

A safe model for implementing live streaming of surgery to improve surgical education

Maya Keeka¹, Oren Tirosh¹, and Phong Tran^{1,2}

1. Department of Orthopaedic Surgery, Western Health, Melbourne, Australia

2. Australian Institute for Musculoskeletal Science (AIMSS), The University of Melbourne and Western Health, St. Albans, VIC, Australia

RESEARCH

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Corresponding Author:

Maya Keeka

Orthopaedic Department at Footscray Hospital, 160 Gordon St, Footscray, VIC 3000, Australia

Email: maya.keeka@gmail.com

ABSTRACT

Background

Live surgery broadcasting has had increasing use in medical education, especially in distributed education models. However, there have been several concerns raised regarding its safety and ethics with many surgical colleges banning its use.

Aims

Our study aimed to implement a model of live surgery broadcasting of Orthopaedic surgery that utilised its educational benefits whilst addressing the current concerns.

Methods

A telemedicine system using a one-way transmission microphone was installed in a tertiary public hospital to securely transmit live Orthopaedic surgery broadcasting from an operating theatre to a lecture theatre holding either medical students, surgical nurses or musculoskeletal physiotherapists. We performed common Orthopaedic operations on patients that were known to the surgeon within their routine time limits. An evaluation survey was administered at the end of each live surgery session using a

5-point Likert scale and open answers. Questions addressed the quality and usefulness of this education model for each discipline.

Results

Five live surgery broadcasting sessions were conducted and 179 survey responses received. 38 per cent of medical students had never attended theatre with 71 per cent having never seen a common Orthopaedic operation. Most surgical nurses and musculoskeletal physiotherapists had also never seen common orthopaedic procedures. There was a statistically significant benefit in the improvement of educational experience gained by live surgery broadcasting for all five sessions ($p < 0.01$). Over 80 per cent of all cohorts would like to expand this model to include other surgical specialties.

Conclusion

Live surgery broadcasting can successfully provide educational benefit to medical students, surgical nurses and musculoskeletal physiotherapists without infringing upon patient safety.

Key Words

Live surgery, broadcasting, education, telemedicine, ethics, orthopaedics

What this study adds:

1. What is known about this subject?

Previous published articles have detailed negative implications of live surgery broadcasting without suggestions on how to make it safer and useful for education.

2. What new information is offered in this study?

A methodology in how to practice live surgery broadcasting in an ethical way that doesn't compromise patient safety and provides exceptional teaching standards.

3. What are the implications for research, policy, or practice?

Changes educational practice in surgery by detailing how to improve previous live surgery broadcasting to be a safe and beneficial educational tool.

Background

Recent technological advances provide an opportunity to improve and enhance medical education. Whilst textbooks and in-person lectures, still form the main modalities of education, video-streaming of surgical procedures is potentially an advanced model of delivering high quality surgical education with interactive real-time applications. Video streaming can be either synchronous (live streaming) or asynchronous (recorded). Synchronous streaming is the transmission of live surgery broadcasts (LSB) viewed from a remote site by real-time audiovisual transmission.¹ LSB allows a large audience to visualize procedures they would otherwise not have access to, in the most practical and realistic manner, and creates a forum for discussion.

Live surgery broadcasts have been utilised in several surgical disciplines to create a forum for sharing interventional techniques and decision-making.²⁻⁴ However, ethical considerations have been raised questioning its benefit and safety.⁵⁻⁸ Several surgical societies have banned LSB or placed strict guidelines on its use.^{1,6,9,10} The published evidence objectively assessing the educational benefits and potential risks of LSB is limited.

In 2011, Kallmes et al expressed concerns with patient safety and ethics of LSB.⁵ They raised a number of key areas of concern including:

- Working in an unfamiliar environment and with unfamiliar nursing staff
- Using equipment that would not normally be used due to sponsorship from a company
- Steering patients towards therapy because of the pressure of an impending live case
- Patient consent to LSB
- Deviating from standard care to limit procedural duration
- Time constraint pressures

The authors raised these concerns from their own personal experience in participating in national and international endovascular and surgical meetings with LSB. These areas have also been similarly raised in other surgical specialties and within surgical college policies.^{1,6,9}

The aim of our study was to implement and assess a model of live surgery streaming that could utilise the educational benefits of LSB whilst addressing the ethical and safety concerns.

Method

Medico-legal and Technical Set-up:

The study was conducted at a large multi-campus metropolitan hospital network. Ethics approval was granted by the local institutional ethics committee and the medico-legal department.

Live streaming visual and audio equipment was installed in the operating theatre complex of one hospital campus (Figure 1). The cameras had the facility to pan, tilt and zoom. A telemedicine system was installed to allow for secure data transmission from the theatre to a projection system in the education auditorium at another hospital campus. The cost of the installation was approximately AUD\$245,000. The installed microphone was constrained to one-way transmission, which prevented the surgeon from receiving any audio from the auditorium and audience but allowed the surgeon to teach the operation to the audience as they would to a training registrar. This one-way audio transmission was implemented to limit distraction to the surgical team, and the conduct of the surgical procedure was uninterrupted, with a normal operating time and pace, replicating the normal surgical environment.

Figure 1: A. Camera installed on the wall of the operating theatre B. Camera located within the head-lights





Patient and Surgeon Consent:

Patients were consented to surgery and the LSB by the Consultant Orthopaedic Surgeon or Registrar involved in the procedure. Informed consent consisted of maintaining patient anonymity throughout the broadcasting, and no personal data other than their condition would be made available to the audience.

Live surgery broadcast sessions:

We conducted 5 live surgery broadcast sessions throughout the year, each moderated by a second Consultant Orthopaedic Surgeon. During the session, live streaming of the operation was displayed simultaneously with a lecture presentation on an adjacent screen.

Our audience were 3rd year medical students, Orthopaedic nurses and musculoskeletal physiotherapists. The operations that were broadcasted were chosen based on the educational benefit to the audience and included only commonly performed procedures such as total hip and knee replacement, and arthroscopy to the hip, knee and shoulder.

Survey:

We developed a survey of 10 questions; 8 in a 5-point Likert scale and 2 in free text answers. The Likert scale assessed satisfaction with the live surgery broadcasting quality, usefulness to their education and a comparison to their current educational resources. The free text allowed the audience to express what they had learnt from the session that they would not otherwise of learnt from their current teaching methods and as a feedback mechanism for LSB improvement.

Statistical Analysis:

Before and after broadcast means and standard deviation (SD) of the surveys were calculated and compared for significant differences ($p < 0.01$) using Student paired t-test. This included the shoulder and knee surveys for medical students, knee survey for nurses, and knee survey for physiotherapists.

Results

Survey for the shoulder broadcast to medical students increased satisfaction between before and after, 2.63 ± 0.94 and 4.33 ± 0.63 ($p < 0.01$) respectively. Survey for the knee broadcast to medical students showed increased satisfaction between before and after, 2.62 ± 1.03 and 4.48 ± 0.85 ($p < 0.01$), respectively. Survey for the knee broadcast to nurses showed increased satisfaction between before and after, 3.12 ± 1.06 and 4.72 ± 0.45 ($p < 0.01$), respectively. Survey for the knee broadcast to physiotherapists showed increased satisfaction between before and after, 3.52 ± 0.91 and 4.68 ± 0.55 ($p < 0.01$), respectively. (Table 1 and 2) 84 per cent of all participants said they would like LSB to be incorporated into teaching practices for other surgical specialities (Figures 2 and 3) (Table 3 and 4).

Figure 2: Satisfaction before the introduction of live surgery broadcasting

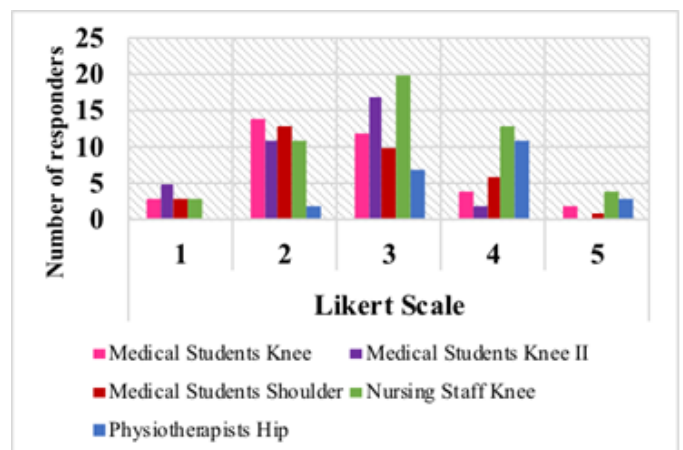


Figure 3: Satisfaction after the introduction of live surgery broadcasting

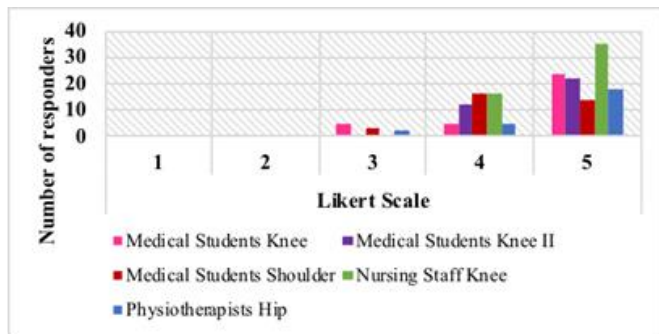


Table 3: Medical Student attendance to theatre prior to LSB

Number of occasions present in theatre				
0	1-5	6-10	11-15	>15
39	20	8	11	25

Discussion

Live surgery broadcasting has raised ethical concerns when performed in international meetings, with surgeons performing in unfamiliar operating environments, staff and equipment.^{2,5} These variables are known stressors to surgeons which can significantly affect technical performance and compromise patient safety. Throughout this study, multiple measures were undertaken to eliminate potential risks associated with LSB. All LSB sessions in this study were conducted within our hospital facilities on patients known to the surgeon.

There has been concern of surgeons coercing patients to undergo surgical procedures due to pressure to find patients suitable for an upcoming LSB.^{2,11} In our study, patients already consented and booked for an eligible procedure were identified, then consented to participate in the LSB.

Selecting the right operation for an LSB is paramount in order to provide educational benefit to the audience. LSB meetings have been criticised for demonstrating uncommon, seldom performed, complex operations with narrow educational benefit.^{2,5,12} Our LSB objective was to educate our intended audience of medical students, nurses and physiotherapist on common operations, therefore offering a much more practical and relevant educational experience. We found from our cohort of medical students, nursing staff and physiotherapists that LSB has provided significant educational benefit in additional to traditional educational pedagogy.

Approximately 38 per cent of medical students had never attended theatre during their training, therefore making LSB a valuable opportunity to witness live surgery. 71 per cent of our student cohort had not previously witnessed a total knee replacement, 66 per cent a knee arthroscopy and 81 per cent a shoulder arthroscopy. In addition, 59 per cent of our nurses had never witnessed a total knee replacement and 55 per cent a knee arthroscopy. Musculoskeletal physiotherapists, who play a large role in providing both pre- and post-operative care to our patients, had also rarely seen these operations despite regularly caring for these patients postoperatively.

The moderating consultant, while largely responsible for fielding questions and coordinating formal presentations during and between cases, also plays a significant role in patient safety and advocacy. As the moderator was able to disable the live feed at any time, should any concerns arise regarding the patient, surgeon, or operation during the LSB. Using a consultant moderator also removes the potential distraction of interactivity between the surgeon and audience during the LSB, allowing them to focus on the patient and avoid compromising education of the operating consultant. Additionally, the moderator and audience share the same view, and as such the moderator is better suited to explaining the operation, further reducing distraction to the operating consultant.

In Sade et al.’s review of ethical concerns of LSB in cardiothoracic surgery, they expressed concerns of a camera crew being present in the theatre compromising the surgeon’s view by seeking better vantage points.¹ This has also been acknowledged as a potential cause of distraction to the surgeon.^{9,12} Our LSB set-up excluded camera crews or large video equipment. Advances in audiovisual equipment allow the installation of unobtrusive wall cameras and light-handle cameras (Figure 1).

Time restraints are also a major concern in LSB sessions. Previous LSBs have reported surgeons rushing to finish their operation to fit within a designated time slot or having requesting a general anaesthetic rather than a spinal anaesthetic to increase case turnover.¹³ As we replicated the normal surgical environment by conducting the LSB session during a normal surgical time slot our study allowed the anaesthetist to pick which anaesthetic was most appropriate for the patient regardless of length of administration. The surgeon also operated within the time allocated as per their usual daily roster. Time restraints were therefore realistic and achievable.

Our model of improving conceptions of LSB can be easily replicated to other surgical specialties as they are not Orthopaedic specific. It is important that surgical specialties pick cases that would provide the best educational benefit for their audience by choosing a common procedure and one that is consistently performed within the timeframe of the session to not cause time constraints. As the cameras are setup on the walls and within the light-handles they should be appropriately placed for most operations performed in other surgical specialties. Furthermore, Table 4 also highlights the audience would like to see live surgery broadcasting being used in other surgical specialties.

Conclusion

Live surgery broadcasting can provide a significant benefit to improving education of medical students, nurses and physiotherapist. If implemented carefully, without compromising patient safety and can help address previous ethical concerns.

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PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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ETHICS COMMITTEE APPROVAL

Western Health Ethics Committee, approval number: QA 2020.35

Table 1: How satisfied were you with your current level of education, before the introduction of live surgery broadcasting?

Audience	LSB Session	Total Participants	Likert Scale*				
			1	2	3	4	5
Medical Students	Knee	35	3	14	12	4	2
Medical Students	Knee II	35	5	11	17	2	0
Medical Students	Shoulder	33	3	13	10	6	1
Nursing Staff	Knee	51	3	11	20	13	4
Physiotherapists	Hip	25	0	4	7	11	3

*Likert scale: 1= Not satisfied, 5= Highly satisfied

Table 2: How satisfied are you with your education, after the introduction of live surgery broadcasting?

Audience	LSB Session	Total Participants	Likert Scale*				
			1	2	3	4	5
Medical Students	Knee	35	0	1	5	5	24
Medical Students	Knee II	35	0	0	1	12	22
Medical Students	Shoulder	33	0	0	3	16	14
Nursing Staff	Knee	51	0	0	0	16	35
Physiotherapists	Hip	25	0	0	2	5	18

*Likert scale: 1= Not satisfied, 5= Highly satisfied

Table 4: Would you like live surgery broadcasting to be incorporated into other surgical specialties?

Audience	Participants	Likert Scale				
		Disagree				Agree
		1	2	3	4	5
Medical Students	103	0	1	4	12	86
Nursing Staff	51	0	0	1	7	43
Physiotherapists	25	0	0	1	3	21