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ARTICLE

# Evaluation of quality and educational effect of microsurgery videos on YouTube: a randomized controlled trial

Jong Yun Choi[a], Jeeyoon Kim[a] and Jongweon Shin[b]

[a]Department of Plastic and Reconstructive Surgery, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Uijeongbu-si, Republic of Korea; [b]Department of Plastic and Reconstructive Surgery, Eunpyeong St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea

**ABSTRACT**

Widespread use of smartphones and wireless internet have made YouTube an easily accessible educational modality. Many residents use YouTube to acquire knowledge regarding microsurgical techniques; however, its quality and effect has not been verified. We included 22 residents working in the Department of Plastic and Reconstructive Surgery at our institute. Using block randomization, seven were allocated to a textbook group (TG), eight to a free-searching group (FSG), and seven to a designated-video group (DVG). After reviewing textbooks, YouTube videos, or designated videos, respectively, each group performed microsurgical anastomosis using artificial vessels. The total procedure time, Objective Structured Assessment of Technical Skills (OSATS), operative errors, and degree of leakage were assessed by blinded evaluators. Self-confidence rates were also compared. The YouTube groups (FSG and DVG) performed better than the TG. Although procedure time was significantly longer in the DVG ($p = .006$), the performance of DVG was better than that of TG in all assessments (OSATS: $p = .012$; operative errors: $p = .002$; leakage: $p = .010$). FSG showed more operative errors ($p = .004$) and leakage ($p = .007$) compared to DVG, but had higher OSATS ($p = .008$) and fewer operative errors ($p = .002$) than TG. The post-intervention confidence rates were significantly higher in FSG and DVG compared to TG ($p = .002$ and $p = .001$, respectively). Although there are concerns regarding the reliability of YouTube videos, microsurgery videos on YouTube had positive effects on microsurgery practice. Therefore, YouTube may help to improve the microsurgical skills of residents. If a quality control system is introduced for YouTube videos, their educational effects may be enhanced.

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## Introduction

Microsurgery is one of the most important skills in the field of reconstruction. However, there is a steep learning curve in acquiring microsurgery skills; therefore, a structured and efficient curriculum is essential [1]. The basic model of microsurgery education is apprenticeship. Hands-on training, on real patients, under direct supervision of senior surgeons may be the best method to learn. However, unstructured training, reduced working hours, and ethical issues are obstacles for such a training model [2,3]. An alternative to these programs may be professional microsurgery training courses, but these courses are expensive, and learners must take time off from work and travel to the course location [4–6].

At the present time, the Internet has become an integral part of everyday life. People can use smartphones to access a wide range of information easily, at any time and in any location. YouTube, an online video-sharing platform, is one of the most popular social-media websites in the world [7]. Countless types of content are created and shared on YouTube every minute, including medical information. Unfortunately, YouTube is biased toward consumer-generated content and, therefore, has great potential to provide inaccurate and biased information. Many studies have been conducted to assess the quality of online medical information for different diseases, but these studies demonstrated poor reliability [8–14]. Nevertheless, YouTube has become a powerful educational tool that a large number of medical personnel use it to prepare for surgery [15,16].

Advancements in Internet technology and widespread use of smart devices are also transforming the traditional microsurgery education environment. Web-based e-learning systems, online community activities using social media platforms, and interactive digital education resources are good examples of new education formats [4,17–21]. YouTube is a tool that many microsurgeons already use for learning [18]. The authors found that residents trained at our institution often use YouTube to prepare for microsurgery. However, to date, no study has evaluated the effectiveness of YouTube videos for learning microsurgical procedures. Therefore, the purpose of this study was to investigate the quality of microsurgery YouTube videos that residents actually watch and to determine the practical effect of these videos on their skill improvement.

## Materials and methods

This study included 22 residents of the Department of Plastic and Reconstructive Surgery at The Catholic University of Korea. Participation in this study was voluntary, and no rewards were given. This study was exempt from institutional review board

CONTACT Jongweon Shin psjwshin@gmail.com Department of Plastic and Reconstructive Surgery, Eunpyeong St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Tongil-ro 1021, Eunpyeong-gu, Seoul 03312, Republic of Korea

assessment and informed consent was obtained. Participants with experience as the primary operator in microsurgery were excluded. To reduce the gap between grades, a block randomization method was used to partition the residents, in which each grade was assigned to a single block, then participants withdrew notes from a blind container and assigned to each group.

All participants were informed that microsurgical anastomosis would be practiced. Before the microsurgery, 30 min were allocated to all group members. During this time, residents in the Textbook Group (TG) were requested to review a textbook (chapter 24: principles and techniques of microvascular surgery; volume 1; 4th edition of the *Plastic Surgery)* [22]. Residents in the Free-Searching Group (FSG) were requested to use their personal computers or smartphones to search for YouTube videos. Residents in the Designated-Video Group (DVG) were requested to review pre-designated YouTube videos, which included an explanation of the basic microsurgery procedures and techniques suitable for beginners, with clear content delivery using subtitles or tables. Similarity with the training model of this study was also considered. The videos were searched and selected using pre-experimental discussion between two microsurgery professionals (J.Y.C. and J.S.).

The analysis of the viewed videos was conducted by referring to previous studies [13]. Information about each video's title, length, upload date, number of views, and likes/dislikes was collected. Uploaders were categorized according to their sources: professional educational institutions, medical information channels, independent experts with clear affiliations, independent users with unclear affiliations, and medical advertising/profit companies. Video quality was assessed using two methods: the modified DISCERN tool and the Global Quality Score (GQS). The DISCERN score was originally developed for patients and information providers to judge the quality of written information in making treatment choices [23]. In this study, the modified DISCERN score, which was created by selecting and modifying only the items suitable for YouTube video evaluation, was used [11–13]. The modified version consists of five questions, and each question carries a score of one. A score of five on this tool signifies reliability, whereas a score of 0 signifies unreliability (Table 1). The second evaluation method, GQS, is a method of evaluating how much the video is helpful to residents in general [13,24]. GQS uses a five-point scale to evaluate the overall video quality (Table 2). These two methods were applied by two senior microsurgeons independently (J.Y.C. and J.S.), and discrepancies were resolved by discussion with the third microsurgeon (J.K.). YouTube was searched for videos on November 19, 2020.

Microsurgery was practiced by all groups using an artificial silicone tube (artificial vessel; SINI Inc., Gyeonggi-do, Republic of Korea) with an inner diameter of 2 mm. A 9-0 nylon suture (Ethilon; Ethicon, Somerville, NJ, USA) and a surgical microscope (Zeiss OPMI Pentero; Carl Zeiss Meditec Inc., Oberkochen, Germany) were used for the anastomosis. To mimic real microsurgery, we used an intermittent saline flow through the tube during the procedure. A 24 G angioneedle was connected to the tube, and normal saline was injected at a pressure of 90 mmHg (the average pressure of the digital artery of a patient with normal blood pressure) [25].

All microsurgical interventions were videotaped. Results were evaluated in the following five tools: (1) Procedure time, (2) modified Objective Structured Assessment of Technical Skills (OSATS), (3) Operative checklist, (4) Leakage, and (5) Self-confidence rates. The procedure time was recorded by measuring the time from the start to the completion of the anastomosis. Surgical performance was evaluated using modified OSATS [2]. It consists of a total of six evaluation items: respect for tissue, time and motion, instrument handling, knowledge of instruments, flow of operation, and knowledge of specific procedure, excluding 'use of assistant' in the original version (Table 3). Each category is rated 1–5, with the highest score being 30. Operative checklist was evaluated and grouped into six categories: positioning, instrument use, tissue damage, knot-tying, checking the anastomosis after the procedure, and operating room efficiency (Table 4). It was originally designed for the evaluation of carpal tunnel release surgery, and was later modified for microsurgery using a microsurgery textbook by the authors [6,22]. OSATS and operative errors were independently assessed by two blinded microsurgery specialists (J.Y.C. and J.S.). All discrepancies were resolved by discussion with a third specialist (J.K.). The accuracy of the anastomosis was measured by the degree of leakage. On average, when normal saline was injected at 90 mmHg for 1 min, 35 ml of fluid passed through the artificial vessel. At the end of all procedures, the amount of leakage was calculated by measuring the saline collected on the other side. Finally, self-confidence rates before and after the review of textbooks or videos were assessed subjectively using a visual analog scale (range 0–10, 0 = worst, 10 = best).

The data were analyzed using SPSS Statistics software (version 24.0 for Windows; IBM Corp., Armonk, NY, USA). Concordance between the two reviewers was assessed using the intraclass correlation coefficient (ICC) and 95% confidence intervals (CIs) based on a two-way mixed model with mean rating (k) = 2 and absolute agreement. Continuous variables were analyzed using the Kruskal-Wallis H test. For variables with statistical difference in the Kruskal-Wallis H test, the groups were compared using the Mann-Whitney U test with Bonferroni correction. Proportions were analyzed using linear-by-linear association. All tests were two-tailed, and $p$-values $< .05$ were considered statistically significant.

Table 1. Modified DISCERN tool for assessment of the reliability of videos.

| Reliability of information (1 point for every Yes, 0 points for No) |
|---|
| 1. Are the aims clear and achieved? |
| 2. Are reliable sources of information used? |
| 3. Is the information presented balanced and unbiased? |
| 4. Are additional sources of information listed for resident reference? |
| 5. Are faults or cautions mentioned? |

Table 2. Global Quality Scale (GQS) criteria used to evaluate microsurgical videos.

| GQC | Description |
|---|---|
| 1 | Poor quality, poor flow of the video, most information missing, not at all useful for residents |
| 2 | Generally poor quality and poor flow, some information listed but many important topics missing, of very limited use to residents |
| 3 | Moderate quality, suboptimal flow, some important information is adequately discussed but others poorly discussed, somewhat useful for residents |
| 4 | Good quality and generally good flow. Most of the relevant information is listed, but some topics not covered, useful for residents |
| 5 | Excellent quality and flow, very useful for residents |

Table 3. Objective Structured Assessment of Technical Skills (OSATS).

| | Score description | | | | |
|---|---|---|---|---|---|
| Parameter | 1 | 2 | 3 | 4 | 5 |
| Respect for tissue | Frequently used unnecessary force on tissue or caused damage by inappropriate use of instruments | | Careful handling of tissue but occasionally causes inadvertent damage | | Consistently handled tissues appropriately with minimal damage |
| Time and motion | Many unnecessary moves | | Efficient time/motion but some unnecessary moves | | Economy of movement and maximum efficiency |
| Instrument handling | Repeatedly makes tentatively or awkward movements with instruments | | Competent use of instruments although occasionally appeared stiff and awkward | | Fluid moves with instruments and no awkwardness |
| Knowledge of instruments | Frequently used inappropriate instruments | | Knew the name of most instruments and used appropriate one for the task | | Obviously familiar with instruments required and knew their names |
| Flow of operation | Frequently stopped operating or needed to discuss next move | | Demonstrated ability for forward planning with steady progression of operative procedure | | Obviously planned course of operation with effortless flow from one move to the next |
| Knowledge of specific procedure | Deficient knowledge. Needed specific instruction at most operative steps | | Knew all important aspects of the operation | | Demonstrated familiarity with all aspects of the operation |

Table 4. Operative errors checklist.

(1) Positioning
(2) Instrument use
(3) Tissue damage
(4) Knot-tying
(5) Checking procedure after anastomosis
(6) Operating room efficiency

Table 5. Demographics of participants.

| | Textbook group | Free-searching group | Designated-video group | $p$ value |
|---|---|---|---|---|
| Number of residents | 7 | 8 | 7 | – |
| Mean age (years) | 28.7 (26–31) | 28.4 (25–32) | 28.1 (26–31) | .890** |
| Male to female ratio (M:F) | 4:3 | 3:5 | 3:4 | .600*** |
| Post-graduate year | | | | .467*** |
| 1 | 1 | 2 | 2 | |
| 2 | 2 | 2 | 2 | |
| 3 | 2 | 2 | 2 | |
| 4 | 2 | 2 | 1 | |
| Pre-confidence rate (0–10)* | 2.71 ± 1.11 | 3.00 ± 0.76 | 3.14 ± 1.35 | .765** |

*Mean ± standard deviation. **$p$ value obtained from Kruskall Wallis test. ***$p$ value obtained from linear-by-linear association test.

## Results

Table 5 summarizes the demographics of the 22 study participants. Seven participants were assigned to TG, eight to FSG, and seven to DVG. There were no significant differences between the groups in terms of mean age, sex, grades, and pre-intervention confidence.

The seven residents in TG reviewed a relevant chapter in the textbook. The eight residents in FSG searched for videos on YouTube. The most frequently used keywords were combinations of 'anastomosis' or 'microanastomosis' with 'vessel', 'vascular', and 'microvascular' (seven residents), 'arteriorrhaphy' and 'end-to-end' (six residents), 'artery' and 'arterial' (five residents), 'digital', 'finger', and 'hand' (four residents), or 'microsurgery' and 'microsurgical' (three residents). Other keywords included 'replantation', 'training', 'beginner', and 'basic'. All residents used the default YouTube setting of displaying the results by 'relevance' to the search term. Following exclusion of videos viewed for less than 30 s, nine videos were included in this analysis. All videos were displayed among the first ten search results or the first page of related videos. Three videos were provided by professional educational institutions, two by medical information channels, four by independent experts with clear affiliations, and one by an independent user with unclear affiliation. There was excellent correlation between the two reviewers (ICC = 0.928; 95% CI = 0.682–0.984 for modified DISCERN; ICC = 0.933; 95% CI = 0.562–0.986 for GQS). Table 6 summarizes the information and ratings of the videos.

The seven residents in the DVG watched the three designated videos. All videos were provided by professional educational institutions. The total duration of these videos was 26.6 min. The modified DISCERN scores were 5, 3, and 4 and the GQS were 5, 4, and 4, for the three videos respectively (Table 7). Because there were only three DVG videos, we did not compare them statistically with the FSG videos. However, compared to the FSG videos, DVG videos showed a higher trend in the modified DISCERN score (2.67 ± 1.58 and 4.00 ± 1.00, respectively) and GQS (2.78 ± 1.30 vs 4.33 ± 0.58, respectively). Table 7 summarizes the information of the designated videos.

All microsurgical procedures were completed as per instructions. The mean procedure durations were 10.04 ± 0.75 min for TG, 10.89 ± 1.44 min for FSG, and 12.35 ± 1.59 min for DVG, with statistically significant differences among the groups ($p$ = .023). There were no significant differences between TG and FSG ($p$ = .247) or FSG and DVG ($p$ = .118). However, there was a significant difference between TG and DVG ($p$ = .006). There was excellent correlation between the two experts for the OSATS assessment (ICC = 0.952; 95% CI = 0.813–0.983). There were statistically significant differences in OSATS among the groups (16.86 ± 3.24 for TG; 23.00 ± 3.59 for FSG; 22.43 ± 3.74 for DVG; $p$ = .011). The Mann-Whitney U test demonstrated significant differences between TG and FSG ($p$ = .008) as well as TG and DVG ($p$ = .012), but not FSG and DVG ($p$ = .727). There was good correlation between the examiners for operative errors (ICC = 0.861; 95% CI = 0.667–0.942). Unlike OSATS, significant differences were observed between all groups: TG and FSG ($p$ = .002), TG and DVG ($p$ = .002), and FSG and DVG ($p$ = .004). The leakage test demonstrated statistically significant differences between the groups (12.86 ± 5.37 ml for TG; 10.88 ± 2.90 ml for FSG, and 5.29 ± 3.15 ml for DVG; $p$ = .009). For the leakage test, there were no significant differences between TG and FSG ($p$ = .521), but there were significant differences between TG and DVG ($p$ = .010) as well as FSG and DVG ($p$ = .007). Post-intervention confidence rates were significantly higher in FSG and DVG compared to TG ($p$ = .002 and $p$ = .001, respectively), but there was no difference between FSG and DVG ($p$ = .111) (Table 8 and Figure 1).

Table 6. The information of the watched videos of the Free-Searching Group (FSG).

| Internet address | Length (mins) | Number of views | Publishing source | Number of residents ($n = 8$) | Modified DISCERN score (0–5) | Global quality scale (1–5) |
|---|---|---|---|---|---|---|
| youtube.com/watch?v=sEky_awLq_g&feature=youtu.be | 7.52 | 46111 | MI (AboutMicrosurgery) | 8 | 4 | 4 |
| youtube.com/watch?v=U2gAnr4Pp24&has_verified=1 | 6.32 | 93687 | PEI (Summer School of Experimental Surgery Pilsen) | 6 | 3 | 2 |
| youtube.com/watch?v=UjyXJ0Wav5Q&has_verified=1 | 9.18 | 2148 | IU (Yui Haruto) | 5 | 2 | 2 |
| youtube.com/watch?v=UYV04yvXZfU | 10.02 | 14728 | MI (Microtraining World) | 5 | 4 | 4 |
| youtube.com/watch?v=BXFacB2V3W4 | 18.62 | 32547 | IE (Igor Poccia) | 4 | 3 | 2 |
| youtube.com/watch?v=V1lEtoAoWLM | 9.45 | 870 | PEI (Samsung Medical Center) | 4 | 5 | 5 |
| youtube.com/watch?v=JAEoZehzOTM&has_verified=1 | 2.40 | 498 | IE (Dr. Laurent Ganry) | 3 | 2 | 3 |
| youtube.com/watch?v=snqStFqxGvY&t=1s | 42.03 | 4098 | IE (Dr. Murali Chand Nallamothu) | 2 | 1 | 2 |
| youtube.com/watch?v=JCYXyon8mB8&has_verified=1 | 5.37 | 9107 | IE (Shailesh Nisal) | 1 | 0 | 1 |

PEI: professional educational institution; MI: medical information channel; IE: independent experts with clear affiliation; IU: independent users with unclear affiliation; MA/P: medical advertisements/profit companies.

Table 7. The information of the provided videos for the Designated-Video Group (DVG).

| Internet address | Length (mins) | Publishing source | Modified DISCERN score | Global quality scale |
|---|---|---|---|---|
| youtube.com/watch?v=V1lEtoAoWLM | 9.45 | Samsung medical center | 5 | 5 |
| youtube.com/watch?v=rEZGwbdpGuw | 4.97 | University of Wisconsin Department of Surgery | 3 | 4 |
| youtube.com/watch?v=qatjFv7Wt3M | 12.18 | Colombia Orthopedics | 4 | 4 |

Table 8. Summary of the results.

| | Textbook group | Free-searching group | Designated-video group | $p$ value | ICC$^{§}$ |
|---|---|---|---|---|---|
| Procedure time (minutes) | 10.04 ± 0.75 | 10.89 ± 1.44 | 12.35 ± 1.59** | .023* | – |
| OSATS (range 6–30) | 16.86 ± 3.24 | 23.00 ± 3.59** | 22.43 ± 3.74** | .011* | 0.952 |
| Operative errors (range 0–6) | 3.43 ± 0.79 | 1.88 ± 0.35** | 0.57 ± 0.79**,*** | .000* | 0.861 |
| Leakage (mL) | 12.86 ± 5.37 | 10.88 ± 2.90 | 5.29 ± 3.15**,*** | .009* | – |
| Post-confidence rate (range 0–10) | 3.86 ± 1.21 | 7.25 ± 1.65** | 8.29 ± 0.95** | .001* | – |

All values are expressed as mean ± standard deviation.
ICC: Intraclass Correlation Coefficient; OSATS: Objective Structured Assessment of Technical Skills.
*Statistically significant in Kruskall Wallis test. **Significant compared to textbook group in Mann Whitney *U*-test. ***Significant compared to free-searching group in Mann Whitney U-test.
§ICC values are associated with the following 95% CIs: OSATS, 0.800–0.978; operative errors, 0.607–0.931.

## Discussion

YouTube has become a powerful educational tool because of its free or affordable services and ease of access, at all times and locations, using an Internet network and smart device. Several studies have observed that YouTube is widely used in preparation to perform medical procedures [15,16,26–28]. Some high-quality videos have good educational potential, but data from the field of microsurgery are not available. This study was designed to identify the effects of YouTube videos on microsurgical techniques after a 30-min search and view by inexperienced residents.

As expected, residents who watched microsurgical videos on YouTube had better overall results than those who studied the textbooks. Both FSG and DVG residents performed statistically better than TG on OSATS and operative errors assessment (Table 8 and Figure 1). This is because video-based learning is more effective than text-only resources [3,6,15,16,29–32]. By stimulating the visual and auditory centers of the learners, videos improve the understanding of complex spatiotemporal events [32,33]. The use of videos for training also has multiple advantages. First, multimedia resources deliver the same amount of content to learners faster than text-based resources [33]. FSG and DVG residents reviewed microsurgical procedures more efficiently than TG residents, within the limited time of 30 min. Second, surgical videos increase learner confidence [3,6,30,31]. This can improve the residents' self-image and mental models. In this study, we observed a significant increase in the confidence in FSG and DVG residents (Table 8). Finally, learners can reinforce their acquisition of surgical skills by pausing and replaying parts of the procedure videos or controlling the playing speed. Therefore, residents in the FSG and DVG groups performed the procedure with better preparation and more confidence than TG residents, and as a result, FSG and DVG residents performed microsurgical procedures more efficiently than the TG residents.

In the procedure time, however, the video groups did not show an improved result, but rather increased in the DVG group. Surgical skills are typically acquired through three basic steps: perception, integration, and automatization [5]. Improvements in speed and accuracy are achieved through automatization that requires repeated practice using simulation or clinical exposure [29,34]. Because the FSG and DVG residents watched the videos for only 30 min, they did not show improvement in the procedure time.

It is important to consider that YouTube was designed to host user-generated content and does not have a verification system for the contents of videos. Many studies have observed variable credibility of the medical information on YouTube [7–14]. The use of YouTube as an educational tool also may lead to the spread of inaccurate or biased content [26–28,32,35]. In this study, however,

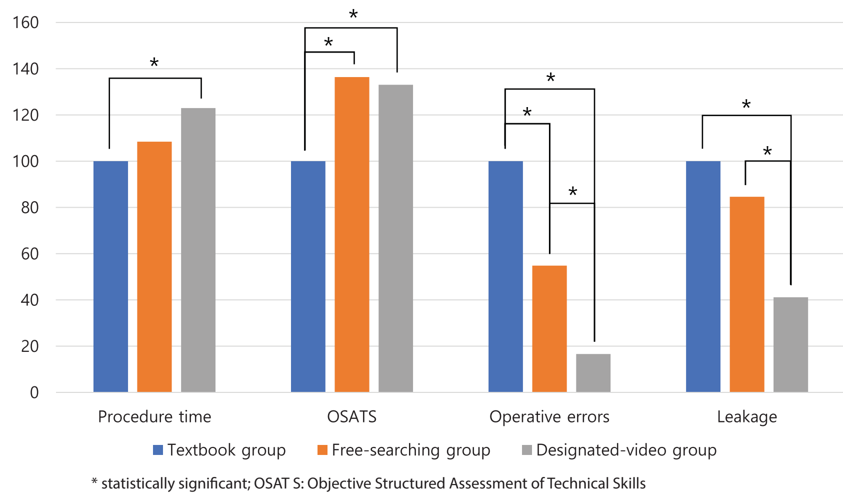


**Figure 1.** Summary of the results. The data for each category are shown on the assumption that the value of the textbook group was 100.

it is noteworthy that both the FSG and DVG residents had better results than the TG residents. Although FSG videos scored slightly lower in DISCERN and GQC compared to DVG videos, watching YouTube videos was more effective than reviewing textbooks. This may be due to several reasons. First, FSG residents unexpectedly selected videos within a relatively limited range. Microsurgery is only a small part of the myriad of content on YouTube and, therefore, there are a limited number of videos related to microsurgery on YouTube. Although it is not easy to predict which YouTube videos will appear higher on the search list because of the complexity of the YouTube ranking system (based on view count, upload date, rating, comments, bookmarks, age of user, etc.), all residents in this study chose videos from within the first ten search results using the default YouTube settings (results sorted by relevance to the search term). This is similar to results of previous studies, which showed that videos were selected from within the first 50 results in more than 90% of searches [11,13,32]. Second, videos related to microsurgery are of higher quality than videos related to general content because people uploading these videos are more likely to be field experts. Most of the videos watched by the FSG residents were uploaded by educational organizations or professionals (Table 6). In general, videos uploaded by universities or reputable organizations are of better quality than those uploaded by individuals [7,10,13,15,26–28,32,35]. Third, the residents already had considerable knowledge about microsurgery. Our institute has various microsurgery educational programs, such as weekly microsurgical journal reviews, written examinations three times a year, and an annual cadaver dissection program. The residents are also trained using an apprenticeship model. Therefore, residents had the ability to select more qualified videos, and they were able to more efficiently accept the content they wanted to convey from the video than the general public. As a result, the effectiveness of YouTube videos in our study differed from that of other studies that targeted non-medical practitioners [7–14] or less specialized procedures [26–28,35].

It should be noted that there were also differences between FSG and DVG. The operative errors and degree of leakage were significantly lower for DVG residents than FSG residents. This difference is probably because the DVG videos were more suitable for beginners and used schematics to describe the process of microsurgery. These videos used easier and more comprehensible language, with appropriate subtitles and well-organized tables. In general, residents place more value on illustrations and well-described narration than specialists [15]. In addition, beginners often have difficulty identifying appropriate and accurate educational resources because of their lack of experience [31]. Therefore, if YouTube videos are reviewed by professionals to rank them according to their quality and this ranking is used to sort the search results, the quality of videos being watched will be higher and the educational potential of YouTube will be enhanced [7,12,15,26–28,30,35].

There were some limitations to our study. First, our study results do not reflect the current YouTube videos related to microsurgery. Search results show videos available at that point in time; YouTube is ever-evolving, with new videos being uploaded and rated constantly. However, the videos in our study were uploaded an average of 46 months before analysis. This reflects the slow addition of microsurgery videos on YouTube, which would reduce bias. Second, we included only a limited number of microsurgery videos uploaded to YouTube in our evaluation. This was because our aim was not to evaluate all YouTube videos related to microsurgery, but rather to investigate the impact of YouTube videos on the skills of participants. Therefore, the quality was evaluated only for videos that were searched and watched by the residents. Third, the individual characteristics of each resident were not included in this study. For a more accurate assessment, the level of competency of each participant prior to the intervention should have been evaluated. In this study, a block randomization method was used to ensure that an equal number of residents with each grade were assigned to each group to reduce the difference between grades, because junior residents are influenced more positively by videos and simulation than senior residents [6,19,29]. We also did not evaluate the personal aptitude of residents. Psychometric characteristics may affect the learning of microsurgical techniques [2]. Therefore, future studies based on more participants should be conducted to identify differences in the results based on grades and individual variables. Finally, English was not the first language for the study participants. Although the residents can read English, many may not be able to understand all of the words spoken in English in YouTube videos. We did not objectively measure the English listening skills of residents.

This study evaluated the reliability and quality of YouTube microsurgery videos, which are frequently viewed by the residents, and examined the effects of these videos on their practice.

The best method to evaluate the educational effects of YouTube videos would be to compare the learning from YouTube videos with traditional face-to-face education in residents with little or no experience in microsurgery. In the current coronavirus disease 2019 pandemic, there is an increasing need for online education. A comprehensive analysis of microsurgery videos available on YouTube and their comparison with other educational methods for learning microsurgery will be an interesting topic for future research.

## Conclusions

Microsurgical procedures are essential skills for reconstructive surgeons, but these skills are difficult to master. Errors are an inevitable part of the trainee's learning curve. Various educational programs, such as specialized microsurgery training courses, have been developed to overcome the shortcomings of the existing apprenticeship models. However, these courses have certain limitations. YouTube is a powerful educational modality because of the low cost and no limitations of time or place with regard to accessing the videos. There have been concerns regarding the reliability of YouTube videos. However, in the field of microsurgery, YouTube has played a positive role in improving microsurgery skills. If YouTube introduces a peer-review or quality control system, the usefulness of YouTube videos for educational activities will be enhanced. In addition, we believe that inexperienced surgeons may benefit significantly from YouTube videos during emergency situations, such as flap survival or amputation, in which time for preparation is limited.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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