Know - Dr. Nabil Ebraheim | nabil ebraheim | 260763 | 4 | 4 | 5 | 78.41 |
| Carpal Tunnel Release for carpal tunnel syndrome, by John Mahoney, M.D. more at www.DoctorMahoney.com | John Mahoney | 254070 | 1 | 1 | 2 | 40.78 |
| How to Determine if You Really Have Carpal Tunnel Syndrome - Dr Mandell, DC | motivationaldoc | 246712 | 3 | 4 | 7 | 230.45 |
| Carpal Tunnel Syndrome: Fast Natural Relief in Minutes - Dr Alan Mandell, DC | motivationaldoc | 242162 | 3 | 5 | 11 | 225.27 |
| Hand Exam For Carpal Tunnel Syndrome | Jedediah Jones | 226138 | 3 | 3 | 4 | 96.37 |
| Carpal Tunnel Syndrome Operation | nandapillai | 225022 | 3 | 3 | 4 | 40.59 |
| Carpal Tunnel Syndrome Repair Surgery - PreOp® Patient Education Medical HD | PreOp.com Patient Engagement | 222895 | 2 | 3 | 6 | 68.29 |
| Carpal Tunnel Release Surgical Procedure Part I | Patient Education | 220636 | 2 | 2 | 2 | 166.91 |
| Forearm Anatomy: Help Relieve Carpal Tunnel Syndrome | Medscape | 219562 | 2 | 3 | 5 | 361.31 |
| 3D CGI medical video carpal tunnel syndrome | Massage Therapeutics | 210471 | 1 | 2 | 3 | 39.52 |
| Carpal Tunnel Release - Teaching Video | 3dmusclepep | 203590 | 1 | 4 | 6 | 169.30 |
| Recognizing Thumb Muscle Atrophy - Carpal Tunnel Syndrome | Malek Racy | 199659 | 3 | 3 | 5 | 45.13 |
| Top 3 Exercises to Perform AFTER Carpal Tunnel Surgery (Release) | handarmdoc | 193791 | 3 | 2 | 3 | 95.94 |
| One month after carpal tunnel surgery | Bob & Brad | 183613 | 1 | 1 | 2 | 56.38 |
| Early symptoms and warning signs of carpal tunnel syndrome | JoeCubicle | 180793 | 1 | 2 | 7 | 61.50 |
| 5 Exercises to PREVENT and ALLEVIATE Carpal Tunnel | Carpalix | 179735 | 2 | 2 | 4 | 481.82 |
| Carpal Tunnel Release - Dr. Jon Hernandez | Rehab and Revive | 179707 | 2 | 4 | 4 | 73.79 |
| | Coordinated Health | | | | | |

Figure 4. Data-bar visualization of the top 55 carpal tunnel syndrome and release videos with the highest number of views

100x91mm (800 x 800 DPI)

Supplementary Material for: “Quality and Reliability Evaluation of Online Videos on Carpal Tunnel Syndrome: A YouTube Video-based Study”**Journal:** *BMJ Open***Authors:** Donghee Kwak, Jong Woong Park, Yousun Won, Yeongkeun Kwon, Jung Il Lee**Corresponding author:** Jung Il Lee, M.D., Ph.D.; Email: osjungil@gmail.com**Supplementary Table 1.** Full list of video URLs included in the study

| Full list of video URLs | | | |
|-------------------------|-------------------------|---|---|
| Number | Channel Name | Video Title | URLs |
| 1 | BroadcastMed Network | Podcast: See a live surgery for carpal tunnel syndrome | https://www.youtube.com/watch?v=XCplgeQzrU |
| 2 | David Kuckhermann | exercises for tendinitis (tendonitis) and carpal tunnel (cps) | https://www.youtube.com/watch?v=hUyM1NyrOHJQ |
| 3 | Dr. Josh Axe | How to Get Natural Carpal Tunnel Relief in 24 Hours Dr. Josh Axe | https://www.youtube.com/watch?v=LTKr1ioqoZVM |
| 4 | KT Tape | KT Tape: Carpal Tunnel | https://www.youtube.com/watch?v=FAW00_SWDhM |
| 5 | Nucleus Medical Media | Carpal Tunnel Syndrome Nucleus Health | https://www.youtube.com/watch?v=z-SjH5-nOo |
| 6 | Madden Physical Therapy | Top 3 Exercises for Carpal Tunnel Syndrome | https://www.youtube.com/watch?v=gTx0nqu9USC4 |
| 7 | Cleveland Clinic | Worried About Carpal Tunnel? Try 3 Simple Stretches | https://www.youtube.com/watch?v=f2IH1WNaQaQ |
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