UiT Norges arktiske universitet

Det helsevitenskapelige fakultet

Telementoring in robot-assisted laparoscopic surgery. A critical assessment of the learning curve using GEARS score

A prospective cohort study

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Master´s thesis in medicine, MED-3950 – Kull 2016, juni 2021

PREFACE

The surgical field has caught my interest since I started in medical school in 2016. I contacted the man who would later become my supervisor, Khayam Butt, through an online advertisement posted by a classmate of mine. He wanted to recruit a fifth-year medical student to have a student´s perspective on one of his research projects.

The original objective of this thesis was to explore the use of telementoring in robot-assisted surgery. Initially, it was intended to be a combined literature and patient series study, assessing the use of telementoring in a specific robotic procedure, comparing it to traditional on-site mentored robotic procedure. Unfortunately, this objective proved too time-consuming and complicated. Thus, the project was ultimately revised several times until it reached its current form.

The project required no external funding. Both the literature search and internally conducted research were solely done by me. I would like to thank my supervisor, Khayam Butt, and my co-supervisor, Knut Magne Augestad. The project would not have been possible without their knowledge, nor would it have been possible without their willingness to adapt when facing difficulties while conducting this study.

Denne reviderte versjonen er dedisert til min samboer, Vilde Arnesen. Uten hennes tekniske rådgiving hadde også denne utgaven av oppgaven hatt de styggeste figurene i UiTs historie.

Tromsø, 15.08.2021

Olav Salterød Jonas

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Summary

Background

With the rapid development in in telecommunication technology and surgical techniques, the traditional method of surgical mentoring may, in many cases, prove expensive and ineffective. Telementoring is an innovative technique in robotic surgery that allows for only the mentee to be present at the operating room during surgery, with additional health personell maintaining the same role during surgery as the would during on-site mentored procedures. The mentor may be anywhere in the world, verbally and visually mentoring the mentee. This is made possible through a camera lens, which allows the mentor to watch live images from the procedure, through a video broadcast over the internet. The invention may enable surgical procedures in hospitals with absence of surgeons with experience in that specific surgical procedure. This may in turn, reduce the need for experienced surgeons to travel between hospitals, which can both reduce cost and increase the availability of robotic surgical procedures and -teaching.

The objective of this study was to assess the learning curve associated with telementored robotic ventral mesh rectopexy, and the feasibility of introducing a new surgical procedure to a hospital through telementoring.

Methods

At Bodø Regional Hospital, an educational program for robotic ventral mesh rectopexy (RVMR) was created. Prior to conducting the project, an application to the Norwegian committee of ethics was approved. Each of the patients in the study gave their formal consent after receiving a standardized form containing information about the procedure. An experienced robotic surgeon with no prior experience with RVMR conducted twenty procedures. The RVRM procedures were telementored by an experienced robotic surgeon affiliated at Aarhus University Hospital, Denmark. The learning curve was examined by the author of this thesis, by assessing video recordings of the procedure and scoring each of the procedure with the Global Evaluative Assessment of Robotic Skills (GEARS) score. The video assessment was performed blindly, i.e., without knowing the temporal number of the procedure. The results were analyzed using the statistics tool SPSS.

Results

The study revealed that throughout his 20 first robot-assisted rectopexies, the technical proficiency displayed by the surgeon increased across all parameters of the GEARs score and the total GEARs score.

Conclusion

The study suggests that performing telementored RVMR with an inexperienced on-site mentee and an experienced off-site mentor is feasible, and that it´s associated with an increase in the surgeon´s GEARS score. The study, however, does not take into account whether the increase in GEARS score is attributed to the educational aspects of the telementoring program, rather than the surgeon having a natural improvement in his learning curve, due to his general robotic practice.

Abbreviations

GEARS	Global Evaluative Assessment of Robotic Skills
MIS	Minimally Invasive Surgery
IDEAL	Idea, Development, Exploration, Assesment, Long term study
SPSS	Statistical Package for the Statistical Sciences
RVMR	Robot-assisted ventral mesh rectopexy
SAGES	Society of American Gastrointestinal and Endoscopic Surgeons

1 INTRODUCTION

1.1 Objective

The objective of this study is to critically assess the learning curve of a single surgeon during telementored RVRM, using consecutive surgical videos that are scored with the validated scoring instrument for robotic surgery, i.e. the “GEARS” score, as well as assessing the feasibility of an educational program for telementoring RVMR with a mentee with no prior RVMR experience. The assessment will focus on the technical proficiency displayed by the surgeon over the course of a total of 20 surgeries.(1)

1.2 Telementoring

1.2.1 Definitions

As follows are definitions on key terms within telementoring, as defined by The society of American Gastrointestinal and Endoscopic Surgeons, SAGES.

Telementoring:

“A relationship, facilitated by telecommunication technology, in which an expert (Mentor) provides guidance to a less experienced learner (Mentee) from a remote location”(2)

Mentor:

“An expert surgeon who undertakes to impart his/her clinical knowledge and skills in a defined setting to a mentee. The mentor must be appropriately privileged, skilled, and experienced in the procedure(s) and or technique(s) in question. In order to serve as a mentor in a specific procedure or technique, the surgeon (mentor) must be a recognized authority (e.g., publications, presentations, extensive clinical experience) in the particular field of expertise” (2)

Mentee:
«A surgeon with appropriate basic knowledge and experience seeking individual training in skills and/or procedures not previously learned in prior formal residency or fellowship training. The mentee must have appropriate background knowledge, basic skills, and clinical experience relevant to the proposed curriculum. The mentee should be board eligible or certified in the appropriate specialty or possess equivalent board certification from outside the United States» (2)

1.2.2

Traditional surgical training requires that an experienced surgeon, the mentor, is physically present at an operationg room, mentoring an inexperienced surgeon, the mentee. With the rapid development in telecommunication technology and surgical techniques and procedures, the traditional method of surgical training may in many cases prove excessively expensive and ineffective. With the traditional method of surgical training, implementing new surgical procedures in a hospital does not only require the importation of the necessary surgical equipment, but also importation of one or more experienced surgeons. (3)

Telementoring is a form of telemedicine, which is defined as: "A relationship, facilitated by telecommunication technology, in which an expert (Mentor) provides guidance to a less experienced learner (Mentee) from a remote location"(4) The first reported case of telementoring being used for educational purposes dates back to the sixties, with DeBakey performing the first open-heart surgery(5).

Instead of standing over the patient, looking directly into the area of the body in which the procedure is to be conducted, a camera lens attached to a rod is used in order for the performing surgeon to see the relevant area of the patient´s body on a computer screen. By broadcasting these images through the internet, an experienced surgeon (the mentor) may see images from the same angle as the mentee, in real-time, without being remotely close to the actual operating room. (3, 6, 7)

An additional advantage to telementored surgical training is the fact that both mentor and mentee have the exact same view of the operation site. With on-site mentoring, the mentee stands right above the site of surgery, while the mentor stands either on the left/right side of the mentee, or right above him. This makes the mentee´s view of the operation site differ slightly from the mentor´s view.

There are, however, some potential drawbacks to surgical mentoring without a mentor on-site. With the traditional method of surgical training, the presence of an experienced surgeon is also a form of safety net in regards to patient safety. Under traditional surgical training, should complications occur during a procedure, an experienced surgeon may at any time intervene and take control over the surgical tools. With telementoring, this is currently not an option. This places an increased responsibility on the mentee in regards of safety for the patient. (2) (8)

Another potential hazard to surgical telementoring is the increased chance of technical malfunctions. In Bove et al.'s study from 2004, 5 out of 17 telementored procedures were interrupted due to loss of connection to the proctoring site. This causes an additional risk to patient health, due to the possibility that the mentee may have to complete parts of- or potentially the whole procedure without any guidance from a mentor whatsoever. (9, 10)

The initiative to conduct this study came from a need of surgical experience in the robot-assisted ventral mesh rectopexy-procedure in the hospital of Bodø, a medium sized hospital in northern Norway. Due to the lack of a surgeon in Bodø sykehus with experience with the ventral mesh rectopexy-procedure, as well as Bodø sykehus´ remote location, inducting the procedure at Bodø hospital through on-site mentoring would prove difficult and costly. These obstacles were overcome by organizing an initiative to introduce RVMR in Bodø sykehus through off-site telementoring. The Department of GI Surgery at Bodø Regional Hospital developed a structured educational program for RVMR based on the SAGES educational framework (Augestad et al Surg Endoscopy). This study was conducted to assess the learning curve and feasibility associated with an educational telementoring program, introducing a RVMR to surgeons with no prior experience with the procedure. The objective of this study is to describe and critically assess the learning curve over the course of the first 20 RVMR of an individual experienced robotic surgeon. Simultaneously, the study aims at assessing whether this educational program of RVMR, based on the SAGES educational framework, is feasible.

1.3 Robot surgery and robot assisted ventral mesh rectopexy (RVMR)

Robotic surgery is gradually becoming more commonly used for surgical procedures, due to its technical advantages over traditional surgery (11). Robotic surgery offers several advantages over traditional surgery, such as filtrating the surgeon´s tremor, the ability to magnify images, and creating more ergonomic postitions for the surgeon compared to what traditional surgery allows. This, in addition to the increased role of surgery globally, due to shifting patterns in disease and an increase in global population, is causing an increased demand for robotic surgery and robotic surgical skills worldwide. (6, 12)

Robotic ventral mesh rectopexy is a form of *minimally invasive surgery* (MIS). MIS is a surgical technique which allows the surgeon to perform a procedure without inflicting large surgical wounds. The procedure is made possible by using a rod lens with a camera attached, and an insufflation device. The camera system allows the surgeon to visualize the inside of the patients body. The insufflating device distends the patient´s body cavity, which provides the surgeon with ample space to perform the surgery. MIS provides several advantages over traditional open surgery. Among these are the reduced reconvalence time after surgery, and the cosmetic benefit of the small laparatomic incisions wounds, compared to the much larger wounds of a laparotomy. Both robotic surgery and the more traditional laparoscopic surgery are examples of MIS. (13) (14)

There are some vital differences between robotic and laparoscopic surgery. Laparoscopic surgery provides a two-dimensional imaging, a restricted range of motion, and poor positioning of the surgeon. As a solution to minimize these shortcomings of laparoscopic surgery, robotic surgery system were introduced. Robotic systems provide the surgeon with features such as 3D imaging, tremor filters and greater range of motion of the surgical tools. These features are unavailable with traditional laparoscopic surgery, which rely on the surgeon´s free-hand movements of the surgical tools. (15)

Robotic ventral rectopexy is a form of minimally invasive surgery in which the rectum is reattached into its normal placement within the pelvis. The procedure is primarily used to treat external rectal prolapse, but may also be used to treat rectal intussuception and rectocele. (11)

The procedure is performed by first making an incision at the sacral promontory. The incision is then continued, superficially along the right side of the rectum, and over the pouch of Douglas. The rectovaginal septum is then opened, in order to gain access to the anterior wall of the rectum taking care to not injure the posterior vaginal wall. The caudal end of a mesh is then sutured to the distal end of the anterior rectum wall, by fixating the sutures to the seromuscular borders of the rectum. The cranial end of the mesh is then fixed upon the sacral promontory using either sutures or an endofascia stapler. The patient´s posterior vaginal fornix may then be sutured to the anterior part of the mesh, which closes the vaginal rectal septum. Finally, the lateral borders of the incised peritoneum are sutured over the mesh. The procedure is standardized, and the performing surgeon follows a step by step-description when performing the procedure. (13).

1.4 Background literature of telementoring in robotic surgery

1.4.1

A 2005 study compared the clinical outcomes of individually executed, on-site mentored and telementored hand-assisted laparoscopic living donor nephrectomies, which is a laparoscopic procedure used for kidney transplantations. The study used 7 parameters to assess the success of each procedure (see table 1)

Group/parameter	Operative time (min)	Warm ischemic time (min)	Estimated blood loss (mL)	Donor length of stay (d)	Donor creatinine (mmol/L)		Recipient creatinine (mmol/L)			Return to work/full activity (weeks)
					Preop	Day 1	Preop	Day 1	Day 7	
Locally mentored										
M, 30 y	180	175	50	4	104	164	851	236	100	6
M, 48 y	240	285	40	3	83	153	881	337	138	4
Mean	160	230	45	3.5	93.5	159	866	287	119	5
Telementored										
M, 40 y	185	146	28	2	94	165	553	357	157	1
F, 56 y	230	185	287	3	66	120	734	599	156	1
M, 70 y	296	245	185	4	83	136	1433	892	140	5
M, 55 y	250	180	100	3	110	176	375	292	88	1
Mean	240	189	171	3	88	149	774	535	135	2
Independent										
M, 29 y	220	226	100	3	108	182	718	444	122	4
F, 54 y	256	285	23	3	83	116	717	423	192	1
F, 61 y	250	470	250	4	59	99	1076	728	169	6
M, 44 y	270	192	300	5	77	128	643	456	192	6
M, 42 y	197	220	150	4	90	130	645	534	109	6
F, 42 y	155	187	100	3	69	102	425	31	33	3
Mean	225	263	134	3.7	81	126	704	436	136	4.3

Table 1 The procedures are divided into three groups; locally mentored, telementored and independently performed. The success of each procedure is measured by quantifying each of the seven surgical and post-surgical parameters displayed in the figure. The unit of measurement is specified in the parethesis () under each parameter. The prefix "M" stands for "male", while "F" stands for "female". Creatinine levels in the kidney donor is measured before and 1 day after the procedure, while in the recipient it is measured before, 1 day after and 7 days after the procedure. Source: Sciencedirect.com (6)

In this study, each of the procedures were completed without operative complications. The mean differences within the parameters were considered statistically insignificant between the three groups. The study concludes that telementoring as a form of mentoring laparoscopic robotic surgical procedures is feasible, and may facilitate individual practice. (16)

1.4.2

A 2007 multicentered descriptive study compared the quality of telementored minimally invasive robot-assisted procedures on pigs, to traditional on-site mentored procedures. In the study, 40 inexperienced surgeons performed surgery under guidance of an experienced surgeon, through on-site passive mentoring, on-site active mentoring and through telementoring. On-site passive mentoring consisted of an experienced surgeon, the mentor, being physically present at the operation room, giving exclusively verbal guidance to the inexperienced surgeon, the mentee. On-site active mentoring enabled the mentor not only to verbally assist the mentee, but additionally enabled the mentor to operate one or two of the surgical instruments. (7)

After performing each surgery, the mentees evaluated the quality of the mentoring by filling out a predetermined questionnaire (see table 6). The results are based on the mentees´perception of the quality of the mentoring, as well as the technical performance of the surgical robot used for the study. It does not assess, nor compare the quality of the surgical performances under the different forms of mentoring. (7)

Mentoring	Bad 0	Poor 1	Regular 2	Good 3	Excellent 4
Active onsite mentoring					
Passive onsite mentoring					
Robot-assisted telementoring					
Robot Performance	**Bad 0**	**Poor 1**	**Regular 2**	**Good 3**	**Excellent 4**
Image					
Quality					
Sharpness					
Color					
Interference					
Sound					
Quality					
Sharpness					
Movements					
Smoothness					
Appropriateness					

Table 2 Questionnaire filled out by the surgeons after performing each surgery. The score is based on the surgeons´subjective assessment of the quality of mentoring during the procedure. Source: Journal.sagepub.com (8)

The study found an overall significantly lower score for the telementored procedures, compared to the on-site mentored procedures.

1.4.3

A multicenter descriptive study from 2020 evaluated the use of telementoring in robotic surgical training. The test was conducted by randomly selecting volunteers with no surgical training into three groups; a control group, a “group 1” and a “group 2”, each of them consisting of n=14 volunteers. The three groups would be tested by performing three tasks with the surgical robot. The first task consisted of moving a rubber triangle with a hole in the center from one peg on a peg board, to another peg. The second task consisted of cutting a gauze into a circle shape with a surgical cutter. The last task consisted of suturing a penrose drain, which is a surgical drain used for fluid draining under surgical procedures. (3)

The first task aimed at demonstrating fine-motor dexterity, as the volunteer would have to transfer the rubber triangle from the surgical tool operated with the volunteer´s non-dominant hand onto the tool operated by the dominant hand. The second task aimed at demonstrating the ability to perform precision and accuracy of dissection, an important skill in robotic surgery. The last task demonstrates the volunteers ability to perform sutures with the surgical robot, a difficult task which is necessary to master in order to perform real life robotic surgery. (3)

Several parameters were applied in order to numerically quantify the volunteers´performance in each of the test. This included, amongst others, applying penalty scores if the volunteer dropped the rubber triangle, or deviated from the outlined area when performing the circle cut, or if he or she did not manage to finish the surgical knots in the knot-tying task. (3)

All three groups would first watch an introductional video, instructing them on how to perform three different tasks with the surgical robot. After watching the video, each group either practiced freely with the robot for 45 minutes, or received telementoring in surgical technique by an expert surgeon located off-site for 45 minutes. The volunteers then performed three surgical tasks, and then either practice freely or receive training from expert surgeons. Then all three groups performed the same three tasks again. Table 3 displays the order and method used for training and testing the volunteers.

Session	Control Group (P-P)	Group 1 (P-T)	Group 2 (T-P)
1	Video	Video	Video
2	Practice	Practice	Training
3	Test 1	Test 1	Test 1
4	Practice	Training	Practice
5	Test 2	Test 2	Test 2

Table 3 All three groups first watched the same video. Then the members of the control group and group 1 practiced with the robot freely, while the members of group 2 received telementored surgical training by an expert surgeon. After performing the three tasks (the «test»), the control group and group 2 practiced freely, while group 1 received telementored surgical training. Source: onlinelibrary.wiley.com (17)

The study revealed that each of the 3 groups made a statistically significant improvement between their first and second test. The control group increased their overall performance by 19% between the first and the second test. Group 1 increased their performance by 55%, which is a significantly larger degree of improvement compared to the control group. The study concludes that telementoring with guidance from an expert in robotic surgery demonstrates a significantly higher degree of improvement in surgical skills compared to unsupervised practice with the robot over the same period of time. (3)

1.4.4 Educational programs and SAGES recommendations

In order to quality proof the use of telementoring in surgical education, several educational frameworks have been conceptualized. The society of American Gastrointestinal and Endoscopic Surgeons, SAGES, recommends a structured surgical telementoring curriculum. The educational program used in this study is based on these recommendations. The recommendations consist of four main domains, these being: *prerequisites for entering the program, teaching modalities, curricular components* and *methods of assessments. (2)*

Prerequisites for entering the program consists of defining the entry level of performance for both mentor and mentee prior to initiating an educational program. The level of performance is defined by the mentor/mentee´s knowledge, skills and leadership. It is important to make sure that potential mentors in an educational program display not only excellent surgical skills in the given procedure, but they also demonstrate high-level knowledge in pedagogical methodology, as well as expertise in surgical telementoring. Regarding mentees, it is important to ensure that they are affiliated at an accredited institution, and they should have a letter of support from their institution. Mentees should also certain predefined surgical skills which are relevant to the given procedure. (2)

The *Teaching modalities*-domain recommends that mentee and mentor in their initial experience with telementoring conduct some form of simulated practice sessions prior to performing surgical procedures. These sessions should reflect the different settings of telementoring, and contain elements that are appropriate to the surgical procedure. (2)

The *Curricular components*- domain serves the purpose of providing curriculum which may help facilitate progression towards proficiency in the given surgical procedure. The curriculum should focus on the technology of telementoring, underlining issues that may arise, and how to overcome these. I. e there may be a need to develop a structured communication method in order to overcome communication problems during surgery. (2)

Assesment methods consists of reviewing each telementored procedure. This may be done by video coaching, where the mentor and mentee review footage of the procedure, or by doing a blinded review of footage from the procedure. The blinded review may be performed by utilizing a scoring tool, such as the GEARS score (2)

2 MATERIAL AND METHOD

2.1 Process

In the fall of 2019, I contacted Dr Khayam Butt, a Norwegian colorectal surgeon working in the hospital of Bodø, Norway. He had expressed his intentions of doing a project regarding a new gastrosurgical innovation, which I was informed about through a fellow medical student. Due to my interests in surgery, I approached Dr Butt through email, and we began discussing possible approaches to the project.

2.2 Ethics and PVO approval

Before initiating the project, an application was sent to the Norwegian national committee of ethics. The project was approved as a quality-insuring project. Prior to the procedures, a written statement of consent was signed by each of the patients. Each patient also received an informative letter with detailed information about the procedure, which they received when giving their written consent to the procedure.

2.3 Description of the mentee and mentor

The 20 procedures were are all conducted by the same mentee, a colorectal surgeon located in Bodø, and mentored by the same mentor, a colorectal surgeon located in Aarhus.

The mentor, Dr N. Thomassen is a danish colorectal surgeon practicing at Aarhus university hospital, Denmark. Thomassen has vast experience with robotic ventral mesh rectopexy. In addition, Thomassen is a practicing mentor in surgery with the DaVinci surgical robot, which is the robot used in this study.

The mentee, Dr Khayam Butt, is a colorectal surgeon practicing in the hospital of Bodø, Norway. Butt has prior experience in laparoscopic and robotic colorectal cancer surgery, but no experience with neither robot-assisted ventral mesh rectopexy, nor telementoring of surgical procedures.

2.4 Description of the educational program

The project was a step-by-step educational program created to facilitate skill improvement in a surgical specialist from the stage of being a novice in RVMR, to becoming sufficiently skilled to conduct the procedure independently.

The project started with talks between mentor and mentee, and a contract of cooperation was signed by both parties. The contract contained a training plan on how to conduct the educational program.

Patient inclusion to the standardized procedure of ventral mesh rectopexy was initiated by on-site mentoring of two procedures carried out at the mentee's institution with the mentor approving the mentee and the institution for further telementoring guidance.

After the institution and mentee had been greenlit by the mentor, the project commenced. It was agreed upon by both mentor and mentee to follow a step-by-step description of the surgical procedure in all the 20 surgeries performed.

After finishing each procedure, a short debriefing was held between the mentor and mentee while still being in contact through the telementoring device. In the debriefing, mentor and mentee discussed successful elements of the procedures, as well as elements of the procedure which should be improved. Telestration pictures utilized during telestration sessions during surgery were utilized in the debriefings.

2.5 Description of the robot and the telementor equipment

The telementoring of the procedures was enabled through utilizing the *InTouch RP Viewpoint* system, a software enabling the off-site mentor to see the mentee performing the procedure through a real-time broadcast. The software enabled the mentee to see the procedure from two different views; an endoscopic view, observing the movements of the surgical tools, or through a "boom camera", which shows an external view of the patient´s abdomen and pelvis.

The mentee and mentor may communicate orally through a live audio feed. This allows continuous verbal interaction between mentor and mentee through the procedure. The audio may be provided either through a headset worn by the mentee, or through loudspeakers in the OR. (5)

The mentor has the option to guide the mentee through telestration. This consists of the mentor providing the mentee with instructions by making freehand sketches on a stillpicture of the continuous video feed. The mentor takes the stillpicture, and may ask the mentee to stop the ongoing surgery for a "telestration session". Telestration enables the mentor to provide the mentee with insight that may prove difficult through audio, such as identifying anatomical landmarks, displaying planes of dissection, etc. Currently, only still-picture telestration is available. (18)

2.6 Method of blinding of the videorecordings

The videos of the procedures were sent in three encrypted flash drives by an operations director at Bodø sykehus. I received the code to the flashdrives through text, after confirming my identity over email. The order of which the procedures had been performed were unknown (i.e blinded) to both the operations director and myself. Although, the order of which I received the flash drives were not randomized. The first flashdrive, containing surgery one to eight was delivered by mail to my home address 4 weeks before the second flashdrive, which contained videos of surgery nine to 15. About 6 weeks later, the third and last flashdrive, containing surgery 16-20 arrived.

2.7 Education in RVMR and use of GEARS score

Prior to assessing the 20 recordings, I was taught how to utilize the GEARS scoring tool by Khayam Butt, the colorectal surgeon who performed the 20 procedures. I also received a series of personal lectures from Butt, containing a step-by-step approach to how the ventral mesh rectopexy is performed. Due to travelling restrictions under the COVID 19 pandemic, these lectures were conducted via Skype. This was done as an attempt to provide me with the necessary base knowledge needed to utilize the GEARS scoring tool correctly.

2.8 Video assessment and the GEARS scoring procedure

Each of the 20 video recordings of the procedures were assessed using the GEARS score. The GEARS score is a validated and standardized assessment tool for robotic surgical skills. It is developed by deconstructing different elements of robotic surgery, and assessing each of them using a scale from 1-5. A rating of 1 represents the lowest level of performance, while the rating of 5 represents the highest. GEARS score consists of a total of six domains, these being; depth perception, bimanual dexterity, efficiency, autonomy, force sensitivity and robotic control. (19)

Each of the domains have performance anchors connected to the rating of 1, 3 and 5. These performance anchors are descriptions of the surgical skills associated with each of the three ratings. I.e; a rating of 1 in the "depth perception"-domain, represents a surgical performance described as "Constantly overshoots target, wide swings, slow to correct", while a performance rated as 5 represents a performance described as "accurately directs instruments in the correct plane to target". The GEARS score is thus a tool for reviewing the technical proficiency displayed in a robot assisted surgery. It does not take into account other factors which define a successful surgery; such as surgical or clinical judgement. (19)

The GEARS score of a robotic surgical procedure is calculated by adding the ratings from each of the 6 domains. Thus, the GEARS score of a robotic surgical procedure is a numeric value between 6 and 30.

2.9 Patient safety

During the procedures, there were at all times an experienced robot surgeon present at the hospital in Bodø. This safety measure provided the mentee with an option to receive on-site surgical assistance during the procedures if necessary.

2.10 Study population

The study population consisted of 20 female patients. 18 of the included patients were diagnosed with external rectal prolapse. There were 2 patients in the cohort not presenting with external rectal prolapse, but were clinically diagnosed with either a symptomatic rectocele or enterocele. Except the two first mentored RVMR, the surgeon managed to complete each of the remaining 18 procedures without interruption or assistance from other on-site surgeons.

2.11 Variables

Each of the 20 surgical videos were catalogued as "numbers of surgeries perfomed", and given a numerical value of 0 to 19. The first video is given the numerical value of 0, since the surgeon prior to this procedure has performed 0 telementored robot-assisted ventral mesh rectopexies. The decision to assign the first video with the value of 0 instead of 1 was made so that when analyzing the results of the study, it would become more apparent whether there is a clear relation between performing telementored surgeries and increasing technical surgical proficiency.

Each of the videos were assigned a score between 6 and 30, with 30 being the highest possible score and 6 being the lowest. The total GEARS score is, as previously discussed, the sum of a scoring system on 6 individual technical parameters within robotic surgery, with each parameter ranging from 1 to 5. As the lowest score in each of the 6 categories is 1, the lowest total GEARS score is 6. Table 4 describes the scoring system, with anchor points assigned to the scores of 1, 3 and 5 in each category.

Depth perception

1	2	3	4	5
Constantly overshoots target, wide swings, slow to correct		Some overshooting or missing of target, but quick to correct		Accurately directs instruments in the correct plane to target

Bimanual dexterity

1	2	3	4	5
Uses only one hand, ignores nondominant hand, poor coordination		Uses both hands, but does not optimize interaction between hands		Expertly uses both hands in a complementary way to provide best exposure

Efficiency

1	2	3	4	5
Inefficient efforts; many uncertain movements; constantly changing focus or persisting without progress		Slow, but planned movements are reasonably organized		Confident, efficient and safe conduct, maintains focus on task, fluid progression

Force sensitivity

1	2	3	4	5
Rough moves, tears tissue, injures nearby structures, poor control, frequent suture breakage		Handles tissues reasonably well, minor trauma to adjacent tissue, rare suture breakage		Applies appropriate tension, negligible injury to adjacent structures, no suture breakage

Robotic control

1	2	3	4	5
Consistently does not optimize view, hand position, or repeated collisions even with guidance		View is sometimes not optimal. Occasionally needs to relocate arms. Occasional collisions and obstruction of assistant		Controls camera and hand position optimally and independently. Minimal collisions or obstruction of assistant

Table 4 GEARS score. Anchor points describing the skills required for the scores of 1, 3 and 5 for each of the 6 parameteres. The score 2 and 4 are assigned when the skills displayed during a procedure fall between the scores of 1, 3 and 5. Source: Researchgate

In addition, the scores of each of the parameters, these being depth perception, bimanual dexterity, efficiency, autonomy, force sensitivity and robotic control were each logged individually. This allowed for a systematic review of not only the improvement in overall surgical proficiency, but also a comparison in improvement between the different parameters

2.12 Statistical methods

Reviewing the data from the scoring of videos was done by logging results in *SPSS Statistics* version 26 (2019), a software package provided by the technology company *IBM*. The findings were reviewed by applying descriptive statistics and analysis in SPSS. Linear regression is applied to graphically display correlation between two numerical variables. Pearsons coefficient was applied in order to determine degree of correlation between the number of procedures performed and the GEARS score/ score in each parameter of GEARS score for each procedure.

The correlation between number of surgeries performed (n), and the GEARS score/ score in each parameter of GEARS score is reviewed at 95% confidence interval. Thus, any p-value of less than 0.05 is considered statistically significant.

3 RESULTS

3.1 Surgical scores

3.1.1 Total GEARS score

Figure 1 displays the distribution of GEARS scores for each of the performed procedures.

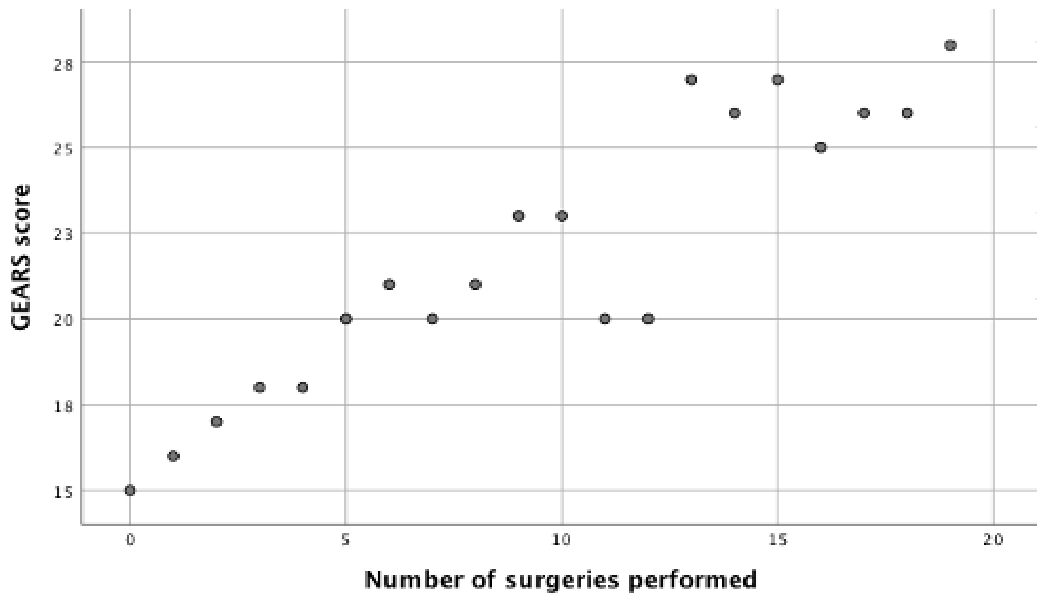

Figure 1 Scatter plot displaying total GEARS (score raging from 6 to 30) for each of the 20 procedures.

By applying linear regression to the data set, I got a Pearson correlation factor of 0.928. At a population of n=20, the Pearson correlations factor of 0.928 equals a P-value of 0.00001. At a confidence interval of 95%, a P-value of 0.05 or lower for a result is considered significant. The mean GEARS score for the 20 surgeries was 21.85 points.

3.1.2 Parameters in GEARS score reviewed individually

As follows are the scatter plots of the different parametres in GEARS score as a product of numbers of surgeries performed:

3.1.2.1 Depth perception

Within the "Depth perception"-parameter, a Pearson´s correlation factor of 0.726 was calculated. This equals a P-value of 0.00029 at population of n=20: Mean score (on scale 1-5) was 3.60. See figure 2

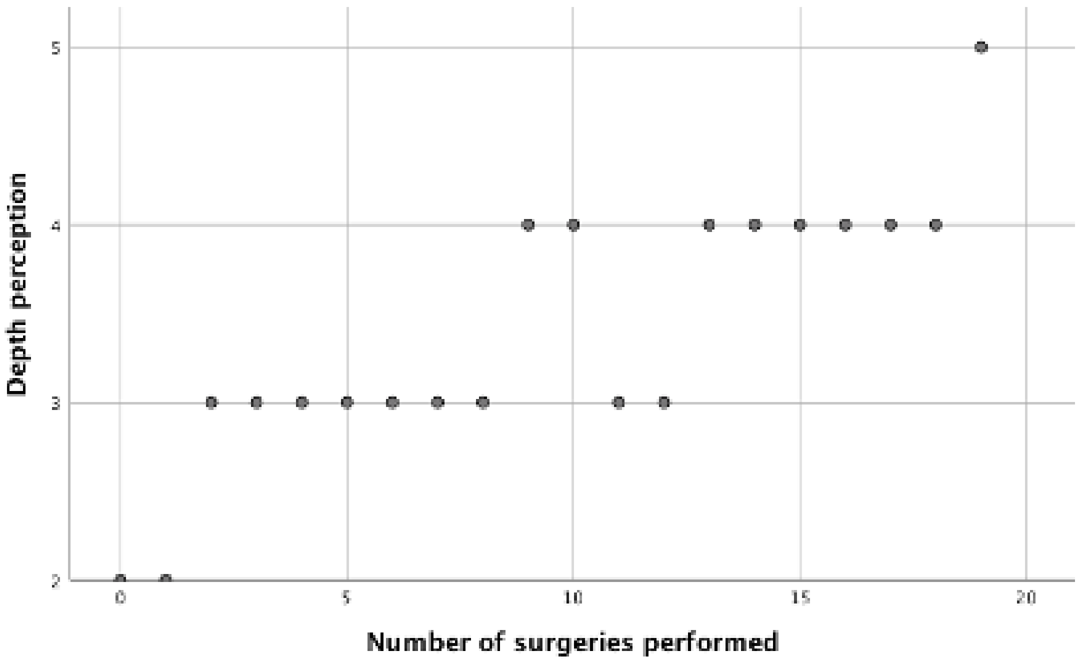

Figure 2 Scatter plot displaying scores given for the parameter "depth perception" (score ranging 1-5) for each of the 20 procedures.

3.1.2.2 Bimanuality

Within the "Bimanuality"-parameter, a Pearsons correlation factor of 0.726 was calculated. This equals a P-value of 0.00029 at population of n=20: Mean score (on scale 1-5) was 3.60. See figure 3

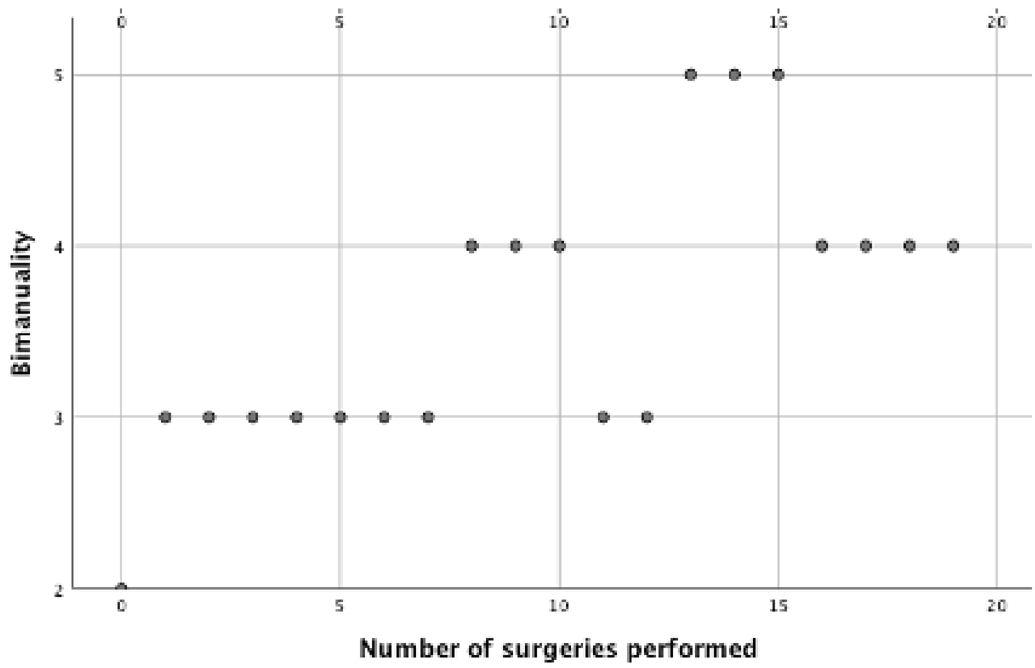

Figure 3 Scatter plot displaying scores given for the parameter "bimanuality" (score ranging 1-5) for each of the 20 procedures.

3.1.2.3 Effectivity

Within the "Effectivity"-parameter, a Pearsons correlation factor of 0.937 was calculated. This equals a P-value of <0.00001 at population of n=20: Mean score (on scale 1-5) was 3.10. See figure 4

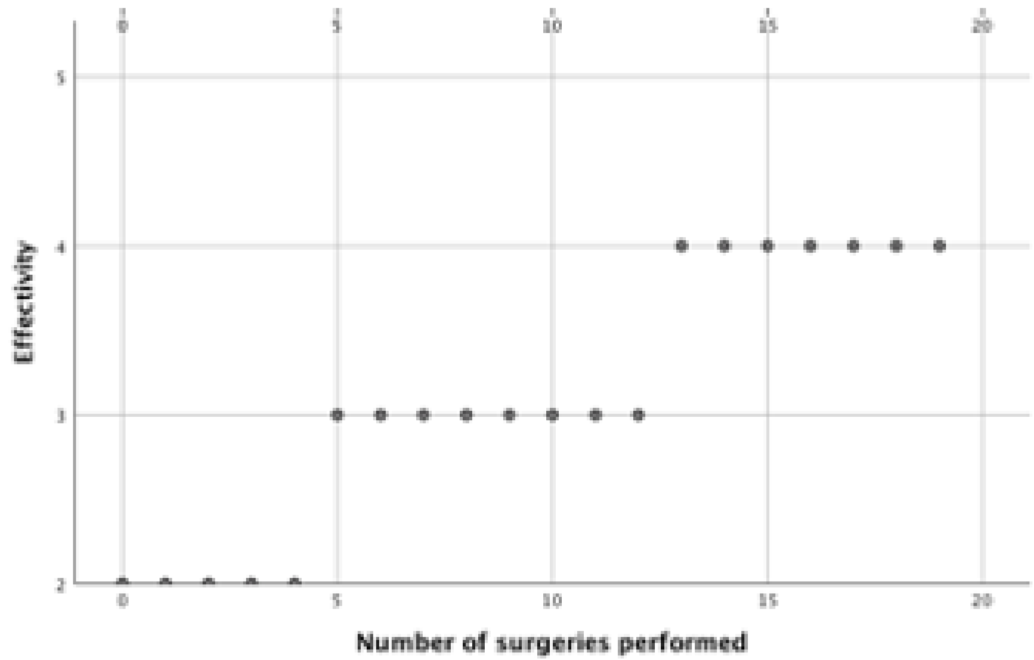

Figure 4 Scatter plot displaying scores given for the parameter "effectivity" (score ranging 1-5) for each of the 20 procedures.

3.1.2.4 Force sensitivity

Within the "Force sensitivity"-parameter, a Pearsons correlation factor of 0.732 was calculated. This equals P-value of 0.000244 at population of n=20: Mean score (on scale 1-5) was 3.10. See figure 5

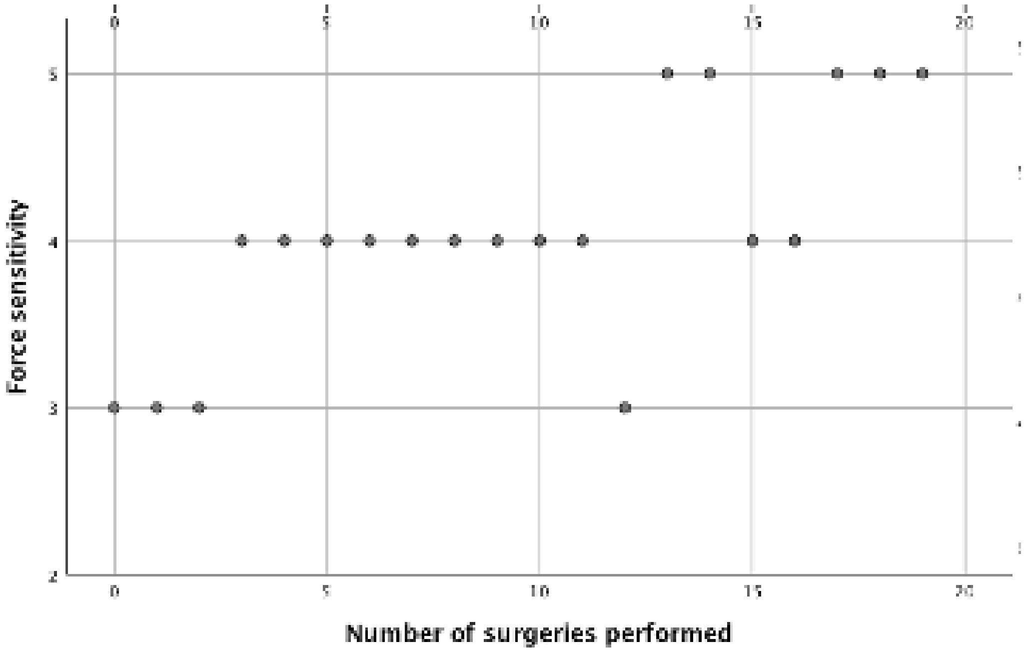

Figure 5 Scatter plot displaying scores given for the parameter "Force sensitivity" (score ranging 1-5) for each of the 20 procedures.

3.1.2.5 Robot control

Within the "Robot control"-parameter, a Pearsons correlation factor of 0.886 was calculated. This equals P-value of <0.00001 at population of n=20: Mean score (on scale 1-5) was 3.70. See figure 6

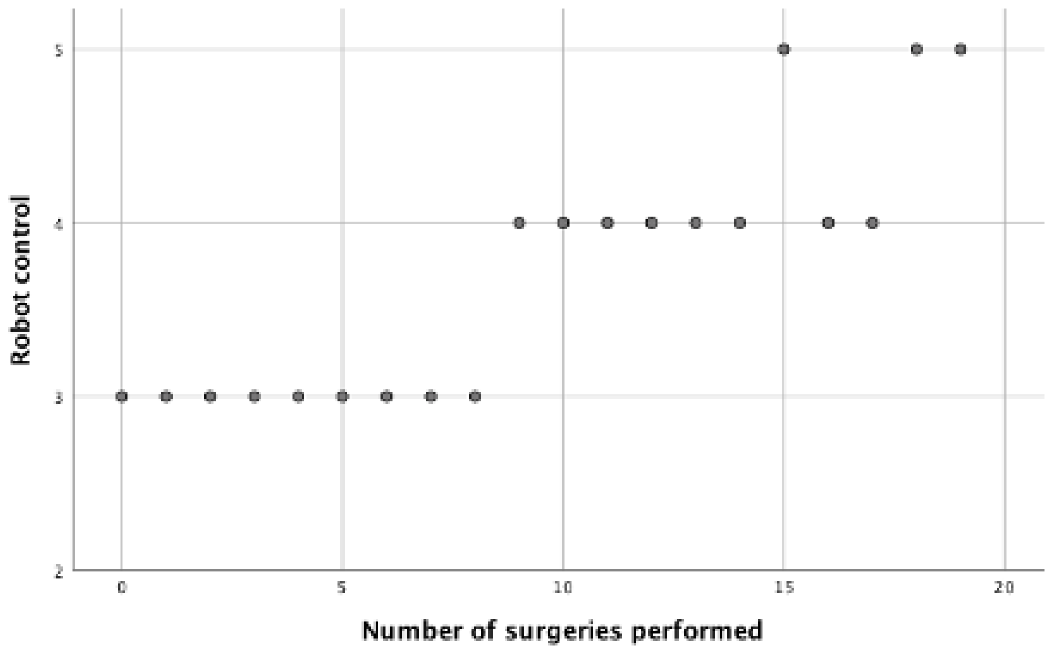

Figure 6 Scatter plot displaying scores given for the parameter "Robot control" (score ranging 1-5) for each of the 20 procedures.

3.1.2.6 Autonomy

Within the "Autonomy"-parameter, a Pearsons correlation factor of 0.803 was calculated. This equals P-value of 0.00002 at population of n=20: Mean score (on scale 1-5) was 3.95. See figure 7

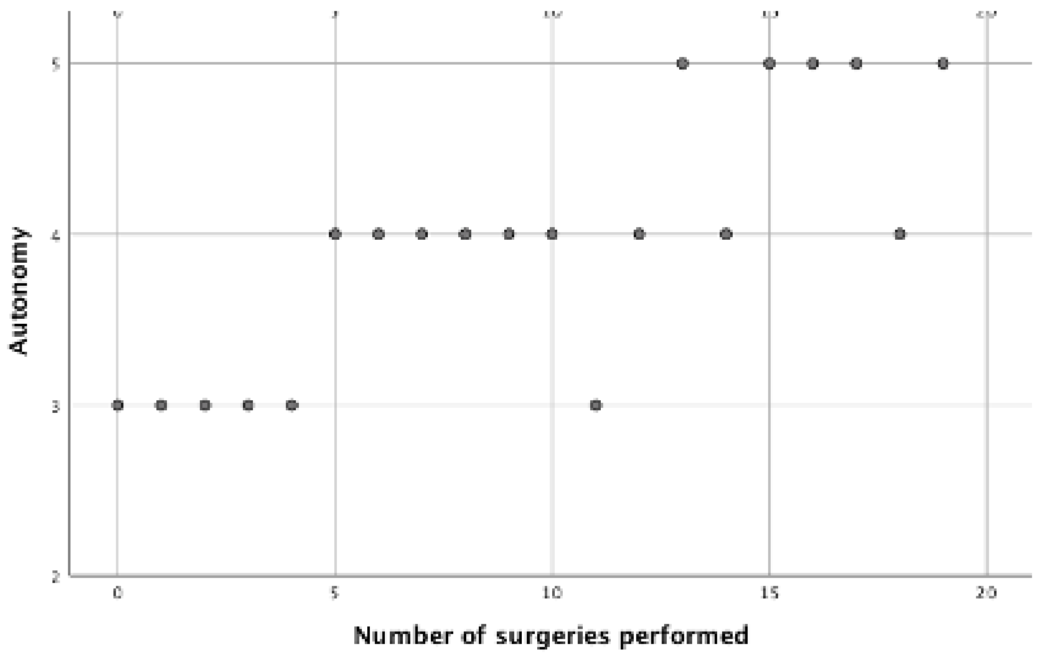

Figure 7 Scatter plot displaying scores given for the parameter "Autonomy" (score ranging 1-5) for each of the 20 procedures.

3.1.3 Interpretation of findings

As previously mentioned, a confidence interval of 95% was chosen for the statistical analysis. The analysis shows statistical significant improvement of technical proficiency across all 6 parameters within the GEARS score, as well as for the total GEARS score.

I divided the procedures into an "early", "middle" and "late" stage, with the early stage consisting of video 1-7, the middle stage consisting of video 8-14 and the late stage consisting of video 15-20. Then I calculated the average score of each of the 6 GEARS parameters, as well as the total GEARS score, within each of the three stages. This allowed me to compare the degree of technical improvement across the seven different categories. See table 5 and 6 for results.

Mean total GEARs score	Range: 6-30
Early stage (video 1-7)	17.86/30
Middle stage (video 8-14)	22.85/30
Late stage (video 15-20)	26.33/30

Table 5 Mean total GEARS score, with videos divided chronologically into the three stages: early, middle and late.

	Mean bimanuality score (1-5)	Mean force sensitivity score (1-5)	Mean autonomy score (1-5)	Mean depth perception score (1-5)	Mean effectivity score (1-5)	Mean robot control score (1-5)
Early stage (video 1-7)	2.86	3.57	3.29	2.71	2.29	3.00
Middle stage (video 8-14)	3.71	4.00	4.00	3.42	3.29	3.71
Late stage (video 15-20)	4-33	4.67	4.67	4.17	4.00	4.50

Table 6 Mean score given to each of the 6 parameters within the GEARS score system, with videos divided chronologically into the three stages: early, middle and late.

As table 6 displays, the surgeon´s scores increased by the largest margin in the "effectivity"-parameter, with an increase of 1.71 points between the early and the late stage. This is a 74% increase in the effectivity category between the early and the late stage. The scores increased by the smallest margin in the "Force-sensitivity"-parameter, with an increase of 1.1 points between early and late stage. In this category, the score increased by 30.8% between the early and the late stage.

The mean total GEARS score increased by 8.47 points between the early and the late stage. This equals a 47% increase in overall technical proficiency. The total GEARS score increased by 4.99 points between early and middle stage, and by 3.48 points between middle and late stage. This indicates that in general, the surgeon´s skills increased more rapidly in the early stages of telementored surgical training, than in the latter stages.

4 DISCUSSION

4.1 Strengths

The use of GEARS score to score surgical videos is a new approach in the assessment of telementoring in surgery. This research assesses the technical aspects of the surgical procedures themselves using a validated scoring tool (GEARS score), rather than simply assessing the clinical outcomes of procedures. This, in our opinion, provides a unique insight in the learning curve associated with the use of telementoring in these surgical procedures. Another strength of this study is the fact that the displayed surgical proficiency is assessed in a clinical surgical setting, unlike for example Prince et. Al´s. study, which used a non-clinical test setting.

4.2 Weaknesses

There are several weaknesses to the research i´ve conducted. Firstly, there is no control group in this study. The surgeon´s improvement in technical proficiency is measured by comparing the level of proficiency displayed in the first few videos, to the level of proficiency displayed in the last few videos. Thus; there is no comparison with surgeons who are on-site mentored. This, in turn, means that the technical improvement displayed by the surgeon may be quantified, but the cause of this improvement may not. An increase in technical skill over the course of 20 surgeries may be attributed to the fact that the surgeon has had ordinary surgical practice on the robot (i.e. other elective procedures), as it is due to telementoring being an effective tool in teaching robotic-surgical skills.

Secondly: Another weakness is the difficulties I´ve encountered with grading surgical proficiency with the GEARS score. The GEARS score does not take into account the many complications that may occur during a surgery. I.e; when suturing the mesh onto the rectum of a patient with a narrow pelvis, the available space for the surgical tools to move is limited. This causes the surgeon´s suturing technique to appear far less fluent than in a patient with ample space within the pelvis. Thus; an unfairly disadvantageous GEARS score may be assigned to a procedure due to an anatomically challenging procedure, rather than an unproficient performance by the surgeon.

Thirdly: The recordings were scored by me, a fifth-year medical student. This may prove as a source of error, due to a general lack of knowledge and experience in the surgical field. Receiving one-on-one guidance and tutoring on how ventral mesh rectopexy and GEARS scoring tool are done and utilized gave me a broader perspective, but my knowledge on the subjects prior to scoring the videos were still admittedly scarce compared to that of trained surgeons. Nevertheless, there exists several publications of medical students participating in research focusing on the learning curve of surgical procedures, and it might be argued that medical students are a valuable asset in educational research(20)

As forementioned, the recordings were randomized within each of the three flashdrives. Although, the first flashdrive I received contained the first eight procedures, the second flashdrive contained the ninth to fifteenth procedure, and the third contained the last 5 procedures. As a result, the videos were not truly blinded, but rather divided into three groups, and then randomized withing these groups. This may have affected the outcome of the video assessment in the sense that while scoring the videos, one may have unintentionally expected a higher level of technical proficiency to be displayed in the procedural recordings on the third flashdrive than in the first one. This example of both randomization- and confirmation bias must be taken into account when reviewing the findings of the study.

4.3 Further discussion

A valid point of thought when reviewing the findings of this study, is to consider how prior experience with colorectal surgery may affect the learning curve when adapting telementored robot-assisted colorectal procedures. As described previously, the mentee had prior experience with both laparoscopic and robot-assisted colorectal surgery, albeit not with the ventral mesh-procedure or telementoring as a whole. The prior experience with robot surgery implicates an increased level of skill with the surgical robot compared to that of a colorectal surgeon with no prior experience with robotic surgery. This increase in baseline robot-surgical skills may cause a significantly different learning curve compared to those with a lower baseline of robot-surgical skill prior to their first procedures.

There are additional factors that may affect the GEARS score across the 20 assessed videos. One of these is the alternative surgical experience the mentee may have acquired during the same time period he conducted the 20 telementored procedures. It may be particularly relevant whether the mentee has performed any additional robotic surgeries during this time frame. However, certain non-robotic procedures, such as surgery in the pelvic area, may also affect the technical performance during RVMR, due to increased surgical experience with the same anatomical structures as in RVMRs.

5 Implications

This thesis has assessed the technical learning curve and the aspect of feasibility associated with the implementation of an educational program of telementored robotic ventral mesh rectopexy.

6 CONCLUSION

The findings of this study suggest that an educational program of telementored RVMR is feasible. Telementoring as a tool of guiding a surgeon in a robot-assisted laparoscopic procedure of which he/she has little to no experience with is feasible. It also suggests that telementoring of RVMR is associated with a significant increase in technical proficiency displayed by the operating surgeon over the initial procedures the surgeon conducts. The study, however, does not take into account whether the increase in technical proficiency is attributed to the telementoring process itself, rather than being a result of a general increase in the surgeons general robotic skills. It will require further investigation with an on-site mentored control group in order to disclose the efficacy of telementoring in regards of technical proficiency.

7 References

1. Aghazadeh MA, et al. External validation of Global Evaluative Assessment of Robotic Skills (GEARS). Springer link 2014.

2. Augestad KM, Han H, Paige J, Ponsky T, Schlachta CM, Dunkin B, et al. Educational implications for surgical telementoring: a current review with recommendations for future practice, policy, and research. Surg. Endosc. 2017;31(10):3836-46.

3. Prince SW, Kang C, Simonelli J, Lee Y-H, Gerber MJ, Lim C, et al. A robotic system for telementoring and training in laparoscopic surgery. The Int J Med Robot. 2020;16(2):e2040.

4. Society of American Gastrointestinal Endoscopic S. Guidelines for the surgical practice of telemedicine. Surg Endosc. 2000;14(10):975.

5. Butt K, Augestad KM. Educational value of surgical telementoring. J Surg Oncol. 2021;124(2):231-40.

6. Kalan S, Chauhan S, Coelho RF, Orvieto MA, Camacho IR, Palmer KJ, et al. History of robotic surgery. J. Robot. Surg. 2010;4(3):141-7.

7. Sereno S, Mutter D, Dallemagne B, Smith CD, Marescaux J. Telementoring for minimally invasive surgical training by wireless robot. Surg Innov. 2007;14(3):184-91.

8. Bogen EM, Schlachta CM, Ponsky T. White paper: technology for surgical telementoring-SAGES Project 6 Technology Working Group. Surg Endosc. 2019;33(3):684-90.

9. Bove P, Stoianovici D, Micali S, Patriciu A, Grassi N, Jarrett TW, et al. Is telesurgery a new reality? Our experience with laparoscopic and percutaneous procedures. J Endourol. 2003;17(3):137-42.

10. Santomauro M, Reina GA, Stroup SP, L'Esperance JO. Telementoring in robotic surgery. Curr Opin Urol. 2013;23(2):141-5.

11. Albayati S, Chen P, Morgan MJ, Toh JWT. Robotic vs. laparoscopic ventral mesh rectopexy for external rectal prolapse and rectal intussusception: a systematic review. Tech Coloproctol. 2019;23(6):529-35.

12. Miskovic D, Wyles SM, Ni M, Darzi AW, Hanna GB. Systematic review on mentoring and simulation in laparoscopic colorectal surgery. Ann Surg. 2010;252(6):943-51.
13. D'Hoore A, Cadoni R, Penninckx F. Long-term outcome of laparoscopic ventral rectopexy for total rectal prolapse. Br J Surg. 2004;91(11):1500-5.
14. Jaffray B. Minimally invasive surgery. Arch Dis Child. 2005;90(5):537-42.
15. Köckerling F. Robotic vs. Standard Laparoscopic Technique - What is Better? Front Surg. 2014;1:15-.
16. Challacombe B, Kandaswamy R, Dasgupta P, Mamode N. Telementoring facilitates independent hand-assisted laparoscopic living donor nephrectomy. Transplant Proc. 2005;37(2):613-6.
17. Prince SW, Kang C, Simonelli J, Lee YH, Gerber MJ, Lim C, et al. A robotic system for telementoring and training in laparoscopic surgery. Int J Med Robot. 2020;16(2):e2040.
18. Budrionis A, Augestad K, Bellika J, editors. Telestration in mobile telementoring. Proceedings of The Fifth International Conference on eHealth, Telemedicine, and Social Medicine (eTELEMED 2013); 2013.
19. Goh AC, Goldfarb DW, Sander JC, Miles BJ, Dunkin BJ. Global evaluative assessment of robotic skills: validation of a clinical assessment tool to measure robotic surgical skills. J Urol. 2012;187(1):247-52.

20. Augestad KM, Butt K, Ignjatovic D. Video-based coaching in surgical education: a systematic review and meta-analysis. Surg Endosc. 2019;34(2):521-35

8 GRADE TABLES

8.1

Referanse: Challacombe B, Kandaswamy R, Dasgupta P, Mamode N. Telementoring facilitates independent hand-assisted laparoscopic living donor nephrectomy. Transplant Proc. 2005;37(2):613-6.			Studiedesign: Pasientserie Grade – kvalitet: Lav
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Sammenligne klinisk utfall av telementorerte, lokal-mentorerte og ikke-mentorerte laparoskopiske nyretransplantasjoner. **Konklusjon** Studien konkluderte med at det ikke var signifikante forskjeller i klinisk utfall ved de ulike formene for kirurgisk veiledning. I tillegg konkluderes det med at telementoriering kan fasilitere selvstendig gjennomføring av inngrepene. **Land** USA **År data innsamling** 2005	**Populasjon:** Totalt 12 pasienter ble nyretransplantert. **Utfall – hovedutfall:** 8 separate parametre ble kvantifisert i etterkant av hvert inngrep: operasonstid, iskemisk tid, estimert blodtap, lengde på sykehusopphold for donor etter inngrep, kreatininverdi for donor og mottaker etter inngrep, uker før tilbake i jobb/full aktivitet. **Viktige konfunderende faktorer** **Statistiske metoder:** 8 parametre ble målt for å kvantifisere klinisk utfall av inngrepene. Gjennomsnittsverdier målt for hver av de tre gruppene (telementorert, lokalmentorert og ikke-mentorert). Ikke beskrevet hvordan signifikans ble beregnet fra resultater.	**Hovedfunn :** Ingen signifikant forskjell i utfall for de tre gruppene. Gjennomsnittlig operasjonstid: - Lokalmentorert gruppe: 160 min - Telementorert gruppe: 240 mi - Ikke-mentorert gruppe: 225 min Iskemisk tid: - Lokalmentorert gruppe: 230 min - Telementorert gruppe: 189 min - Ikke-mentorert gruppe: 263 Gjennomsnittlig estimert blodtap - Lokalmentorert gruppe: 45 ml - Telementorert gruppe: 171 ml - Ikke-mentorert gruppe: 134 ml Gjennomsnittlig lengde på sykehusopphold for donor etter inngrep: - Lokalmentorert gruppe: 3.5 dager - Telementorert gruppe: 3 dager - Ikke-mentorert gruppe: 3.7 dager Gjennomsnittlig postoperativ kreatininverdi, donor - Lokalmentorert gruppe: 159 mmol/L - Telementorert gruppe: 149 mmol/L - Ikke-mentorert gruppe: 126 mmol/L Gjennomsnittlig postoperativ kreatininverdi, mottaker: - Lokalmentorert gruppe: 287 mmol/L - Telementorert gruppe: 535 mmol/L - Ikke-mentorert gruppe: 436 mmol/L Gjennomsnittlig antall uker før tilbake i full jobb/aktivitet: - Lokalmentorert gruppe: 5 uker - Telementorert gruppe: 2 uker - Ikke-mentorert gruppe: 4.3 uker **CI:** ikke beskrevet.	**Sjekkliste:** • **Er formålet klart formulert?** Nei. Manglende informasjon om formål med studie. • **Var studien basert på et tilfeldig utvalg fra en egnet pasientgruppe?** Ikke gjort rede for seleksjonsprosess. • **Var inklusjonskriteriene klart definert?** Nei. • **Var alle pasientene i samme stadium av sykdommen?** Ikke gjort rede for stadie. • **Var responseraten høy nok?** Ingen frafall i studien. • **Ble det brukt objektive kriterier for å vurdere/validere endepunktene?** Ja. Utfall av undersøkelse ble vurdert med konkrete kvantitative målinger knyttet til grad av suksess ved inngrep. • **Ved sammenligninger av pasientserier, er seriene tilstrekkelig beskrevet?** Ja. • **Er prognostiske/konfunderende faktorer beskrevet/tatt hensyn til i design/analyse?** Nei. • **Var registreringen prospektiv?** Nei. • **Var oppfølgningen lang nok!** Ja. • **Var oppfølgningen tilstrekkelig for å nå endepunktene?** Ja • **Stoler du på resultatene?** Ja. • **Kan resultatene overføres til praksis?** Trolig ikke, da populasjon er så liten at • **Annen litteratur som støtter resultatene?** Ja. **Hva diskuterer forfatterne som:** • **Styrke-** Ingen konkret diskusjon rundt styrker. • **Svakhet-** Liten studie med for liten pasientserie til å vurdere komplikasjonsrate ved inngrepene. Har resultatene plausible biologiske forklaringer? Ja.

8.2

Referanse: D'Hoore A, Cadoni R, Penninckx F. Long-term outcome of laparoscopic ventral rectopexy for total rectal prolapse. Br J Surg. 2004;91(11):1500-5.			Studiedesign: Pasientserie Grade – kvalitet: Høy (4/4)
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Å observere de kliniske utfallene over tid ved bruk av en ny, nervesparende kirurgisk teknikk brukt til å korrigere rektalte prolaps, kalt «laparoskopisk ventral rektopeksi». **Konklusjon** Ventral rektopeksi er er en effektiv teknikk for korreksjon av rektalt prolaps. Det virker som om man ved den nye teknikken unngår betydelig postoperativ konstipasjon. **Land** Belgia **År data innsamling** 2004	42 pasienter ble operert for total rektal prolaps med ventral rektopeksi mellom 1995 og 1999. 38 av pasientene var kvinner, 4 var menn. Medianalder på pasienter var 49.7 år, med en aldersgruppe som strakk seg fra 22 til 88 år. 31 av pasientene var plaget med inkontinens preoperativt, mens de resterende 11 var kontinente. Pasientdata ble uthentet fra en prospektiv database. Diagnose ble bekreftet ved å klinisk undersøke pasientene med defekasjons-proktografi, en teknikk der pasientens avføringsmønster fremstilles radiologisk. Pasientene ble postoperativt observert i en periode på mellom 29 og 98 måneder, med en medianlengde på 61 måneder. Pasientenes postoperative plager ble dokumentert ved utfyllelse av et spørreskjema om anorektal- og seksuell dysfunksjon, bruk av ROMA II-kriterier for forstoppelse, og bruk av Cleveland Clinic Incontinence Scoring System. Intraoperative komplikasjoner, tidlig postoperativ morbiditet, operasjonstid, tid liggende på sykehus postoperativt og reinnleggelser på sykehus ble dokumentert. En paired t-test ble brukt for å vurdere statistisk signifikans mellom parede og ikke-parede prøver. Wilcoxon signed rank test ble brukt for å vurderer signifikans i ikke-parametriske parede data. En p-verdi under 0.05 ble anslått som signifikant.	**Hovedfunn** Det forekom ingen intraoperative komplikasjoner, og det behøvdes ingen transfusjon av blod under noen av de 42 gjennomførte inngrepene. Ingen pasienter døde postoperativt. 2 pasienter fikk UVI postoperativt, utover dette ingen postoperative komplikasjoner To av pasientene utviklet rektal prolaps, som ble oppdaget under oppfølging etter hhv 54 og 91 måneder. Blant de 31 pasientene plaget med inkontinens preoperativt, opplevde samtlige reduserte inkontinensplager etter å ha gjennomgått operasjon. 16 av 31 ble fullstendig kontinente etter operasjon. 23 av pasientene var før inngrepet plaget med forstoppelse. 2 av pasientene som preoperativt ikke var plaget med forstoppelse utviklet forstoppelse etter inngrepet, og ingen av pasientene med konstipasjonsplager preoperativt fikk forverret konstipasjon etter inngrepet. 29 av de 42 pasientene var seksuelt aktive før inngrepet. Ingen av pasientene rapporterte om nedsatt seksuell funksjon i etterkant av inngrepet.	**Sjekkliste:** • **Er formålet klart formulert?** Nei. Formålet beskrives vagt, uten klart definerte endepunkter. • **Var studien basert på et tilfeldig utvalg fra en egnet pasientgruppe?** Ja • **Var inklusjonskriteriene klart definert?** Ja • **Var alle pasientene i samme stadium av sykdommen?** Nei. • **Var responseraten høy nok?** Ja. Ingen frafall. • **Ble det brukt objektive kriterier for å vurdere/validere endepunktene?** Usikkert. Objektive kriterier ble målt og analysert, men endepunkter ble ikke klart definert. • **Ved sammenligninger av pasientserier, er seriene tilstrekkelig beskrevet?** Ja. • **Er prognostiske/konfunderende faktorer beskrevet tatt hensyn til i design/anal?** Nei, ikke diskutert. • **Var registreringen prospektiv?** Ja. • **Var oppfølgningen lang nok!** Trolig. Median 61 mnd (> 5 år) • **Var oppfølgningen tilstrekkelig for å nå endepunktene?** Ja, slik jeg vurderer det. • **Stoler du på resultatene?** Ja, jeg anser resultatene som høyst troverdige. • **Kan resultatene overføres til praksis?** Ja, sannsynligvis. **Hva diskuterer forfatterne som:** • **Styrke**- Ingen diskusjon • **Svakhet**- Ingen diskusjon Har resultatene plausible biologiske forklaringer? Ja. Det gjøres også rede for sannsynlige årsaker til utfallene.

8.3

Referanse: Moore RG, Adams JB, Partin AW, Docimo SG, Kavoussi LR. Telementoring of laparoscopic procedures. Surgical Endoscopy. 1996;10(2):107-10.			Studiedesign: Pasientserie Grade – kvalitet: Moderat (3/4)
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Å evaluere gjennomførbarheten og vurdere sikkertheten ved bruk av telementorering i laparoskopiske inngrep. **Konklusjon** Bruk av telementorering i laparoskopiske prosedyrer er trygt og gjennomførbart. Det trengs flere studier før telementorering implementeres i kirurgisk opplæring **Land** USA **År data innsamling** 1996	Totalt 23 pasienter gjennomgikk laparoskopiske telementorerte inngrep. 14 av disse inngrepene ble klassifisert som «kompliserte», mens de resterende 9 ble klassifisert som «enkle». Et utvalg av inngrepene ble sammenlignet med 12 tilsvarende inngrep gjennomført med tradisjonell mentorering. Sammenligningen mellom de to gruppene. Sammenligningen inkluderte utfall av inngrep, operasjonsti, behov for analgetika postoperativt, ligge tid på sykehus postoperativt, tid fra operasjon til gjenopptatt normal aktivitet og komplikasjoner fra inngrepet. Statistiske analyser ble gjennomført ved å bruke unpaired Student´s t-test.	**Hovedfunn** 22 av 23 inngrep ble gjennomført vha telementorering. 1 inngrep, en radikal nefrektomi, var ikke mulig å gjennomføre med telementorering alene, og en erfaren kirurg intervenerte underveis i inngrepet. Studien viste en statistisk signifikant økt operasjonstid for gruppen med avanserte inngrep ($p=0.08$). Utover dette var det ingen statistisk signifikant forskjell mellom telementorerte- og tradisjonelt mentorerte inngrep, målt etter de oppgitte parametrene.	**Sjekkliste:** • **Er formålet klart formulert?** Nei. Vag beskrivelse av formål. • **Var studien basert på et tilfeldig utvalg fra en egnet pasientgruppe?** Ja. • **Var inklusjonskriteriene klart definert?** Nei. • **Var alle pasientene i samme stadium av sykdommen?** Nei. • **Var responseraten høy nok?** Ja, alle deltakere i studien gjennomførte hele studien. • **Ble det brukt objektive kriterier for å vurdere/validere endepunktene?** Det ble benyttet objektive kriterier, men endepunkter var ikke klart beskrevet. • **Ved sammenligninger av pasientserier, er seriene tilstrekkelig beskrevet?** Tildels. Noe mangelfull beskrivelse av gruppen med tradisjonelt mentorerte inngrep. • **Er prognostiske/konfunderende faktorer beskrevet?tatt hensyn til i design/anal?** Ja. Konfunderende faktorer diskuteres i diskusjonsdelen av studien. • **Var registreringen prospektiv?** Ja. • **Var oppfølgningen lang nok?** Trolig. Oppfølging var • **Var oppfølgningen tilstrekkelig for å nå endepunktene?** Ja, da endepunkter ble vagt definert. • **Stoler du på resultatene?** Ja. • **Kan resultatene overføres til praksis?** Trolig. Dog er utvalget sannsynligvis for lite til å slå fast at telementorering på dette stadiet ikke medførte en høyere komplikasjonsrisiko enn tradisjonell mentorering. • **Hva diskuterer forfatterne som svakhet?** At studien ikke er konklusiv, og at det kreves mer forskning på emnet før telementorering innføres som kirurgisk standard Har resultatene plausible biologiske forklaringer? Ja.

8.4

Referanse: Sereno S, Mutter D, Dallemagne B, Smith CD, Marescaux J. Telementoring for minimally invasive surgical training by wireless robot. Surg Innov. 2007;14(3):184-91.			Studiedesign:multisentrert deskriptiv studie Grade – kvalitet: 2/4 Lav
Formål	**Materiale og metode**	**Resultater**	**Diskusjon/kommentarer/sjekkliste**
Å sammenligne lokal aktiv og passic mentorering med fjern-mentorering ved bruk av trådløs kirurgisk robot. **Konklusjon** Studien konkluderer med at det er blitt bevist at fjernmentorering vha en trådløs kirurgisk robot er et verdifullt verktøy i telementorering av minimalt invasive prosedyrer. Robot-assistert mentorering kan muligens forsterkee kvaliteten på kirurgisk utdanning ved å øke tilgjengeligheten av kirurgisk ekspertveiledning. **Land** Frankrike **År data innsamling** 2007	Populasjon n=44 uerfarne kirurger ble delt inn I 4 grupper, klassifisert som "a", "b", "c" og "d", der gruppe a: n = 12; gruppe b: n = 8 gruppe c: n = 12 og gruppe d: n = 12 44 uearfarne kirurger gjennomførte kirurugi under veiledning av en erfaren kirurg, gjennom tilstedeværende passiv mentorering, tilstedeværende aktiv mentorering og gjennom telementorering. Tilstedeværende passiv mentorering innebar at et erfaren kirurg, mentoren, var fysisk tilstede på operasjonsrommet, og ga utelukkende verbal veiledning til den uerfarne kirurgen. Tilstedeværende aktive mentorering tillot mentor å ikke bare verbalt veilede uerfaren kirurg, men også å ta kontroll over en eller to av de kirurgiske intrumentene brukt under inngrepet. Etter å ha gjennomført hver kirurgi, evaluerte de uerfarne kirurgene kvaliteten på mentoreringen ved å fylle ut et spørreskjema. Restultatene er basert på de uerfarne kirurgenes oppfatning av mentoreringens kvalitet, I tillegg til kirurgirobotens tekniske prestasjon under inngrepet. Statistiske metoder 2-tailed Fisher's exact test og 2-tailed unpaired *t* tests ble brukt for å analysere resultatene fra undersøkelsen. En p-verdi <0.05 ble ansett som statistisk signifikant	**Hovedfunn** Den telementorerte gruppene scoret statistisk signifikant lavere enn begge de andre gruppene (p=0.04). Det var ingen statistisk signifikant forskjell i score mellom aktiv of passivt tilstedeværende mentorete grupper.	**Sjekkliste:** • **Er formålet klart formulert?** Ja • **Var studien basert på et tilfeldig utvalg fra en egnet gruppe?** Ja • **Var inklusjonskriteriene klart definert?** Nei. • **Var responseraten høy nok?** Ja. Ingen frafall. • **Ble det brukt objektive kriterier for å vurdere/validere endepunktene?** Nei. Endepunkter ble målt ved bruk av subjektive spørreskjemaer. • **Ved sammenligninger av serier, er seriene tilstrekkelig beskrevet?** Nei. Lite utfyllende beskrivelse av de ulike seriene. • **Er prognostiske/konfunderende faktorer tatt hensyn til i design/anal?** Nei. • **Var registreringen prospektiv** ja. • **Stoler du på resultatene?** Ja. • **Kan resultatene overføres til praksis?** Trolig ikke. Da resultater er basert på subjektive oppfatninger mentoreringens kvalitet, fremstår det som om validiteten i studien er lav, og lite overførbar til praksis.