

# Assessment of the quality of oral biopsy procedure videos shared on YouTube

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## Funding information

European Union's Erasmus + Programme 'Oral Potentially Malignant Disorders: Training of Healthcare Professionals'; grant number 2020-1-UK01-KA202-078917.

## Abstract

**Objective:** The aim of this study was to assess the quality of free-to-access videos on oral biopsy procedures on the YouTube platform.

**Materials and Methods:** We conducted a search on YouTube using the term "oral biopsy" and selected the first 100 videos in order of relevance. The following exclusion criteria were applied: language other than English, videos that did not cover oral biopsy techniques, videos on nonhuman specimens, postoperative instructions, personal experiences, exfoliative cytology, or "brush biopsy." Forty-seven selected videos were classified based on their duration, country of origin, date of upload to the system, author, information source and number of views, and likes and dislikes. Video quality was analyzed using DISCERN, the Global Quality Scale (GQS), and the Video Information and Quality Index (VIQI).

**Results:** The majority (78.7%) of analyzed videos were uploaded by dentists, originating from India (48.9%), with a mean duration of 11.8 min (SD, 20.4), with 104.5 likes (SD, 186.4) and 7.1 dislikes (SD, 10.55). The mean values for DISCERN, GQS, and VIQI were 1.3 (SD, 0.52), 2.1 (SD, 1.04), and 9.62 (SD, 1.69), respectively.

**Conclusion:** The majority of videos on oral biopsy published on YouTube are of low quality.

## KEYWORDS

dental education, oral biopsy, YouTube

## 1 | INTRODUCTION

As healthcare practitioners, dentists should understand the importance of biopsies for the diagnosis of various oral conditions and be

sufficiently qualified to perform them (Lopez Jornet et al., 2007). Various studies have confirmed that a minority of general dental practitioners in Europe perform oral biopsies in their daily practice. The most frequently reported explanation for this is a lack of

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training and exposure during undergraduate dental studies (Diamanti et al., 2002; Seoane et al., 2013).

A recent study aimed to assess knowledge, clinical experience, attitude, and preference for future education on oral potentially malignant disorders (OPMDs) of undergraduate dental students in six European countries (Croatia, France, Italy, Portugal, Spain, and United Kingdom). The authors pointed out that the proportion of students who have observed a biopsy of an oral lesion was 82%, assisted with a biopsy of an oral lesion was 76%, and performed a biopsy of an oral lesion was 42%, although this percentage varied significantly between countries. The majority of students were interested in future education on OPMDs, preferably via short educational videos (Brailo et al., 2022).

In recent decades, technology has been progressively incorporated into all aspects of dental education (Turner et al., 2016). Today's students prefer instant answers through search engines and videos over traditional reading assignments and lectures (Walinski et al., 2023). Videos and social networks have become routine and an important tools for guiding students (Koya et al., 2012), including dental students (Burns et al., 2020; Dias da Silva et al., 2022; He et al., 2021). However, when considering different learning styles and levels of education, YouTube surgical videos may be suitable for students who already have previous surgical training and experience but may be lacking for less-experienced students (Karic et al., 2020).

The amount of surgery-related videos available online, especially on YouTube, has increased in both number and popularity in the last decade (Farang et al., 2020). YouTube is not an accredited medical educational resource, and any individual or organization can upload videos to the platform. For this reason, content is not sorted by quality, but search results appear in order of popularity and other algorithms determined at the discretion of the YouTube organization (Farang et al., 2020; Gul & Diri, 2019; Lee et al., 2014).

Viewers determine the quality of the uploaded information through likes, dislikes, and comments (Koya et al., 2012). For dentistry students, YouTube is one of the preferred methods for viewing videos online due to its accessibility from any location and at any time (Dias da Silva et al., 2019a, 2019b) as well as its considerable diversity in videos content offered (Madathil et al., 2015).

There has been a significant increase in the growth of educational video content on YouTube, and many academic institutions now have their own YouTube channels although in the case of dental schools, most of the videos uploaded to these channels were not educational and focused on promoting dentistry courses. Therefore, students who wish to watch instructional videos will find limited educational content provided by dental schools and are likely to access related material on other Internet sites that may not have been peer-reviewed (Dias da Silva et al., 2019a, 2019b).

Many educational videos available online, lack an evidence base, are out of date, unreliable, and potentially harmful (Greenberg et al., 2004). Numerous studies have assessed the educational quality of videos on various oral conditions, such as leukoplakia (Kovalski et al., 2019) and lichen planus (Romano et al., 2021), and dental procedures such as third molar extractions (Kidy et al., 2021). To date,

however, there is no evidence that videos on oral lesion biopsy have been evaluated. The main objective of this study was to assess the educational quality of oral biopsy videos published on YouTube.

## 2 | MATERIALS AND METHODS

### 2.1 | Search on YouTube

We conducted a search on YouTube (<https://www.youtube.com>) on September 14, 2021 with the term "oral biopsy." To make the search as objective as possible, we used Google's incognito window, erased the browser's cache and cookies, and did not start a YouTube session (Dias da Silva et al., 2019a, 2019b). For video selection, we used the default configuration of YouTube based on their relevance. Given that 95% of YouTube users view no more than the first 60 videos (Desai et al., 2013), we analyzed the first 100 search results.

We established the following exclusion criteria: duplicate videos, language other than English, videos not covering oral biopsies, videos on nonhuman specimens, postoperative instructions, personal experiences, exfoliative cytology or "brush biopsy," oral surgery instruments, liquid biopsy and those aimed at informing patients. After applying these exclusion criteria, 47 of the 100 preselected videos were included in this study (Figure 1).

### 2.2 | Interaction index and ratio of views (visibility and popularity)

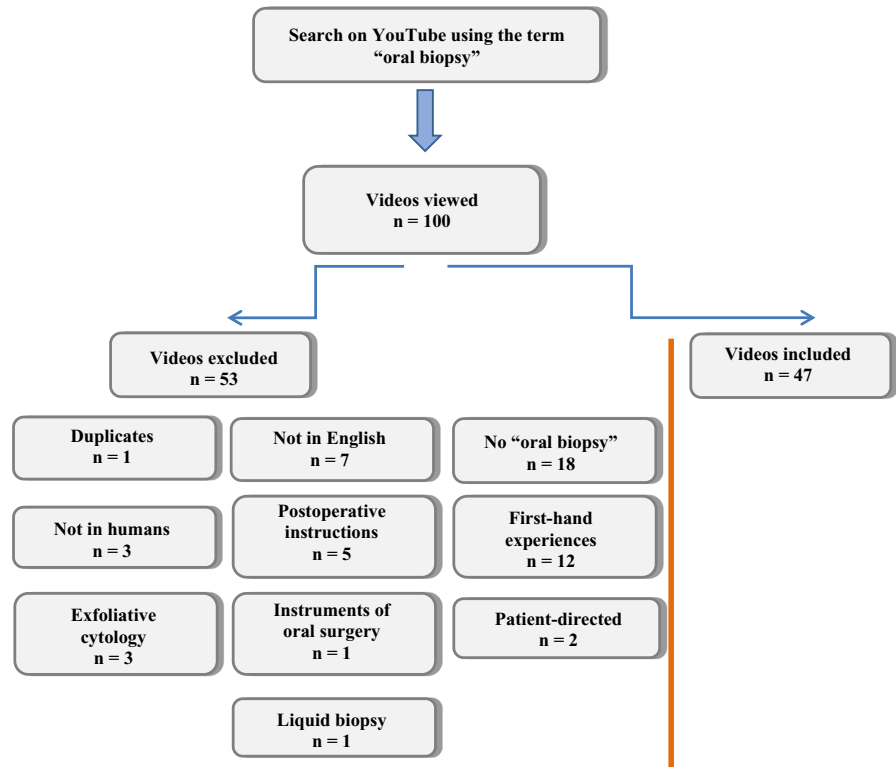
From each video, we extracted the following data: duration, country of origin, date the videos were uploaded to the platform, author, source of information, views, and likes and dislikes. Based on these data, we calculated the interaction index and ratio of views using the following formulae: interaction index =  $(\frac{\text{likes} - \text{dislikes}}{\text{views}} \times 100)$ , and ratio of views =  $(\frac{\text{views}}{\text{daysinceupload}} \times 100)$  (13).

### 2.3 | Utility evaluation

The assessment of the video's utility was based on the quantity of information they contained on the following 10 aspects related to the performance of an oral biopsy, based on classic articles on oral biopsy (Jephcott, 2007; Melrose et al., 2007; Pippi, 2006; Chan and Wolf 2012), and based on the author's own clinical experience: necessary instrumentation, anesthetic technique, indications, contraindications, clinical context (diagnosis, follow-up, treatment), types of biopsies, auxiliary procedures, suturing, treatment of the sample, and the protocol for requesting the histopathological analysis. Each item was assigned 1 point, resulting in a total score for each video ranging from 0 to 10. Based on the total number of points obtained, the videos were classified as Inadequate (score 0), Somewhat Useful (score 1–3), Moderately Useful (score 4–7), and Highly Useful (score 8–10) (Table 1) (Kovalski et al., 2019).



**FIGURE 1** Flow diagram of the selection process for the analyzed videos.



**TABLE 1** Criteria for evaluating the videos' utility.

Criteria to analyze	Points
The video mentions:	
Necessary instrumentation	1
Anesthetic technique	1
Indications	1
Contraindications	1
Clinical context (diagnosis, follow-up, treatment)	1
Types of biopsies	1
Auxiliary procedures	1
Suturing	1
Treatment of the sample	1
Request for pathology analysis	1
<b>Total</b>	<b>10</b>

Note: 0, Not at all useful; 1–3, Somewhat useful; 4–7, Moderately useful; 8–10, Highly useful.

## 2.4 | Reliability analysis (DISCERN)

For the reliability analysis, we applied an adaptation of the DISCERN tool to assess the written medical information. This tool consists of five sections: (1) Are the objectives clear and were they achieved? (2) Are the sources of information reliable? (3) Is the presented information balanced and impartial? (4) Are other sources of information listed for patient reference? and (5) Are the areas of uncertainty mentioned? Each of these parameters was assigned a dichotomous

score (1/0) depending on whether these requirements were satisfied in the video, with a total achievable score for each case of at least, 0 points, and at most, 5 points (Charnock et al., 1999; Kidy et al., 2021).

## 2.5 | Quality analysis (Global Quality Scale)

We applied a modification of the Global Quality Scale (GQS), which scored (from 1 to 5) each of the videos based on the following considerations: (1) poor quality and flow; the most important information does not appear. Not useful for students; (2) poor quality and flow; some information appears, but some of the relevant issues are not addressed. Limited utility for students; (3) moderate quality and suboptimal flow; some important information is adequately discussed, but other information is poorly discussed. Some utility for students; (4) good quality and flow; most of the relevant information is discussed, but some relevant issues are not addressed. Useful for students; (5) excellent quality and flow. Highly useful for students (Kodonas & Fardi, 2021).

## 2.6 | Quality analysis (Video Information and Quality Index)

The Video Information and Quality Index (VIQI) consists of analyzing separately four items that make up the GQS. We employed a Likert scale to score flow, exactness, and accuracy from 1 to 5. To assess the quality section, we analyzed whether the videos used

fixed images or animations, whether interviews were conducted with individuals from the community, whether they had subtitles, and whether they included a summary (Nagpal et al., 2015). The total score for each video ranged from 5 to 20. The video quality was classified as poor (score 5–9), good (score 10–11), or excellent (score 12–20).

## 2.7 | Statistical analysis

Descriptive statistics are presented as absolute and relative frequencies for categorical variables, and as mean and standard deviation, and range for continuous variables.

To analyze the interobserver variability, we randomly selected nine videos that were evaluated by six different observers and estimated the Fleiss Kappa coefficient, an adaptation of Cohen's Kappa for  $n$  observers. According to Landis and Koch (1977), the magnitude of the effect was established as poor ( $<0$ ), slight (0.00–0.20), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80), and almost perfect (0.81–1.00) (Landis & Koch, 1977).

To analyze the association between the ordered categorical outcomes DISCERN, GQS, and VIQI and utility indices and the videos' variables (duration in minutes, time online in months, number of views, number of likes, and number of dislikes and image quality), we applied a proportional odds regression model with logit link and parameters estimated using maximum likelihood and with the bottom category of the outcome established as the reference category. The log odds of being in a category higher than  $k$  is expressed as  $\ln\left(\frac{P(y > k)}{P(y \leq k)}\right) = \beta x - \gamma_k$ , where  $\beta$  represents the slope of the variable,  $x$  and  $\gamma$  the intercept of the ordered category  $k$ . When taking exponents the effect of a unit change in variable  $x$  on the odds of the outcome  $y$  being in a higher category is beta. For interpreting purposes, an odds ratio greater than 1 is indicating higher odds of being in higher categories (% of increased risk = 100 (OR - 1)), whereas values lower than 1 are indicating lower odds of being in higher categories (% of reduced risk = 100 (1 - OR)). The calculation of the  $p$ -values for the model's coefficients was based on the Wald method.

The statistical analysis is carried out with the free software R (R Core Team, 2021), using the package `irr` for estimating Fleiss Kappa (Gamer et al., 2019), and the package `ordinal` (Christensen, 2019) for adjusting the proportional odds regression model.

## 3 | RESULTS

### 3.1 | Interobserver agreement

For the utility index, we obtained a correlation of 0.22, which was interpreted as a fair degree of interobserver agreement, and we rejected the null hypothesis of being equal to zero for the kappa value ( $p < 0.05$ ).

In the case of the DISCERN index, the kappa value was 0.05, which represents slight interobserver agreement and was not statistically significant ( $p > 0.05$ ).

For the GQS and VIQI, we obtained similar values to the utility index (0.23 and 0.26, respectively), both statistically significant ( $p < 0.05$ ). The observed degree of agreement can be interpreted as fair.

### 3.2 | General characteristics, visibility, and popularity

Appendix A details the general characteristics of each of the videos, including URL, name, duration in minutes, country, date of upload to the platform, author, sources of information, views, and likes and dislikes.

Between July 14, 2009 and July 6, 2021, the videos were uploaded to YouTube from various countries, predominantly India (48.9%) and the USA (23.4%). Some 78.7% of the authorship was attributed to doctors/dentists or to their clinic/hospital accounts, and 14.9% was attributed to universities and learning platforms. No case mentioned the sources of information consulted for the video's implementation, and they were, therefore, considered unknown.

Table 2 shows the distribution of the general characteristics, interaction index (visibility), and ratio of views.

### 3.3 | Utility analysis

The results of the utility index are shown in Table 3. The most common content was regarding anesthetic techniques (44.7%), types of biopsies (36.2%), treatment of the tissue sample (34%), indications (31.9%), and necessary instrumentation (25.5%). The remaining parameters did not exceed 20%: contraindications (19.1%), suturing (17%), clinical context (14.9%), request for histopathological analysis (14.9%), and auxiliary procedures (8.5%).

Based on these criteria, the mean score of the selected videos was  $2.47 \pm 2.61$  (0–9), and most were classified as somewhat useful. As shown in Table 3, only 8.5% of the videos were classified as highly useful.

### 3.4 | Reliability analysis (DISCERN)

According to the reliability analysis using the DISCERN index, 95.7% of the videos were clear and achieved the objectives, given that their purpose was to perform a biopsy. In no case were the sources of information considered reliable. In addition, none of the videos referred to areas of uncertainty. In 61.7% of the cases, the information was not balanced or impartial.

The mean DISCERN score of the analyzed videos was  $1.34 \pm 0.52$ , none of which exceeded a score of 2, which represents highly deficient quality (Table 2).

**TABLE 2** General characteristics, visibility, popularity of the sample, and quality rating tools.

	Mean (SD)	Minimum	Maximum
Duration, min	11.85 (20.46)	0.58	110.95
Views	23,336 (41,238)	9	242,538
Likes	104.5 (186.4)	0	942
Dislikes	7.1 (10.55)	0	40
Interaction index (visibility)	1.32% (1.57)	0%	6.38%
Ratio of views (popularity)	1346.95% (2143.29)	4.07%	10,048.11%
Quality rating tools			
DISCERN	1.34 (0.52)	0	2
GQS	2.13 (1.04)	1	4
		n (%)	
	1	17 (36.2)	
	2	12 (25.5%)	
	3	13 (27.7)	
	4	5 (10.6)	
	5	-	
VIQI			
Flow	2.60 (0.61)	1	3
Information	2.30 (0.88)	1	3
Quality	2.38 (0.82)	1	4
Accuracy	2.47 (1.28)	1	4
		n (%)	
	Poor	21 (44.7%)	
	Good	20 (42.6%)	
	Excellent	6 (12.8%)	

Abbreviations: GQS, Global Quality Scale; VIQI, Video Information and Quality Index.

### 3.5 | Quality analysis (Global Quality Scale Index)

The mean GQS index for these videos (Table 2) was  $2.13 \pm 1.04$ . Only 10.6% of the videos achieved a score of 4, whereas 36.2%, 25.5%, and 27.7% achieved a score of 1, 2, and 3, respectively. The results of this index showed that, in general, the YouTube videos on oral biopsy were of deficient quality.

### 3.6 | Quality analysis (Video Information and Quality Index)

The mean values for flow, accuracy of the information, quality, and precision were  $2.60 \pm 0.61$  (range, 1–3),  $2.30 \pm 0.88$  (range, 1–3),  $2.38 \pm 0.82$  (range, 1–4), and  $2.47 \pm 1.28$  (range, 1–4), respectively. None of the videos achieved a score of 5 in any of the sections, with a score of 3 being the most frequent when assessing flow (66%), accuracy of the information (57.4%), and quality (40.4%). When assessing precision, the values obtained more frequently were 1 (34%) and 4 (34%).

According to the VIQI, 44.7% of the oral biopsy videos published on YouTube have poor quality, 42.5% have good quality, and 12.8% have excellent quality. The mean VIQI was  $9.62 \pm 1.69$  (Table 2).

### 3.7 | Determinants of the utility index

In the model adjusted for the utility index, we observed that the risk of obtaining high scores increased a 3% as the length of the video increased by one unit (OR ( $\exp(\beta_1)$ ) = 1.03;  $p > 0.05$ ) and less than 1% as the number of likes increased (OR ( $\exp(\beta_4)$ ) = 1.005;  $p = 0.019$ ). In contrast, with each unit of increase of the time online and the number of dislikes variables, the risk of obtaining high scores for the utility index is reduced a 1% and a 5%, respectively (OR ( $\exp(\beta_2)$ ) = 0.987 and OR ( $\exp(\beta_5)$ ) = 0.944, respectively;  $p > 0.05$  in both cases).

With regard to views, the videos with more views and greater image quality were associated with lower categories of the utility index, although without statistical significance.

### 3.8 | Determinants of the DISCERN index

The risk of obtaining high scores on the DISCERN index increased in a 31.2% as the length of the video increased (OR ( $\exp(\beta_1)$ ) = 1.312;  $p = 0.007$ ) and as the video resolution (measured in the number of horizontal lines) increased: OR ( $\exp(\beta_6[\text{quality: 480p}])$ ) = 59.85

TABLE 3 Utility.

	n (%)
Necessary instrumentation	12 (25.5)
Anesthetic technique	21 (44.7)
Indications	15 (31.9)
Contraindications	9 (19.1)
Clinical context (diagnosis, follow-up, treatment)	7 (14.9)
Types of biopsies	17 (36.2)
Auxiliary procedures	4 (8.5)
Suturing	8 (17)
Treatment of the sample	16 (34)
Request for pathology analysis	7 (14.9)
Utility	
Not at all useful	15 (31.9)
Somewhat useful	19 (40.4)
Moderately useful	9 (19.1)
Highly useful	4 (8.5)

( $p=0.205$ ); OR ( $\exp(\beta_6[\text{quality: } 720\text{p}])=1791.84$  ( $p=0.020$ ); and OR ( $\exp(\beta_6[\text{quality: } 1080\text{p}])=768.93$  ( $p=0.045$ ).

The number of likes and dislikes also resulted in a positive coefficient but without reaching statistical significance.

The videos with the most views were associated with a higher likelihood of being classified into the low categories of the DISCERN index, although without reaching statistical significance.

### 3.9 | Determinants of the GQS index

A higher number of likes increased less than 1% the probability of achieving higher scores on the GQS index (OR ( $\exp(\beta_5)$ )=1.004;  $p=0.048$ ), as occurred when increasing the video duration; in this case, however, without reaching statistical significance (OR ( $\exp(\beta_1)$ )=1.009;  $p>0.05$ ). In contrast, the longer the video was online and the number of views and dislikes increased, the chances of a low score on the GQS index increased.

### 3.10 | Determinants of the VIQI

For the videos with resolutions of 480p, 720p or 1080p, the likelihood of obtaining low scores on the VIQI increased: OR ( $\exp(\beta_6[\text{quality: } 480\text{p}])=75.04$  ( $p=0.035$ ); OR ( $\exp(\beta_6[\text{quality: } 720\text{p}])=51.16$  ( $p=0.037$ ); OR ( $\exp(\beta_6[\text{quality: } 1080\text{p}])=16.29$  ( $p>0.05$ ).

## 4 | DISCUSSION

To our knowledge, the present study is the first to examine the content and quality of YouTube videos on oral biopsies with educational

goals. Previously published studies on oral health-related information provided by YouTube videos concluded that the information was deficient in videos on third molar extractions (Kidy et al., 2021), incomplete in the case of endodontics (Nason et al., 2016), and of low quality in pulpotomies and pulp capping (Kodonas & Fardi, 2021), among others.

### 4.1 | Use of YouTube in dental education

Although academic institutions are considered reliable sources when administering information, it is estimated that only 5% of the dental information available on YouTube has been published by universities (Dias da Silva et al., 2019a, 2019b). Regarding the use of YouTube by students, Aldallal et al. conducted a survey of fourth- and fifth-year students of dentistry at the University of Manchester (UK) to assess their perception of the training they received in oral surgery and their use of YouTube; 67% of the 122 students who responded used YouTube videos to study the content of oral surgery, and 27.05% thought that the information on YouTube did not agree with that they had received in class (Aldallal et al., 2019).

A survey was also performed in the United States among third- and fourth-year students of five dental schools. Of the 479 students who responded to the questionnaire, 89.6% had used YouTube for more than 5 years, and 51.8% used it daily; 74.3% visited YouTube for entertainment, and only 17.3% used it mainly for educational purposes. Regarding the use they made of YouTube as a learning tool, 73.6% used it as a complement to their classes, and 76.8% used it to prepare a procedure they had never performed. Some 58.3% of the students regarded YouTube as useful for training in various clinical techniques. Forty-five percent sought videos that were based on scientific evidence, and 65.6% considered that the videos they watched reflected some of the content they had received in class. Some 89.1% of the students would recommend YouTube as a learning tool to their colleagues, and 88.7% would like their teachers to upload tutorials of clinical procedures to YouTube or other social networks, although only 37.9% indicated having received recommendations from their teachers for using YouTube as a learning tool (Burns et al., 2020).

An international, multicenter study with participants from Australia, Brazil, Chile, Scotland, France, Greece, Italy, and the United Kingdom surveyed 515 students on their use of the Internet for education in the dental setting and obtained very similar results. Some 94.5% of the respondents used the internet in addition to other learning tools, 37.1% used it to clarify some aspect that was not made clear in class, 27.6% used it to complement the study material, and 20.2% used it to prepare for an examination. The majority (53.8%) found the online content on their own, although 95% of the Greek students had received online content from their professors, as well as recommendations on how to search for information online (22.4%). YouTube was the second most used website for finding dental information (55.9%), only behind the Google search engine (72.2%). The majority considered that they had learned the most



from videos (78.2%), particularly YouTube videos (79.9%), especially before performing a dental procedure for the first time (74.8%). Sixty-eight percent of the students considered the inclusion of videos of dental procedures on the university's website extremely useful (Dias da Silva et al., 2022).

Helming et al. (2021) conducted a systematic review of the literature to identify and evaluate studies that assessed the quality of the content of YouTube videos aimed at professional medical education. Due to the heterogeneity of methods used to evaluate the quality of the videos, the authors classified the studies into three categories based on the type of quality rating tool (QRT) used to assess the content quality of the videos: externally validated, internally validated, or limited global QRTs. The first category included studies that used externally validated standardized QRTs such as the Journal of the American Medical Association benchmark criteria (JAMA), the DISCERN instrument score, and the Global Quality Score (GQS) score. These tools have been validated as methods for evaluating the quality of information on the internet, although they have not been explicitly validated as evaluations of online information for medical education. The second category included studies that used an internally validated QRT to evaluate video content based on the presence and accuracy of key elements. These QRTs were developed by the authors of the studies using published guidelines or standards or expert opinion. The third category, limited global QRTs, was assigned to studies that did not use a formally validated QRT (i.e., externally or internally). In any case, the use of multiple indices to achieve the most objective result possible is recommended, although various indices can interpret the same parameters differently, such as the GQS index and VIQI. Though they analyze the same parameters, the GQS does so globally while the VIQI breaks them down.

In the present study, we used both externally validated and internally validated QRTs.

## 4.2 | General parameters, visibility, and popularity

The mean duration of the oral biopsy videos published on YouTube was similar to that of other procedures, such as genioplasty (Ayranci et al., 2021), leukoplakia (Kovalski et al., 2019), third molar extractions (Kidy et al., 2021), and Sjögren's syndrome (Delli et al., 2016). The considerable majority of the videos analyzed in this study were published in India, unlike other studies where the USA was the main exporter (Abukaraky et al., 2018; Kidy et al., 2021; Romano et al., 2021). Those responsible for publishing the information on YouTube were oral health practitioners, coinciding with other previously published studies (Abukaraky et al., 2018; Ceylan Sen et al., 2023; Kodonas & Fardi, 2021; Nason et al., 2016; Romano et al., ); however, there are articles in which independent users and individuals unrelated to dentistry more frequently published content on dental procedures (Ayranci et al., 2021; Morais et al., 2020; Nason et al., 2016; Ramadhani et al., 2021). None of the analyzed videos indicated the sources from which the information was obtained, a

finding coinciding with that of previous publications (Abukaraky et al., 2018; Passos et al., 2020).

The present study showed a low mean interaction, consistent with the results of other similar articles (Abukaraky et al., 2018; Kovalski et al., 2019; Morais et al., 2020). With regard to popularity, the videos on oral biopsy procedures were more popular than those of other procedures (Kovalski et al., 2019; Ramadhani et al., 2021).

## 4.3 | Utility

In terms of the content of the videos, most did not address important aspects when performing a biopsy, such as the necessary instrumentation for performing the biopsy, and the biopsy indications and contraindications. This also occurred when analyzing videos on other dental procedures, such as dental implant insertion, which overlooked aspects as important as maintaining the implants and contraindications (Abukaraky et al., 2018), or in which information lacking scientific evidence was included (Kovalski et al., 2019).

It is noteworthy that the utility index item included most frequently in the videos was the anesthetic technique (44%). As in any surgical oral procedure, correct anesthesia is imperative to properly perform the procedure. Local anesthesia is administered either as a local infiltration or through a nerve block technique. For most oral lesions that require a biopsy, adequate anesthesia is achieved with the local infiltration technique without the need for a nerve block. In this case, it is essential to avoid direct injection into the lesion (Shanti et al., 2020) as it may produce artifacts in the histopathological sample (hemorrhage with extravasation and separation of connective tissue bands with vacuolization) (Margarone et al., 1985).

In this study, the majority of videos were classified as somewhat useful, unlike other publications in which they were categorized as moderately useful (Kovalski et al., 2019) or even highly useful (Ceylan Sen et al., 2023).

In the present study, equal weight was given to each criterion on the Utility Index checklist, however, it is possible that some criteria are more important than others. A scoring system that weighs each criterion may be more accurate (Karic et al., 2020).

## 4.4 | DISCERN index

The DISCERN score obtained in this study confirmed the low quality of the oral biopsy videos, agreeing with the results of previous publications on various dental procedures such as third molar extractions (Kidy et al., 2021), pulpotomy (Kodonas & Fardi, 2021), and adult orthodontics (Yavan & Gokce, 2022).

## 4.5 | GQS index

Based on the GQS scores, we observed that the YouTube videos on oral biopsy were of low quality, consistent with the quality analysis

of the videos on other dental procedures or on oral conditions, such as third molar extractions (Kidy et al., 2021), regenerative endodontics (Kaval et al., 2022), oral lichen planus (Romano et al., ), pulpotomy (Kodonas & Fardi, 2021), and halitosis of oral origin (Ramadhani et al., 2021).

#### 4.6 | VIQI

The VIQI values appear to indicate that the quality of the YouTube videos on oral biopsy was good, which is consistent with the results of other studies, where the VIQI was even higher, as is the case for regenerative endodontic treatments (Yavan & Gokce, 2022), rapid palatal expansion (Hatipoglu & Gas, 2020) and lingual orthodontics (Lena & Dindaroglu, 2018). Despite this, most videos were encompassed in the Poor Quality category.

Although the results of the VIQI categorized the video quality as good, this index considers aspects such as flow, which is more related to the technical aspects of the video than to the quality of the information in it.

#### 4.7 | Other considerations

As with other studies (Hatipoglu & Gas, 2020; Kidy et al., 2021; Kodonas & Fardi, 2021; Kovalski et al., 2019), the quality of the YouTube videos on oral biopsy was categorized as low, because the more specific index for analyzing the quality of the procedure's information is that of utility, which truly shows the aspects directly related to the technique.

Given that students use YouTube as a learning tool, it would be appropriate to create and publish content with reliable, exact, and sufficient information, which could be solved if YouTube videos were analyzed by experts before being published. It would also be appropriate for professors to train students in searching for scientific, evidence-based information, and in sharing previously selected videos, as we found only one study (performed in Greece) in which the students received training on this issue (Dias da Silva et al., 2022).

Online videos are particularly valuable in medical education. The cognitive theory of multimedia learning and a growing body of evidence suggests that videos enhance learning by activating visual and auditory pathways and by presenting words and images in a congruent manner, which can help students efficiently consolidate the vast body of medical knowledge (Brame, 2016). However, to maximize the benefit of educational videos, it is important to consider the three key components of cognition load, elements that impact engagement, and elements that promote active learning. In base of these elements, Brame (2016) proposes some recommendations: (1) keep the videos brief and focused on the learning objectives, (2) use audio and visual elements to convey appropriate parts of an explanation; consider how to make these elements complementary rather than redundant; (3) use signaling to highlight important ideas

or concepts; (4) employ a conversational and enthusiastic style to enhance engagement; and (5) embed videos in a context of active learning by using guiding questions, interactive elements, or associated tasks/assignments.

It would also be appropriate for professionals in this sector, as well as universities and other societies related to dentistry, to create short videos with explanations, legends, and time stamps, given that they increase the confidence that students place in the videos and allow professors to know the difficulties encountered by students (Dias da Silva et al., 2022).

#### 4.8 | Study limitations

We assessed only those videos edited in English; they, therefore, do not represent a sufficiently representative sample of all videos published on YouTube. Additionally, the assessment indices have a subjective component, as confirmed by the interobserver agreement index encountered in this study.

In conclusion, the majority of oral biopsy procedure videos available on YouTube are of low quality and include incomplete information. Due to the use of these videos by dentistry students as a means of learning, professionals in the sector, as well as at universities and other related organizations, should oversee the production of high-quality material based on scientific evidence and clinical experience.

#### AUTHOR CONTRIBUTIONS

**Díaz-Rodríguez A:** Methodology; investigation; data curation; formal analysis; writing – original draft. **Limeres-Posse J:** Conceptualization; methodology; investigation; writing – review and editing. **Albuquerque R:** Conceptualization; investigation; funding acquisition; writing – review and editing. **Brailo V:** Investigation. **Cook R:** Writing – review and editing; investigation. **Fricain JC:** Investigation. **Lodi G:** Investigation. **Monteiro L:** Investigation. **Silva L:** Investigation. **Carey B:** Writing – review and editing. **Diniz-Freitas M:** Conceptualization; methodology; investigation; writing – review and editing.

#### ACKNOWLEDGEMENTS

The authors have nothing to report.

#### FUNDING INFORMATION

This project is co-funded by the European Union's Erasmus + Programme "Oral Potentially Malignant Disorders: Training of Healthcare Professionals" (grant number 2020-1-UK01-KA202-078917). The European Commission's support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

#### CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.



## DATA AVAILABILITY STATEMENT

The data are available upon request to the corresponding author.

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**How to cite this article:** Díaz-Rodríguez, A., Limeres-Posse, J., Albuquerque, R., Brailo, V., Cook, R., Fricain, J. C., Lodi, G., Monteiro, L., Silva, L., Carey, B., & Diniz-Freitas, M. (2023). Assessment of the quality of oral biopsy procedure videos shared on YouTube. *Oral Diseases*, 00, 1–13. <https://doi.org/10.1111/odi.14690>

## APPENDIX A

## A.1 | General characteristics of evaluated videos.

URL	Title	Duration (minutes, second)	Country	Upload date	Author	Sources of information	Views	Likes	Dislikes
<a href="https://www.youtube.com/watch?v=kU4Vav5VVZO">https://www.youtube.com/watch?v=kU4Vav5VVZO</a>	Excisional Soft Tissue Biopsy - with Steven T. Cutbirth, DDS	4, 05	USA	17 May 2019	Doctor	Unknown	84.397	485	22
<a href="https://www.youtube.com/watch?v=Qzas_JYdZDE">https://www.youtube.com/watch?v=Qzas_JYdZDE</a>	To Biopsy or Not? Examining Oral Lesions	7, 42	USA	13 December 2017	ADA	Unknown	23.269	105	7
<a href="https://www.youtube.com/watch?v=zB08AVntCUC">https://www.youtube.com/watch?v=zB08AVntCUC</a>	Oral Surgery   Biopsy Techniques   NBDE Part II	13, 48	USA	29 September 2019	Learning platforms	Unknown	48.024	942	11
<a href="https://www.youtube.com/watch?v=W-5hpRblyWWM">https://www.youtube.com/watch?v=W-5hpRblyWWM</a>	Biopsy of an intraoral lesion	1, 82	India	23 January 2017	Doctor	Unknown	24.363	86	6
<a href="https://www.youtube.com/watch?v=GmzOVIsgMoE">https://www.youtube.com/watch?v=GmzOVIsgMoE</a>	Incisional biopsy or wedge biopsy for tongue cancer	1, 12	India	5 September 2017	Hospital	Unknown	14.827	66	4
<a href="https://www.youtube.com/watch?v=s4T-qqWJJOQ">https://www.youtube.com/watch?v=s4T-qqWJJOQ</a>	Biopsy as aid to oral diagnosis	32, 98	USA	14 July 2009	University	Unknown	9.889	20	3
<a href="https://www.youtube.com/watch?v=khvT_loERAY">https://www.youtube.com/watch?v=khvT_loERAY</a>	Intraoral Biopsy Techniques for Pemphigus & Pemphigoid (in Collaboration w/ Western University)	4, 45	Canada	26 February 2021	Learning platforms	Unknown	3.052	87	0
<a href="https://www.youtube.com/watch?v=iQuA4zoKDbw">https://www.youtube.com/watch?v=iQuA4zoKDbw</a>	BIOPSY II ORAL PATHOLOGY AND ORAL SURGERY II imp	31, 18	USA	1 Ago 2020	Doctor	Unknown	2.154	29	0
<a href="https://www.youtube.com/watch?v=WsfC3ImrMsg">https://www.youtube.com/watch?v=WsfC3ImrMsg</a>	Soft Tissue Biopsy	2, 30	Unknown	9 May 2012	Doctor	Unknown	51.322	74	13
<a href="https://www.youtube.com/watch?v=WIKr1EMTRw">https://www.youtube.com/watch?v=WIKr1EMTRw</a>	How to take an incisional biopsy with a scalpel oral mucosa biopsy	1, 6	Unknown	17 February 2021	Doctor	Unknown	2.325	35	0
<a href="https://www.youtube.com/watch?v=vmG4jZ05euc">https://www.youtube.com/watch?v=vmG4jZ05euc</a>	Incision Biopsy for Lesion inside the Mouth - Dr. Sunil Richardson	2, 12	India	18 February 2020	Hospital	Unknown	2.978	33	0
<a href="https://www.youtube.com/watch?v=yRMQss7k4UI">https://www.youtube.com/watch?v=yRMQss7k4UI</a>	Oral Biopsy Procedure	1, 37	Unknown	11 September 2020	Doctor	Unknown	188	2	0
<a href="https://www.youtube.com/watch?v=e9kaLhNHln4">https://www.youtube.com/watch?v=e9kaLhNHln4</a>	Wedge or Incisional biopsy of the gums   oral surgical video	2, 12	India	6 February 2020	Hospital	Unknown	2.483	18	3
<a href="https://www.youtube.com/watch?v=VCLHFTxuXyM">https://www.youtube.com/watch?v=VCLHFTxuXyM</a>	Oral compound nevus: excisional biopsy	1, 75	France	12 December 2018	Doctor	Unknown	2.736	30	0
<a href="https://www.youtube.com/watch?v=nz29HmaaVwo">https://www.youtube.com/watch?v=nz29HmaaVwo</a>	Excisional biopsy of the lateral border of the tongue	4, 45	Denmark	14 Oct 2012	Doctor	Unknown	108.510	407	31
<a href="https://www.youtube.com/watch?v=JsuHt4cprNo">https://www.youtube.com/watch?v=JsuHt4cprNo</a>	BIOPSY	11, 37	India	19 Ago 2020	Doctor	Unknown	2.816	94	0



URL	Title	Duration (minutes, second)	Country	Upload date	Author	Sources of information	Views	Likes	Dislikes
<a href="https://www.youtube.com/watch?v=3npW478Y1Q">https://www.youtube.com/watch?v=3npW478Y1Q</a>	Oral Surgery – Preprosthetic & Orthognathic Surgery and Miscellaneous – Biopsy and cytology – Biopsy	9, 55	India	19 May 2020	Doctor	Unknown	1.804	41	0
<a href="https://www.youtube.com/watch?v=R8oD-e7pVNc">https://www.youtube.com/watch?v=R8oD-e7pVNc</a>	Oral biopsy in OPD	1, 77	India	14 December 2018	Doctor	Unknown	836	24	0
<a href="https://www.youtube.com/watch?v=42V4NJeX4Js">https://www.youtube.com/watch?v=42V4NJeX4Js</a>	BIOPSY II METHODS IN DEPTH II ORAL PATHOLOGY AND ORAL SURGERY II PART-2	42, 53	USA	4 Ago 2020	Doctor	Unknown	1.300	31	0
<a href="https://www.youtube.com/watch?v=bonTirKEVDU">https://www.youtube.com/watch?v=bonTirKEVDU</a>	oral pathology L1 (biopsy and dental caries)	110, 95	Iraq	8 Mar 2021	University	Unknown	2.842	59	0
<a href="https://www.youtube.com/watch?v=dV3YpcN6B1c">https://www.youtube.com/watch?v=dV3YpcN6B1c</a>	Excision Biopsy – Cancer of Oral Cavity – Dr.Paulose FRCS (ENT)	7, 45	India	13 Jun 2017	Doctor	Unknown	14.733	Ocultos	Ocultos
<a href="https://www.youtube.com/watch?v=drnjK9BOeNw">https://www.youtube.com/watch?v=drnjK9BOeNw</a>	Endoscopic Biopsy of Suspected Case of Oral Cavity Cancer Under LA – SCC	2, 28	India	14 January 2017	Doctor	Unknown	31.941	73	12
<a href="https://www.youtube.com/watch?v=z91YU6rPk">https://www.youtube.com/watch?v=z91YU6rPk</a>	Excision Tongue Biopsy – nonhealing ulcer suspected to be cancer	0, 72	India	6 September 2017	Hospital	Unknown	29.936	100	12
<a href="https://www.youtube.com/watch?v=7c4AIKqrZMk">https://www.youtube.com/watch?v=7c4AIKqrZMk</a>	Oral pathology biopsy	22, 42	Unknown	13 December 2020	Doctor	Unknown	74	4	0
<a href="https://www.youtube.com/watch?v=WTBMBxrnrKRI">https://www.youtube.com/watch?v=WTBMBxrnrKRI</a>	Biopsy	29, 50	India	21 January 2021	Doctor	Unknown	4.725	168	Desactivados
<a href="https://www.youtube.com/watch?v=6jQ2Y-umwnA">https://www.youtube.com/watch?v=6jQ2Y-umwnA</a>	Techniques or Types of Biopsy I Dental Guide I Dr. Bimal Chand I	1, 18	Nepal	20 May 2020	Doctor	Unknown	1.596	18	0
<a href="https://www.youtube.com/watch?v=CkP0Fh6u44s">https://www.youtube.com/watch?v=CkP0Fh6u44s</a>	BIOPSY	19, 97	India	23 September 2020	Learning platforms	Unknown	1.241	18	0
<a href="https://www.youtube.com/watch?v=lgbrgBjeEnQ">https://www.youtube.com/watch?v=lgbrgBjeEnQ</a>	Biopsy   Oral Pathology   BDS   796   PPT	5, 70	India	24 Apr 2020	University	Unknown	970	14	3
<a href="https://www.youtube.com/watch?v=S1ydSYzqjMc">https://www.youtube.com/watch?v=S1ydSYzqjMc</a>	Endoscopic Biopsy of Suspected Case of Oral Cavity Cancer Under LA – SCC	1, 92	India	10 July 2018	Doctor	Unknown	45.790	169	40
<a href="https://www.youtube.com/watch?v=7_vciFpYwew">https://www.youtube.com/watch?v=7_vciFpYwew</a>	Webinar18-BIOPSY an Integral component of Diagnosis- Treatment & Prognosis of Oral Precancer & Cancer	76, 02	India	December 7, 2020	Doctor	Unknown	310	12	0
<a href="https://www.youtube.com/watch?v=D1gb4hkGZA">https://www.youtube.com/watch?v=D1gb4hkGZA</a>	Punch Biopsy.....Easy way of Biopsy from Oral Cavity	3, 35	India	25 Oct 2014	Doctor	Unknown	31.998	58	13



URL	Title	Duration (minutes, second)	Country	Upload date	Author	Sources of information	Views	Likes	Dislikes
<a href="https://www.youtube.com/watch?v=Jy44i_zclLw">https://www.youtube.com/watch?v=Jy44i_zclLw</a>	Excisional Biopsy of a Tongue Lesion	13, 48	USA	7 Oct 2009	University	Unknown	42.518	95	14
<a href="https://www.youtube.com/watch?v=u8Do_902bxs">https://www.youtube.com/watch?v=u8Do_902bxs</a>	Excisional Biopsy from oral cavity	2, 57	India	1 July 2014	Doctor	Unknown	16.233	37	Desactivados
<a href="https://www.youtube.com/watch?v=k1VAw8cq39Q">https://www.youtube.com/watch?v=k1VAw8cq39Q</a>	Principles Of Differential Diagnosis & Biopsy Lecture By Dr Alishba Sajjad   #Oral Surgery	29, 97	Pakistan	8 December 2020	Doctor	Unknown	282	13	0
<a href="https://www.youtube.com/watch?v=WabGv-FkMZQ">https://www.youtube.com/watch?v=WabGv-FkMZQ</a>	Endoscopic Suspicious Oral Cavity Lesion Biopsy Under LA	1, 77	India	27 Ago 2016	Doctor	Unknown	9.143	30	8
<a href="https://www.youtube.com/watch?v=8Nx0l_fiRWk">https://www.youtube.com/watch?v=8Nx0l_fiRWk</a>	Biopsy of oral lesion	3, 50	India	7 January 2011	Doctor	Unknown	31.724	28	9
<a href="https://www.youtube.com/watch?v=2jpxHkenC-s">https://www.youtube.com/watch?v=2jpxHkenC-s</a>	Incisional Biopsy inside the mouth and seven Tooth Pulled out	6, 12	India	29 February 2020	Hospital	Unknown	71.643	312	28
<a href="https://www.youtube.com/watch?v=m1LZzrj57ds">https://www.youtube.com/watch?v=m1LZzrj57ds</a>	Excision biopsy on the lateral border of the tongue for a nonhealing ulcer—Dr Richardson	1, 97	India	28 Abr 2019	Hospital	Unknown	8.949	29	0
<a href="https://www.youtube.com/watch?v=DydraYhyV98">https://www.youtube.com/watch?v=DydraYhyV98</a>	Biopsy—Lower Arch	1, 87	Jordan	14 September 2017	Doctor	Unknown	14.101	53	8
<a href="https://www.youtube.com/watch?v=jCHwuTamfLg">https://www.youtube.com/watch?v=jCHwuTamfLg</a>	Laser Fibroma Removal (Excisional biopsy of Fibroma)—LightScalpel CO2 Laser	2, 07	USA	24 February 2015	Fabricante	Unknown	5.617	18	0
<a href="https://www.youtube.com/watch?v=BtiQGedVfj8">https://www.youtube.com/watch?v=BtiQGedVfj8</a>	"How is a Punch Biopsy done? In Oral Cavity."	2, 80	Unknown	9 Nov 2020	Doctor	Unknown	47	3	0
<a href="https://www.youtube.com/watch?v=uVIHzV3IT64">https://www.youtube.com/watch?v=uVIHzV3IT64</a>	Excisional Biopsy of a Fibroma	9, 52	USA	7 Oct 2009	University	Unknown	73.397	55	15
<a href="https://www.youtube.com/watch?v=bNYXNMQHs4Y">https://www.youtube.com/watch?v=bNYXNMQHs4Y</a>	Oral Submucosal Fibrosis Biopsy thereof	2, 15	India	19 Jun 2015	Doctor	Unknown	8.847	22	3
<a href="https://www.youtube.com/watch?v=8wimxfJ5ArQ">https://www.youtube.com/watch?v=8wimxfJ5ArQ</a>	Punch Biopsy on the Upper Lip   Basal Cell Carcinoma	2, 63	USA	9 Oct 2017	Doctor	Unknown	17.007	35	9
<a href="https://www.youtube.com/watch?v=meTl3YG0ftA">https://www.youtube.com/watch?v=meTl3YG0ftA</a>	How to take punch biopsy from buccal mucosa?	2, 43	India	10 Abr 2020	Doctor	Unknown	1.314	51	0
<a href="https://www.youtube.com/watch?v=T9gOJcoVhRU">https://www.youtube.com/watch?v=T9gOJcoVhRU</a>	Oral biopsyslides	14, 47	Unknown	6 July 2021	Doctor	Unknown	9	0	0
<a href="https://www.youtube.com/watch?v=QcJGCB083DQ">https://www.youtube.com/watch?v=QcJGCB083DQ</a>	Excisional Biopsy	0, 58	USA	21 December 2011	Learning platform	Unknown	242.547	725	40

ADA: American Dental Association.