





ORIGINAL RESEARCH

Educational utility of an online video-based teaching tool for sinus and skull base surgery

Timothy Fan BS¹  | Alan D. Workman MD, MTR^{2,3}  | George Koch DMD² |
Vinay K. Rathi MD, MBA^{2,3}  | George A. Scangas MD^{2,3}  | Ralph Metson MD^{2,3}

¹Texas A&M College of Medicine, Bryan, Texas, USA

²Department of Otolaryngology-Head and Neck Surgery, Massachusetts Eye and Ear, Boston, Massachusetts, USA

³Harvard Medical School, Boston, Massachusetts, USA

Correspondence

Ralph Metson, Massachusetts Eye and Ear, Zero Emerson Place, Boston, MA 02114, USA.
Email: ralph_metson@meei.harvard.edu

Abstract

Objective: Surgical education has undergone major changes in recent years, as hands-on learning opportunities have been replaced or supplemented with online tools. The goal of this project is to examine the educational impact of a surgical training website, SinusVideos.com, on otolaryngologists at various levels of training.

Methods: Visitors to the website were asked to complete a survey after viewing a narrated video of a surgical procedure. Surveys were analyzed for demographics, needs assessment, and educational impact.

Results: A total of 105 completed surveys were completed by 68 (64.8%) attendings/practicing physicians, 32 residents/fellows (30.5%), and 5 medical students (4.8%). Whereas 14.3% of viewers reported online videos as their primary source for surgical preparation, 70.5% considered them important secondary supplements. After viewing a video, 92.4% of respondents reported a gained confidence in performing the surgery, and 62.9% said the video altered how they would perform the surgery in the future. Viewers' ratings of their knowledge (on a 1-7 Likert scale) of a particular surgical procedure before vs after watching the observed procedure increased significantly for participants at all levels of training—medical students (2.8 before vs 5.4 after, $P < .01$), residents/fellows (4.8 before vs 5.8 after, $P < .0001$), and attendings/practicing physicians (5.6 before vs 6.4 after, $P < .0001$).

Conclusion: High quality online surgical videos appear to be an effective learning tool for surgical trainees and practicing physicians alike. The educational benefit of such tools, as well as their widespread accessibility, makes them a powerful instrument for the training of surgeons worldwide.

Level of Evidence: Level 5.

KEYWORDS

online learning, otolaryngology education, surgical training, surgical video, video-based learning

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1 | INTRODUCTION

Approaches to procedural education for surgical trainees have undergone major changes in recent years, due to shifts in institutional priorities and technological advancements.¹⁻³ Reduced learning opportunities and decreased case numbers have created an educational gap affecting all surgical specialties, including otolaryngology.⁴ Online and video-based surgical education tools have helped bridge this gap by providing enhanced access to surgical training and continuing education opportunities. Online videos offer unprecedented accessibility to learn at each user's unique pace with choice of content and learning style.⁵ The ability to continually update videos as new evidences emerges offers online video library users exposure to the most current surgical techniques.⁵ The benefits of delivering educational content via online videos were magnified during the COVID-19 pandemic, when in-person learning was diminished or halted across the nation for medical trainees at all levels. Free online video sharing sites are particularly important for surgical trainees in developing countries, where access to educational resources is limited, and training quality differs starkly between urban and rural programs.^{6,7}

While surgical videos can be found from numerous online sources, many websites have no quality checks, and both accuracy and suitability vary substantially.⁸ The need for high-quality, peer-reviewed otolaryngology educational videos prompted the launch of SinusVideos.com, which has traffic of several thousand visitors per month, over 40% of whom are from outside the United States.⁷ This strictly educational website contains over 150 edited, narrated videos ranging from basic to advanced sinus surgery techniques. In recent years, the content has expanded to include skull base procedures, as well as endoscopic ear and Eustachian tube surgeries. The purpose of the current study was to query SinusVideos.com viewers at various levels of surgical training to assess their needs and utilization of the educational content, as well as its impact on their clinical practice.

2 | MATERIALS AND METHODS

2.1 | Website

SinusVideos.com is an otolaryngology online educational tool that hosts videos of live sinus surgeries recorded in the operating room. These videos are edited and narrated by a trained surgeon, and classified according to anatomic region or surgical technique. A total of 154 videos have been uploaded to the site as of October first, 2020. Topics range from basic endoscopic sinus surgery techniques to advanced skull base procedures. Since SinusVideos.com was launched by the senior author (R.M.) and his fellows in 2009, it has received over one million pageviews, with United States (47.4%) having the highest viewer population, followed by India (7.2%), United Kingdom (2.9%), Turkey (2.4%), and Canada (2.2%).⁷ The website is strictly educational and receives no outside funding or commercial support. No income is generated from use of the website, and the authors do not receive any financial resources from its operation. Due to the

anonymous nature of the present study, it was exempted from review by the Mass General Brigham Institutional Review Board.

2.2 | Survey

From October 1st, 2018 through July 1st, 2020, viewers to the website were notified prior to watching videos that there would be an optional survey at the end of the video. The survey asked viewers to identify their gender, education level, age and practice background. Viewers were also asked to identify how they were referred to SinusVideos.com and whether they were utilizing the videos for personal or professional education. Viewers additionally completed Likert scale responses (1-7) regarding their knowledge of the procedure specific to the video that they were watching, both before and after viewing the video. Survey responses were collected using Formidable Forms Pro version 4.04 (Strategy11, Riverton, Utah).

2.3 | Statistical analysis

Stata version 13 (StataCorp, College Station, Texas) software was used for statistical analysis to assess differences between pre- and post-viewing scores, and nonparametric statistics were utilized (Wilcoxon matched-pairs ranked sign test). Graph Pad Prism Version 8 (GraphPad Software, La Jolla, California) was used for visualization of data.

3 | RESULTS

A total of 105 surveys were submitted by website viewers whose demographics are shown in Table 1. Most respondents (64.8%) identified themselves as attendings or practicing physicians, while 30.5% were residents or fellows, and 4.8% were medical students. The majority of viewers was 25-44 years of age (56.2%), practiced general otolaryngology (59%), and was affiliated with an academic institution (54.3%).

A high proportion of individuals found the website through personal recommendation (47.6%), whereas others located it through search engines (37.1%), or the YouTube channel (11.4%). Fifteen participants (14.3%) considered online videos their primary source for preparation for surgical procedures, whereas 74 (70.5%) considered them important secondary supplements for their surgical education.

Preparation to perform a specific surgery was the most common reason given for visiting SinusVideos.com (55.2%). Whereas, 71.4% said that they had previously performed the procedure being viewed, 28.6% had never done so. In addition, 43.8% said they planned to be performing the procedure within the next week.

When viewers were asked to rate their pre-viewing knowledge of a particular surgery based on Likert 1-7 scale, attendings/practicing physicians self-ranked with the highest mean score (5.6 ± 1.3), followed by residents/fellows (4.8 ± 1.6), and medical students (2.8

TABLE 1 Viewer demographics for SinusVideos.com

	Number (total = 105)	Percentage (%)
Gender		
Male	80	76.2
Female	25	23.8
Age		
18-24	4	3.8
25-34	32	30.5
35-44	27	25.7
45-54	22	20.9
55-64	13	12.4
65+	7	6.7
Level of training		
Medical student	5	4.8
Resident/Fellow	32	30.5
Attending/Practicing physician	68	64.8
Specialty		
Otolaryngology—General	62	59
Otolaryngology—Rhinology	21	20
Otolaryngology—Other subspecialty	6	5.7
Other specialty	5	4.8
Trainee	11	10.5
Affiliation		
Academic institution	57	54.3
Private practice	42	40
Federal	1	0.9
Industry	5	4.8
How did you find SinusVideos.com?		
Recommended by a colleague/friend	50	47.6
Google	29	27.6
Other search engine	10	9.5
YouTube channel	12	11.4
Advertisement	4	3.8
How often do you use online videos to prepare for procedures?		
Rarely	16	15.2
Supplement in conjunction with other resources	74	70.5
Primary source	15	14.3
Primary reason for visiting SinusVideos.com?		
General interest	32	30.5
Preparing to perform a surgery	69	65.7
Others	4	3.8
Have you previously performed this procedure?		
Yes	75	71.4
No	30	28.6
Will you perform this procedure within the next year?		
Yes, within the next week	46	43.8

(Continues)

TABLE 1 (Continued)

	Number (total = 105)	Percentage (%)
Yes, within the next month	31	29.5
Yes, within the next year	21	20
No	7	6.7

± 1.6), as shown in Table 2. Comparison of pre- and post-viewing scores, demonstrated a significant improvement in knowledge after viewing the videos for all groups. The magnitude in knowledge gained, however, was greatest for medical students at $2.6 (2.8 \pm 1.6$ before vs 5.4 ± 1.5 after, $P < .01$), followed by residents/fellows at $1.0 (4.8 \pm 1.6$ before vs 5.8 ± 1.2 after, $P < .0001$), and then attendings/practicing physicians at $0.8 (5.6 \pm 1.3$ before vs 6.4 ± 0.8 after, $P < .0001$), as shown in Figure 1.

In addition to a gain in knowledge, the large majority of respondents (92.4%) reported that they also gained confidence in performing the viewed procedure after visiting SinusVideos.com (Table 3). Furthermore, 62.9% of viewers said watching the videos changed how they would perform the procedure in the future. The average ratings of SinusVideos.com's video quality, assessment of expectations for content, and how the website performs in comparison to other similar surgical resources are shown in Table 4.

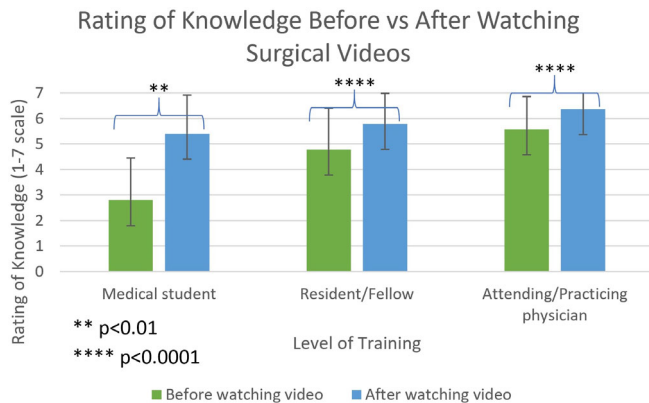
4 | DISCUSSION

Learning theory states that adult education is often self-motivated, relevancy oriented, and practicality-driven.⁹ These criteria appear to closely align with the goals of a surgical training website and its viewership. In contrast to the more traditional print materials available for surgical training, video format offers the viewer the complex movements and subtle cues of the operative field within the realities of live surgery.² With modern access to the internet, surgical videos can be accessed worldwide to match the user's needs and pace, while ensuring up-to-date content.⁵

A unique benefit of educational online resources has become evident with the COVID-19 pandemic. As cases rapidly grew in the United States, clinical participation for medical students across the nation was suspended indefinitely, per recommendations by the American Association of Medical Colleges (AAMC).¹⁰ At the resident and fellow level, cancellation of elective surgeries to preserve medical resources, and restricting essential surgeries to essential personnel significantly decreased trainee case volumes.¹¹ Facing this unprecedented challenge, medical institutions turned to online learning for solutions in fulfilling educational requirements. Online videos offer trainees safe and productive experiences during a hiatus in their didactic and clinical routines. The COVID-19 pandemic accelerated development and increased awareness of online resources that will benefit current and future students alike.

TABLE 2 Rating of knowledge before vs after watching surgical videos

Level of training	Average rating of knowledge of the procedure before watching the video (from 1 to 7)	Average rating of knowledge of the procedure after watching the video (from 1 to 7)	P-value	Average difference	Percentage difference (%)
Medical student	2.8 ± 1.6	5.4 ± 1.5	<.01	2.6	92.9
Resident/Fellow	4.8 ± 1.6	5.8 ± 1.2	<.0001	1	20.8
Attending/Practicing physician	5.6 ± 1.3	6.4 ± 0.8	<.0001	0.8	14.2

**FIGURE 1** Rating of knowledge before vs after watching surgical videos**TABLE 3** Anticipated clinical impact of viewing surgical videos

	Number (total = 105)	Percentage (%)
Did viewing SinusVideos.com give you confidence in performing this procedure?		
Yes	97	92.4
No	5	4.8
Cannot tell	3	2.8
Did viewing SinusVideos.com change how you perform this procedure?		
Yes	66	62.9
No	27	25.7
Cannot tell	12	11.4

In our study, over 90% of respondents reported increased confidence in performing a surgical procedure after viewing it online. In addition, nearly two-thirds of users said that watching the video would change the way they perform the procedure in the future. These findings support the clinical relevance of such a website and its potential to positively impact patient care. Furthermore, more than 70% of viewers stated that they intended to perform the viewed procedure within 1 month. This finding demonstrates the immediate impact of the website and its ability to educate on an as-needed basis, in comparison to formally scheduled training sessions.

Among the study population, over 80% of viewers said that watching online videos is an important part of their surgical education. These findings are consistent with those of Rapp et al, who reported

TABLE 4 Viewer ratings and needs assessment for SinusVideos.com

	Average (from 1 to 7)
Video quality rating	6.2 ± 1.2
Video meeting surgical educational resource expectations rating	6.0 ± 1.2
How does SinusVideos.com compare to other online surgery video resources rating	6.0 ± 1.2

that 90% of residents and medical students actively use videos for surgical preparation, emphasizing the relevance and essential role online resources play in modern surgical training.⁸ They also demonstrate the importance that high quality surgical videos will play in the maintenance of competent and well-trained surgeons for the future.

In the current study, viewership of a surgical procedure on video resulted in a significant improvement in the observer's knowledge base across all stages of training. The medical student cohort had the largest advancement in average rating of knowledge, followed in order by residents/fellows, and attendings/practicing physicians. These results are not unexpected, as those with a greater pre-existing knowledge have less room for improvement. In a study of otolaryngology residents who watched video teaching modules prior to the performance of neck dissection surgery, such viewings led to fewer surgical errors and less "takeover" events by attendings.¹² In studies of general surgery and plastic surgery residents, utilization of online learning videos also resulted in a reduction in operative time and error rates following the educational experience.^{13,14}

The majority of viewers responding to the SinusVideos.com survey identified themselves as attendings or practicing physicians, highlighting the continuing education needs addressed by online teaching tools. Online video sharing also serves to overcome financial and geographical limitations for surgical trainees.⁵ The growth in multinational teaching and learning from surgical videos accelerates global health development, standardizes quality of care, and fosters medical collaborations worldwide.

Our study has several limitations. Because the surveys are voluntary and anonymous, reporting bias may exist in our sample. It is difficult to formally assess what percentage of entire-video viewers responded to the survey, limiting the external validity of the results. Given that Youtube.com is the most popular surgical video sharing site, our data may also not accurately represent the general surgical video viewership population.⁸ The majority of SinusVideos.com users

discovered the website through personal recommendations, which may result in higher correlation of responses amongst our viewers. In addition, the small sample size of only five respondents self-identified as medical students may have limited accurate representation for this subgroup and affected study results. Lastly, SinusVideos.com focuses on otolaryngology specific content, which could potentially restrict translation of results to other medical specialties.

5 | CONCLUSION

Viewing of online videos of otolaryngologic procedures appears to increase both the surgeon's knowledge base and confidence for the procedure viewed. These benefits were found for viewers across all levels of training from medical student to practicing surgeon. The utilization of online surgical training resources, like SinusVideos.com, is likely to increase in the future, as they provide efficient, personalized training, while reducing the burden of travel and expense.

CONFLICT OF INTEREST

The authors declare have no conflicts of interest.

ETHICS STATEMENT

All authors have reviewed and approved this manuscript.

ORCID

Timothy Fan  <https://orcid.org/0000-0001-8542-7086>

Alan D. Workman  <https://orcid.org/0000-0001-9573-6472>

Vinay K. Rath  <https://orcid.org/0000-0002-9763-9075>

George A. Scangas  <https://orcid.org/0000-0002-6687-788X>

BIBLIOGRAPHY

1. Reznick RK, MacRae H. Teaching surgical skills – changes in the wind. *N Engl J Med*. 2006;355:2664-2669. <https://doi.org/10.1056/NEJMr054785>.
2. Brown CS, Iii CDC, Lee WT, Puskas L. Development of a surgical video atlas for resident education: 3-year experience. *OTO Open*. 2020;4(3):1-5. <https://doi.org/10.1177/2473974X20939067>.
3. Mattar SG, Alseidi AA, Jones DB, et al. General surgery residency inadequately prepares trainees for fellowship. *Ann Surg*. 2013;258:440-449. <https://doi.org/10.1097/sla.0b013e3182a191ca>.

4. Mota P, Carvalho N, Carvalho-Dias E, João Costa M, Correia-Pinto J, Lima E. Video-based surgical learning: improving trainee education and preparation for surgery. *J Surg Educ*. 2018;75(3):828-835. <https://doi.org/10.1016/j.jsurg.2017.09.027>.
5. Ruiz JG, Mintzer MJ, Leipzig RM. The impact of e-learning in medical education. *Acad Med*. 2006;81(3):207-212. <https://doi.org/10.1097/00001888-200603000-00002>.
6. Chhabra R, Gupta SK. Neurosurgery videos on online video sharing sites: the next best teacher? *Neurol India*. 2019;67(2):402-403. <https://doi.org/10.4103/0028-3886.258021>.
7. Koch GK, Sethi R, Kozin ED, Bergmark RW, Gray ST, Metson R. Online teaching tool for sinus surgery: trends toward mobile and global education. *OTO Open*. 2017;1(3):2473974X1772981. <https://doi.org/10.1177/2473974X17729812>.
8. Rapp AK, Healy MG, Charlton ME, Keith JN, Rosenbaum ME, Kapadia MR. YouTube is the most frequently used educational video source for surgical preparation. *J Surg Educ*. 2016;73:1072-1076. <https://doi.org/10.1016/j.jsurg.2016.04.024>.
9. Russell SS. An overview of adult-learning processes. *Urol Nurs*. 2006;26(5):349-352.
10. Whelan AJ. COVID-19: Updated Guidance for Medical Students' Roles in Direct Patient Care. AAMC. 2020. Accessed July 28, 2020. <https://www.aamc.org/news-insights/press-releases/covid-19-updated-guidance-medical-students-roles-direct-patient-care>
11. Garneski S, Hamilton D. American College of Surgeons releases new clinical guidance document for elective surgical case triage during COVID-19. *Am Coll Surg*. <https://www.facs.org/covid-19/clinical-guidance/roadmap-maintain-essential-surgery>.
12. Mendez A, Seikaly H, Ansari K, Murphy R, Cote D. High definition video teaching module for learning neck dissection. *J Otolaryngol – Head Neck Surg*. 2014;43:7. <https://doi.org/10.1186/1916-0216-43-7>.
13. Davis JS, Garcia GD, Wyckoff MM, et al. Knowledge and usability of a trauma training system for general surgery residents. *Am J Surg*. 2013;205:681-684. <https://doi.org/10.1016/j.amjsurg.2012.07.037>.
14. Satterwhite T, Son J, Carey J, et al. Microsurgery education in residency training: validating an online curriculum. *Ann Plast Surg*. Philadelphia, US: Wolters Kluwer; Vol 68; 2012:410-414. <https://doi.org/10.1097/SAP.0b013e31823b6a1a>.

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