Video-recorded Observations of Surgical Telementoring

Approaching collaboration among laparoscopic surgeons using videoconference

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Abstract — **In northern Norway, laparoscopic surgeons under training use videoconferencing to access expert surgeons. Videoconferencing as a tool for collaboration and knowledge sharing overcomes the distance between expert mentors and mentees and might improve surgical training. Understanding of videoconferencing in surgical practice is limited, and the educational and clinical benefits of telementoring should be explored. Over a three-year period, from 2015 to 2017, we will undertake an qualitative, explorative study using video-recorded observations of interactions. Our objective is to examine collaboration in surgical training, seeking an in-depth understanding of the non-technical aspects or social processes of collaboration in surgical training. Here we discuss how video-recorded studies may contribute to the understanding of the interactions between mentors and mentees and how to use video for approaching this practice. We discuss the use of video-recorded observations and present a fixed and a flexible design for collecting video recordings. Experiences from 8 real-time cases and one simulation of collaboration using videoconferencing in the operating theatre reflect the optimality of the flexible design, which allows following the dynamic of the surgical team. The results reveal a number of resources that are important both for interactions during surgical (tele)mentoring and for the camera position.**

Keywords - collaboration; surgical training; telementoring; videoconference; interaction; video-recorded observations.

I. INTRODUCTION

Approaching surgeons to explore the social processes of collaboration during training in the operation theater has several obstacles. When gaining access to the operation, the researcher needs to be prepared for the spoken and visual aspects and even the smell of the operating theater. Masks cover the surgeons' faces, the sounds of the machines make it difficult to hear spoken words, and the sterile zone creates a boundary, limiting how closely the researcher can approach the surgical activity. When observing daily activity, it is easy to take actions for granted or focus too narrowly. Video recordings allow us to capture, play back, and re-frame the activity. This paper is an extended version of a paper for the conference eTelemed in which, we outlined the objectives of the Collaboration in Surgical Training (CoaST) study and the qualitative design. We conclude by presenting a design for collecting video recordings to explore surgical training [1]. Here, we extend previous work with experiences from real-time cases and a simulation that reflects the use of video for approaching surgical practice.

In general, surgeons must have six years of education, training, and clinical practice. The clinical practice involves hands-on training, during which, the training surgeons (mentees) are instructed by expert surgeons (mentors).

Access to mentors for the purpose of education presents a problem to many hospitals. Improving access to mentors in surgical training could be accomplished by implementing videoconferencing (VC) telementoring as a tool for knowledge sharing. VC has the ability to overcome the geographic distance between mentors and mentees and allow for organization and full concentration on training locally and at a distance.

In surgical practice, procedures are often challenging. Unexpected issues arise and can lead to a point of no return, where decisions must be made in the moment [2]. The skills of the surgeon and the collaborating operating team are a prerequisite for a good surgical outcome [3][4]. Thus, collaboration and training in team performance are important in surgical practice. Optimal teamwork is essential whether mentors and mentees are located in the same room or they are located at a distance. VC for telementoring is well suited for collaborating and overcoming issues related to distance [5]. However, a recent review of surgical telementoring reported the limited understanding of VC in surgical practice. The review concluded that while focus has been given to piloting the technology, little attention has been paid to the educational and clinical benefits of telementoring [6]. Studies report that surgical mentoring through VC provides opportunities to alter surgical practice and offers patients the best expertise in surgical treatment without geographic limitations [7]. However, little in-depth understanding of the non-technical aspects or social processes of collaboration in surgical training exists.

During the CoaST project, we will examine the current organization of surgical training and the use of VC as well as how knowledge is shared and constructed to complete surgical procedures; the organization of training procedure and practice, that is, the team that participates, the knowledge shared, the knowledge needed, and the use of resources to solve the problem. Together, this will provide insight into team performance and the way in which, non-technical aspects or social processes of collaboration influence the way surgeons are mentored. To approach the collaboration during surgical telementoring, we employ video-recorded observations.

The rest of this paper is organized as follows. Section II describes the framework for the field and the need for knowledge about collaboration and teamwork in surgical training. Section III describes the empirical context for exploring collaboration among laparoscopic surgeons interacting via VC. Section IV addresses the qualitative design, including both the design for this explorative study, and more specifically, the video recordings. Section V provides the results and presents an approach to surgical practice when making video recordings. In Section VI, we discuss video-recorded observations for interaction analysis and show how they can contribute to the understanding of interactions between mentor and mentees, and we discuss the role of the researcher. Section VII is the conclusion.

II. Framework

Research regarding the educational aspects of VC in surgery stresses the educational benefits [8] and refers to telementoring as effective for the development of surgical skills [9], allowing young surgeons to be educated through distance learning by an expert surgeon [10]. Past research has suggested that VC provides access to the best educational resources and experience without the limitations of distance and time; thus, VC facilitates learning [8]. For example, community surgeons with no formal advanced laparoscopic training benefit from expert advice during procedures [11]. Students reported that the experience utilizing VC was better than conventional procedures because of the enhanced learning, better visibility, and verbal accuracy in describing the procedures due to the fact that the instructor was not standing in the way [12]. These studies illustrate the outcomes possible with VC technology, but no studies have explored the social processes of collaboration and the knowledge necessary to complete surgeries (i.e., guidance, problem solving, and interaction). Neither did these studies explore how learning might be an outcome of this collaboration.

Knowledge of the effects of VC on surgical practice is limited [6]. A special focus is needed to gain a better understanding of the factors that influence surgical outcomes, that is, communication and team performance [13]. The CoaST project expands upon previous work by investigating knowledge sharing between surgeons and the way in which, their use of resources affects treatment outcomes. It aims to investigate the current organization of surgical training, the use of VC, collaboration in practice, and the problem-solving process. Here, video recordings are a well-suited tool.

When observing daily activity, we often take actions for granted. Surgeons accomplish daily activities through interactions with others. These activities are the product of a variety of resources, i.e., spoken, bodily, and technological resources. Video recordings of an activity enable us to capture the activity. They also make it possible for those participating in the operating theater to share and discuss information with others outside the operating theater. In this paper, we discuss how video-recorded studies may provide a contribution to understanding the interaction between mentors and mentees and present designs for approaching the practice.

III. Empirical Context

This study investigates collaboration among laparoscopic surgeons in northern Norway interacting via VC. The empirical context includes collaboration between the mentors and mentees during surgical training, where VC is utilized to overcome the distance between the mentor and mentees.

Laparoscopic surgery uses several small abdominal incisions. At each abdominal incision (i.e., port), an instrument is inserted. Telementoring happens by connecting the laparoscopic surgery, the surgeon (mentee), the expert (mentor), and the technological artifacts, that is, robots, monitors, and a mobile touch screen device. The laparoscopic procedure, which is visual, is transmitted to a monitor in the operating theater. The expert can view the procedure on the monitor or at a touch screen device in the operating theater or at a distance. All procedures are transmitted to the monitor. In some cases, mobile touch screen devices may be used. Freehand markups are drawn over the video (telestration) so that the visuals can supplement the verbal instructions.

Telementoring over distance is possible using VC [14]. VC is defined as the sharing of sound and pictures through two- or multi-channel communication. By connecting the monitor or the mobile touch device to an external computer (PC) and using microphones locally to transmit audio to an external computer, the local mentee in the operating theater and the remote mentor are able to collaborate. The surgical operation is viewable on the monitor, which is transferred to the expert mentor's device. The mentor can be mobile, in the operating theater, or at distance while providing full attention and offering required training and instruction to the mentee. The visual representation on the monitor, the instructions being given, and the mentor's telestration drawings on the device supplement the collaborative work during surgical training.

The study follows the traditional education program to explore this practice. The observations will continue until there is a thematic saturation or until the use of VC for mentoring is phased out. The participants will be recruited according to their use of VC for mentoring. When VC is used, it will include the interactions that occur during the training until methodological saturation is achieved. The periods and the length of observation will be determined based on the total activity during the education program. A lower frequency of training using VC will require longer periods of data collection. Periods are defined in regard to the education program and are referred to as the periods of training.

For this paper, the empirical context comprises video observations of the first telementoring procedure held within the CoaST project period. At this stage, we needed to reveal challenges of using video for social research to inform further research. Approaching the practice, experiences from 8 real-time cases, and one simulation of collaboration using VC in the operating theatre illustrate how the design needs to be organized.

IV. VIDEO OBSERVATIONS OF SURGICAL PRACTICE

Exploring collaborative processes requires empirical data and analysis of the social processes and interactions of those who participate. These data and analyses make it possible to explore knowledge sharing among surgeons, mentors, and mentees who collaborate and use VC in surgical training and practice. However, the field lacks an in-depth understanding of the social processes of interaction under training. Thus, an expansion of traditional research methods (i.e., randomized control trials) in this field will enrich the knowledge base. Ethnomethodology analytics and talk-in-interaction, supported through qualitative video observations, offer great potential.

The way in which, telementoring is accomplished is a part of the social organization of surgical work—and a part of everyday clinical practice. Thus, the research on the collaboration in the operation theater with real patients is a workplace study. Workplace studies examine the detailed co-ordination of verbal, visual, and material conduct through which, technology is used [15] and seek to understand how such tools affect organizational practice.

Video-based studies of interactions amongst surgeons are in demand [13]. Heath, Luff, and Svensson [16] have been studying surgical teams and how video provides access to complex forms of interaction. Though, they have completed detailed workplace studies regarding the use of tools, telementoring has not been a part of their studies. As part of a work practice, image-guided surgery produces video recordings of procedures, which are transmitted to a lecture room to improve communication [17], but not for researching the communication itself. Focusing on telementoring, miscommunication between mentors and mentees has been videotaped as a trial [18], disconnected from real-time work practice.

Despite a growing amount of video-based studies, there are few guidelines on how to undertake video-based research [15]. Though we do not aim to provide a guideline, we will reflect on video recordings and provide a contribution to designs for approaching practice. The CoaST project will use qualitative methods. It is designed as an explorative study of the practices of interaction. The knowledge shared and constructed will be explored as surgeons with different types and levels of experience and expertise interact and perform surgeries over periods of time. In this paper, we prepared and explored the design through discussions with technicians and a surgeon, who also participated in the 8 real-time cases. Observations will constitute the main source of data. The second source of data will be qualitative interviews.

A. *Observations*

The observations are built on interaction analyses—the empirical investigation of talk and the use of resources [19]. The observations will be made as surgeons collaborate in surgical training and practice, guiding and discussing treatment using tools such as VC. Observations are well suited to exploring team interactions because reconstructing the medical language and using artifacts is not possible. To intercept the social aspects in the collaborative work between the mentors and mentees, the interaction will be video-recorded using three sources: (1) output from a laparoscopic camera/monitor, (2) connecting the mobile touch screen device to a recording unit, and (3) a camera recording an overview of the operating room.

The use of video recordings during the observation provides access to complex forms of interaction and to collaboration in the visual and spoken data [20][16][22]. By following the language and the use of resources (i.e., talk, gestures, mobile touch screen, and surgical equipment such as knives, scissors and needles), it is possible to see how the mentor and mentees organize the instruction and practice, how problems and routine practices occur, and how the surgery (the medical problem) is solved.

B. Interviews

To complement the observations, the participating surgeons will be interviewed. The purpose of the interviews is to enrich the context by giving the participants the opportunity to express themselves in regard to the surgical training and the use of VC in training, instruction, and collaboration. It is also essential to discuss themes based on the observations. The interviews will be semi-structured [22][23]. They will involve dialogue resulting from a mixture of structured questions (from an interview guide) and the themes that emerge in the dialogue. Interviews will provide insight into mentor and mentee experiences. The interviews will be used to validate the interaction analysis.

C. Ethical Considerations

During surgery, the identification/visibility of the patient in the video recordings is not possible. The patient is covered by sheets, and only the part of the body undergoing the operation will be visible. The videotapes will be collected and handled according to the guidelines established by the Regional Committee for Medical and Health Research Ethics (REK). The interviews will be recorded, transcribed, and handled according to the REK's code of ethics.

V. RESULTS: CAPTURING SURGICAL PRACTICE

Here, we present results from the preparation and the first procedure within the CoaST project period. To prepare for the main collection of audio and visual data, we began with a simulation of a surgery in the operation theater. When the first mentoring case appeared, we used experiences from the simulation to prepare for the eight planned real-time mentoring cases.

A. Simulation of a fixed design

In order to decide where to place the camera and microphone for the best picture and sound, and to capture the most relevant activities, we simulated a fixed design. We have a special interest in the naturally occurring talk and tools that surgeons use when collaborating. Approaching the telementoring team includes giving attention to the mentor, mentees, and the tools they use (i.e., the monitors and the mobile touch device). The monitor shows the picture inside the abdomen, which is the same picture the surgeon sees. The mobile touch device displays the same picture as the monitor and can be drawn on. Both the monitor and the mobile touch device can record within the unit in addition to recording the technical aspects of the surgical performance. These recording units represent the traditional way of exploring surgical performance. To capture the social processes of collaboration, an external camera needed to be located in the room. When we simulated the design, we planned according to the team, the resources they use, and our single camera.

Figure 1 illustrates the fixed design of how the surgical team, monitors, mobile touch device, and camera were placed during the simulation. The arrows in Figure 1 show the three sources recording the surgical practice. The circles in Figure 1 point out the resources that will be focused on for gaining an in-depth understanding of the collaborative work. The green circle illustrates how the social processes of collaboration are an overall understanding of the whole process of surgical practice: the mentor(s), mentee(s), and their interactions with each other, the monitor, and the mobile touch device as they perform surgery. When connecting via VC, the PC is also included in this interaction. The surgical team can see the expert mentor in real time on the computer. Connecting with VC, the expert sees only what happens on the mobile touch device. Figure 1 illustrates the design, after the simulation, of the setup and the team. The external camera was placed in a position that could capture an overview of the collaboration. The external microphone was placed on top of the camera so as not to disturb the surgeons (e.g., by cables twining about their legs).

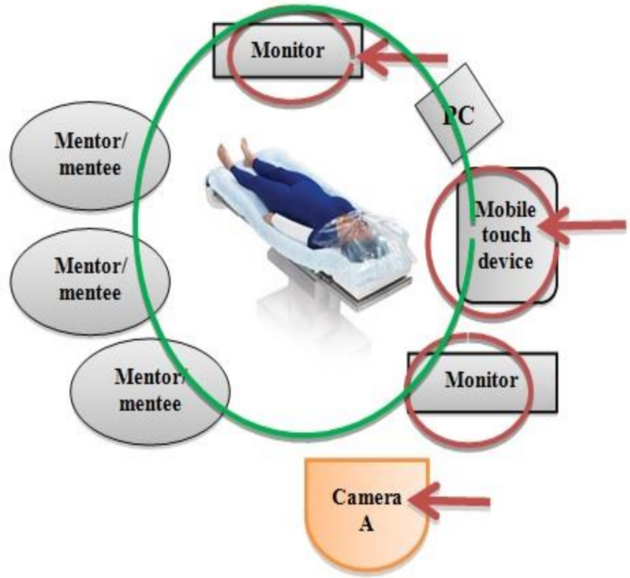

Figure 1. Simulation of the organization of the surgical team, their resources, and the recording units.

By focusing on what happens in the interaction between all elements during surgical training (the green circle), we aimed to expand the traditional method focusing on technical aspects and capture the social processes of collaboration between mentors and mentees in surgical training.

B. *Real-time flexible design*

We planned to use the fixed design when starting to video-record. However, upon entering the operating theater we realized that the fixed design was not suitable in this workplace setting. Contrary to what we had assumed, the mentee preferred to stand at the opposite side of the patient, and the tools were adjusted to fit this team. The team and the tools they use are organized differently between procedures and mentors/mentees. Without foreknowledge of the team, the researcher needs to be flexible in the video recordings. We had to adjust the planned setup as we entered the operating theater.

In the first three cases, the expert surgeon mentored on-site. The mentor moved around in the operating theater (illustrated by a faded-out figure), depending on how actively he was mentoring. During difficult parts, the mentor stepped forward, and during more low-risk parts he stepped backward. The mentor has the opportunity to use the mobile touch device, both when he is located in the operating theater and when he is at a distance. His opportunity to use the mobile touch device is illustrated with a blue arrow in Figure 2. His activity is included in the green circle, illustrating that he is a part of the social processes of collaboration.

Figure 2 illustrates the activity among the surgical team when the mentor moved around the operation theater. It includes the monitor, which represents the picture of the patient and the surgery inside the abdomen. As the mentor was on-site, the VC was not connected. The PC did not have a function other than to record the same picture as on the monitor.

We started video-recording in camera position B. As the PC was not included as a working tool, we moved to camera position C to include the view of the mentor and the monitor showing the abdomen. Since the monitor located on the foot side of the patient shows the picture inside the abdomen, the surgeons orient their faces towards this monitor during the procedure. In position C, we were not able to see the mentees' faces or which, direction they were oriented to at each point during the procedure. Standing behind them also made it difficult to intercept their talk. Since the naturally occurring talk during the procedure is important for our study, we could not choose this position. As the talk was most often directed between the mentees and mentors on each side of the patient's bed and towards the monitor, we placed the external microphone on top of the monitor. This was the best position for capturing the voices.

Moving to the planned position A (Figures 1 and 2), we got a nice overview of the work with the patient: the mentees hands and the tools they used. The video recordings captured the patient's body and a close-up impression of the movement of the tools. However, some equipment on the monitor to the right made distracting sounds, making it difficult to hear the talk. The mentees had their faces oriented towards the monitor in front of them, which made both the physical and verbal communication between them hard to intercept. Camera position D did not fit into the physical organization of the team, standing in the middle of the mentor working space where the rest of the team (i.e., nurses) worked.

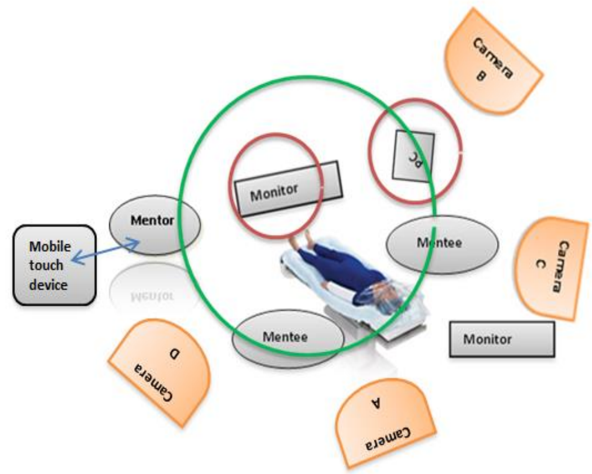

Figure 2. Real-time flexible design of the organization of the on-site surgical team, their resources, and the recording units.

As the mentees became more experienced with the procedure, the mentor started to use VC, providing the opportunity to instruct at distance. To allow the mentor who was not on-site to be seen, another monitor was included. The PC was used to connect the mentor, the mobile touch device, and his PC remotely. In this way, the mentees were mentored using VC, as illustrated in Figure 3.

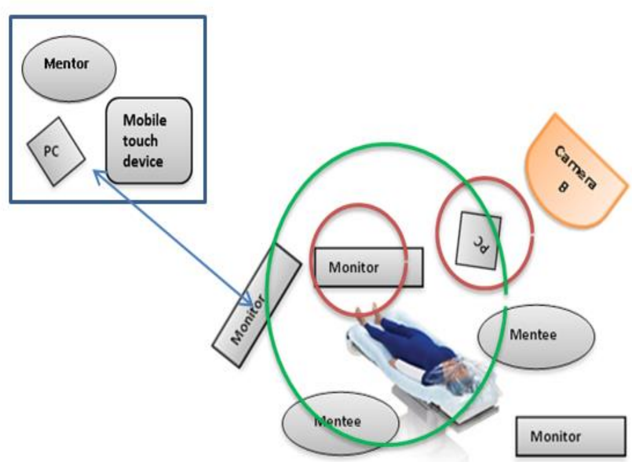

Figure 3. Real-time flexible design of the organization of the surgical team, their resources, and the telementoring.

When using VC, the PC showed the same picture that the surgical team saw on the monitor. This included the picture of the abdomen (which is the same picture the mentor sees and the important working tool when performing laparoscopic surgery), the picture of the mentor at a distance, and the use of the mobile touch device. The mobile touch device supplements verbal explanations with the opportunity to draw while explaining. Using the view of the PC as a way to gather all resources in one picture was an excellent way to video-record all activity. In camera position B, we captured both the communication tools that were important for the local team and the picture on which, the remote mentor was dependent. At the same time, we were able to record the local team, with their faces oriented towards the remote mentor on the monitor. The microphone, connected to the camera, was also nearby, so we did not have worries about long cables crossing the floor.

VI. VIDEO-RECORDED OBSERVATIONS FOR INTERACTION ANALYSIS

Experiences from eight real-time cases and one simulation of collaboration in the operating theater reflect video-recorded observations of surgical telementoring. The results explore both a fixed and a flexible design for video-observations when capturing collaboration between mentors and mentees.

As a work procedure, the technical performance of the surgery in the operating theater is analyzed by recordings from the monitor unit. This unit records a stationary picture of what happens inside the abdomen. These recordings are used to evaluate the mentees' technical skills after surgery. Hence, surgeons are used to produce video recordings of their actions but not of their interactions.

Exploring the interactions between mentors and mentees in the time leading to the surgery provides a broader picture. Using video recordings to analyze the interaction between the mentor and mentees is more complex. When professionals accomplish everyday work activities through interactions with others, they utilize a variety of resources (spoken, bodily, and material) as objects and tools. The individuals interact with each other, and are influenced by actions in the operating theater. During the simulation and eight mentored sessions, a number of resources were identified that are important both for the interaction during surgical (tele)mentoring and for determining the camera position.

Collecting video-recorded observations for approaching the practice presents several issues and queries. Establishing a fixed frame prepared us for entering the setting, even though we could not carry out the recordings in this way. The team is not stationary; that is, the mentee who has the central role decides whether to stand on the left or right side of the patient, and the assistant mentee moves accordingly. The tools the team uses are organized in the room according to the position of the team and the procedure to be accomplished. Hence, the position for telementoring is influenced on-site. For new procedures, on-site mentoring is a first part of the instruction process. When the mentee has obtained a certain skill level, VC can be used for mentoring. Telementoring adds tools to the activity and affects the situation—whether used in the operating theater or at a distance.

It is a methodological debate whether to follow the action with a camera or to maintain one perspective. Here, we have tried several camera positions to determine *one viewpoint* where we are able to follow the activity. The 'best design' is principally dependent on the focus of the study. The results of this study show that the best viewpoint for video-recorded observations of telementoring allows observation of the team as it orients itself towards the monitor showing the picture of the patient (inside the abdomen) and the mentor with the mobile touch device. At the same time, it is important to see the faces of the surgeons and meet the direction of their voices (as talk is a part of the focus in the study). In camera position B, it was possible to use the picture on the PC (showing the same picture as the monitor) while recording the team from a satisfactory angle.

According to the CoaST study, capturing the activity from a 'flexible position B' is not just a practical methodological issue for video recording; it is also characterized by the work practice. The 'flexible position B' is oriented towards the knowledge and tools that are important for the mentor and mentees to complete the laparoscopic procedure.

The flexible design requires the researchers to have dual roles as cameramen and observers. As qualitative researchers, we often observe from a corner in the room, taking field notes. As the activity happens centered towards 'the patient in the middle', we are standing half way behind what is happening. The sound is disrupted by noisy instruments, and the mentor and mentees are covered by gauze masks, making it harder to hear them talking. Around them, there is a sterile zone, which makes it impossible to be close. Thus, we want to maximize the quality of the recordings and capture the activity where it happens. At the same time, we must not disrupt the activity.

In addition to the movement of the team and the tools they use, the shape of the operating theater affects the researchers' role. In large operating theaters, a tripod can be used, and when the camera is placed in a satisfactory position on a tripod, the researcher can leave or change position within the operating theater. In small operating theaters, however, the camera must be handheld to get a satisfactory angle of the team. Handheld cameras make it possible to move closer to a corner than the tripod allows. In such a position, the researcher has to concentrate on being a cameraman and focus on the interaction when watching the recordings afterwards.

In this study, we present designs for video recordings of interactions with telementoring. Revealing the complexity of making these recordings also explores the interactions of the mentor and the mentees. The spoken, bodily, and material objects and tools that are part of the surgical practice make the CoaST study intriguing. Here, the results show that performing a procedure requires more than successful technical performance. Social and organizational factors regarding clinical practice affect the outcome.

VII. Conclusion

This paper describes a work in progress, a project studying collaboration among laparoscopic surgeons who are instructed during education (CoaST). Currently, there is a limited understanding of VC in surgical practice and a lack of in-depth understanding of the non-technical aspects and social processes involved. The project strives to capture the interactions that occur within a surgical team and their use of resources when mentoring surgeons. Knowledge of the social processes could be used to improve surgical education and enhance surgical team performance in everyday practice.

This is not a traditionally study of VC setup in surgery, drawing on previous successes and failures with implementing VC. Here we explore the method of video-recorded observations studying interaction in surgical teams, which are in demand [13]. Capturing several sources of action is challenging. Interactions within the team happen between members, around the patient, on the monitors that depict the patient's body, and on the mobile touch device. We tried to meet this challenge by simulating a fixed design for video recordings. Afterwards, we tested the fixed design during eight real-time cases. We tried several camera positions, one of which was suitable for this specific laparoscopic procedure. At this point in the study, the design for video recordings needs to be flexible with an active researcher.

As researchers, we need to define our own role. Being in the operating theater to perform video observations has an impact on the activity, the setting, and the relationships of the participants. We made a decision to use a single camera source. This was necessary to minimize the workload as multiple cameras might lead to difficulties in analyzing the material [24]. The number of cameras, the strategy for recording sounds, and the way the action is followed (i.e., fixed or dynamic frame) impact the data that is collected and the analysis that is possible.

The experience gained from these cases has brought us one step closer to proposing a less resource-demanding design. When using VC, the monitor could have a built-in video recorder. If a camera and microphone are placed on top of the monitor and the team is video-recorded while directed towards the monitor, it is also possible to capture what they are focusing on. If this recorded picture also appears on the monitor, we are able to collect all the sources in the same video-recorded picture. Then, the challenge is to install this system in all potential operating theaters and give someone in the operating theater the responsibility to inform the team about the recordings and start and stop the recording. This might lead to methodological biases, however, which are not discussed in this work.

Collecting video-recorded observations for approaching surgical practice presents several issues and queries. There are challenges in several phases of this method, from planning, collecting, and analyzing the data. Here, we have focused on some challenges with data collection. This paper is not a guideline for approaching video-recorded observations of surgical telementoring. It is a complex interaction, and the importance of capturing the procedure as an outcome of collective actions is often taken for granted. The present research contributes to the field of interaction studies. The findings will give rich insight into the phenomena itself, which is communication and team performance in surgical education using videoconference. The detailed analysis of the interaction gives insight in specific aspects of how they communicate. Our analytic concepts will be used to create systematic analysis of communication and our analysis becomes a contribution to the field of knowledge that investigates surgical team performance. In ongoing research, these sources together with a review and a theory create the basis for our analytic claims, as we in the future will call analytic generalization. Analytic generalizations aims to develop concepts that make qualitative studies as strong as possible.

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References

[1] L. L. Warth, E. M. Bogen, R.-O. Lindsetmo, H.R.H. Patel, and K. M. Augestad, "Collaboration in Surgical Training: A Qualitative Study of Mentoring Laparoscopic Surgeons by Using Videoconference in Northern Norway," in Proc. The Seventh International Conference on eHealth, Telemedicine, and Social Medicine (eTELEMED 2015), pp. 6-9, Feb. 2015, ISSN: 2308-4359, ISBN: 978-1-61208-384-1.

[2] N. Jacklin, A. Sevdalis, C. Darzi, and C. Vincent, "Mapping surgical practice decision making: An interview study to evaluate decisions in surgical care". American journal of surgery, 195(5): 2008, pp. 689-696.

[3] B. S. Nedrebo et al., "Survival effect of implementing national treatment strategies for curatively resected colonic and rectal cancer". The British journal of surgery, 2011. 98(5): pp. 716-723.

[4] N. J. Birkmeyer et al., "Safety culture and complications after bariatric surgery". Annals of surgery, 2013. 257(2): pp. 260-265.

[5] R. Latifi, K. Peck, R. Satava, and M.R. Anvari, "Telepresence and telementoring in surgery". Studies in health technology and informatics, 2004. 104: pp. 200-206.

[6] K. M. Augestad et al., "Surgical telementoring in knowledge translation- Clinical outcomes and

educational benefits: A comprehensive review". Surgical innovation, 2013. 20(3): pp. 273-281.

[7] K. M. Augestad and R. O. Lindsetmo, "Overcoming distance: video-conferencing as a clinical and educational tool among surgeons". World Journal of Surgery, 2009. 33(7): pp. 1356-1365.

[8] P. Lamba, "Teleconferencing in medical education: a useful tool". The Australasian medical journal, 2011. 4(8): pp. 442-447.

[9] L. Panait et al., "Telementoring versus on-site mentoring in virtual reality-based surgical training". Surgical endoscopy, 2006. 20(1): pp. 113-118.

[10] G. Midiri, V. Papaspyropoulos, and A. Brescia, "Remote teaching in surgery: Problem-based learning, telementoring, and evaluation tests". Annali italiani di chirurgia, 2001. 72(6): pp. 751-755.

[11] H. Sebajang et al., "Telementoring: an important enabling tool for the community surgeon". Surgical innovation, 2005. 12(4): pp. 327-331.

[12] C. Kaufmann, P, Rhee, and D. Burris, "Telepresence surgery system enhances medical student surgery training". Studies in health technology and informatics, 1999. 62: pp. 174-178.

[13] C. Vincent, K. Moorthy, S. Sarker, A, Chang, and W. A. Darzi, "Systems approaches to surgical quality and safety. From concept to measurement". Annals of surgery, 2004. 239(4): pp. 475-482.

[14] T. A. Ponsky, M. Schwachter, J. Parry, S. Rothenberg, and K. M. Augestad, "Telementoring: The Surgical Tool of the Future". Eur J Pediatr Surg, 2014; 24; 4, pp. 287-294.

[15] C. Heath, J. Hindmarch, and P. Luff, Video in Qualitative Reseach. Analysing social interaction in everyday life. 2010, London; sage Publication.

[16] C. Heath, P. Luff, and M.S. Svensson, "Video and qualitative research: analysing medical practice and interaction". Medical Education, 2007. 41: pp. 109-116.

[17] M. Aanestad, J. S. Røtnes, B. Edwin, and T. Buanes, "From operating theatre to operating studio- visualizing surgery in the age of telemedicine". Journal of Telemedicine and Telecare 2002; 8: pp. 56-60.

[18] A. Budrionis, P. Hasvold, G. Hartvigsen, and J. G. Bellika, "Assessing the impact of telestration on surgical telementoring: A randomized controlled trial". Journal of Telemedicine and Telecare; ISSN 1357-633X. Doi: 10.1177/1357633X15585071. Epub ahead of print.

[19] B. Jordan and K. Henderson, Interaction analysis: Foundation and practice. The Journal of the Learning Sciences, 1995. 4 (1): pp. 39-103.

[20] D. Silverman, Interpreting Qualitative Data. Methods for Analysing Talk, Text and Interaction, 2001, London: Sage Publications.

[21] B. Sutter, Instruction at heart. Activity- Theoretical studies of learning and development in coronary clinical work, in Department of Human Work Science and Media Technology, 2001, Blekinge Institute of Technology: Karlskrona, Sweden. pp. 276.

[22] S. Kvale, Det kvalitative forskningsintervju [The qualitative research interview] 1997, Oslo: Ad Notam Gyldendal.

[23] K. Malterud, Kvalitative metoder i medisinsk forskning. En innføring. [Qualitative methods in medical research. An introduction]. 1996, Aurskog: Tano Aschehoug.

[24] T. Koschmann, C. LeBaron, C. Goodwin, A. Zemel, and G. Dunnington, "Formulating the Triangle of Doom". Gesture 2007, 7; 1. pp. 97-118.