Evaluation Of Learning Curve For Basic Laparoscopy Skills

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ABSTRACT

Introduction: Laparoscopy has become an essential skill for general surgeon. However, learning curve for basic laparoscopy has not been defined. Present study is an attempt to define the same.

Aim: Present study was done to determine the minimum number of surgeries required for general surgeon/resident to confidently perform laparoscopic surgery by defining objective of learning curve.

Material & Methods: This study was done in a tertiary referral university hospital and included surgical residents of Second Year (SY), Third Year (TY), Fourth Year (FY) and Young tutors. A questionnaire regarding assessment of skill & training was given to the resident as well as their mentor. Results were rated and assessed on the basis of filled questionnaire.

Results: 70% surgeons required 20 surgeries to hold camera & putting 1st port confidently. Less number was required for initial orientation & working as 2nd assistance. This could be only achieved in surgeons who had undergone dry & wet lab workshops.

Conclusion: Dry & wet lab workshops should be introduced early in residency programme. This reduces the period of learning curve. There was a progressive curve which showed that at every step the resident requires mentorship which helps them to gain proficiency in basic laparoscopy skills.
INTRODUCTION:
Laparoscopic surgery; also called Minimally invasive surgery (MIS) or Key hole surgery is the modern surgical techniques in which operation in abdomen are performed through small incision (Usually 0.5 to 1.5 cm) as opposed to the larger incision needed in the laparotomy. Conceptually, laparoscopic approach is intended to minimize post-operative pain and speed up recovery times, while maintaining an enhance visual fields for surgeons. It’s a demand of this era that every surgery resident should be trained & should perform at least basic laparoscopic procedures. Initially, Learning curve for these procedure is steep, but as more & more procedures are performed it becomes easier. A learning curve operationally defined as an improvement in performance over time. It comprises of, First, the starting point where the performance of an individual surgeon begins. Secondly, the rate of learning measures how quickly the surgeon will reach a certain level of performance and, Thirdly, the asymptote or expert level measures where the surgeons performance stabilizes [1]. Laparoscopy is now a standard procedure for various surgeries like cholecystectomy, appendectomy & Diagnostic laparoscopy. We introduced this study to evaluate the steps that are required for a resident/surgeon in acquiring basic laparoscopic skills. Second year starting from training in Dry laparoscopy laboratory involving Hand-Eye co ordination, to Depth Perception, followed by, working as Second assistance for at least 3-6 months, & than working as Camera/ First assistance which includes putting ports. This is followed by laparoscopic procedures primarily done under guidance & assistance of senior surgeons & finally, last step is doing Independent Laparoscopy Surgery for basic pathology. Learning curve has been established for advanced laparoscopic surgery, viz. laparoscopic colorectal surgery (Tekkis et al), Laparoscopic Cholecystectomy (Richardson et al), etc. However, learning curve for basic laparoscopic surgery has not been defined. Hence with this in mind, present study was designed to determine the minimum number of surgeries required for general surgeon/resident to confidently do basic laparoscopic surgery.

MATERIALS & METHODS
Study included the post graduate residents of Second Year (SY), Third Year (TY), Fourth Year (FY) and Young tutors who have already done open surgeries. These residents were trained in dry lab; wet lab followed by hands on experience. We divided the laparoscopy surgery into small steps like the Primary End Points taken into consideration
1. To hold the retractor confidently
2. To hold the camera confidently
3. To put ports under vision
4. To put 1st port & create pneumo peritoneum (under Hasson technique)
5. To do Diagnostic Laparoscopy
6. To do Laparoscopic Appendectomy
7. To do Laparoscopic Cholecystectomy
Secondary end points were assessed for advances in laparoscopic skills like managing intra operative bleeding & suturing. A questionnaire comprising of minimum surgery required to do various steps of laparoscopy was filled by the trainee residents & their mentors. These questionnaires were analyzed to know minimum number of surgeries required for achieving acceptable skill in basic laparoscopic procedures. The questionnaire addressed basic demographic issues, current training, future career plans, resident interest in performing laparoscopic surgery, the basic and advanced laparoscopic procedures that may be involved in training, the access to MIS surgical skills laboratory, the factors influencing the exposure of residents to MIS techniques, and the role of the MIS surgeon within the academic surgical department. All second year residents underwent dry lap & wet lab workshops at different periods during their residency.

OBSERVATION

<table>
<thead>
<tr>
<th>Total number of residents</th>
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<tbody>
<tr>
<td>Post</td>
</tr>
<tr>
<td>SY</td>
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<tr>
<td>TY</td>
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<tr>
<td>FY</td>
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<tr>
<td>Young Tutor</td>
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All residents were evaluated,
RESULTS:
Out of 44 total residents working as SY, 35 SY who underwent dry lab training workshops could perform surgery to hold retractor after assisting 10 or more surgeries in holding retractor, these 35 residents gained confidence earlier as compared to 9 residents who didn’t attend dry/wet lap workshops, hence these 9 FY residents gained confidence after assisting 20 or more surgeries in holding retractor. Among the 35 residents, 23 SY attended both dry & wet lab workshop & 12 SY attended only dry lab workshop. That’s why only these 23 residents were confident after 15 surgeries of holding camera whose Dry & Wet lab workshops were done. Rest of the SY residents who were not subjected/didn’t attend wet lap workshops gained confidence after assisting 25 or more surgeries in holding camera.

![Figure 1](image1.png)

*Figure 1. (Unadjusted mean overall, number of surgeries and surgeon volume category according to dry and wet laparoscopic workshop attended and not attended).*

At TY post out of all 30 residents, all were confident to hold retractor as they had assisted more than 10 surgeries in their previous posts. Among the 30 residents TY, 21 (70%) of TY were confident to hold camera as they had assisted more than 15 surgeries & only 9 residents TY (30%) were confident to introduce port under vision as they had assisted more than 20 surgeries. Rest of the TY residents who didn’t attend dry/wet lap workshops gained confidence after assisting 30 or more surgeries.

![Figure 2](image2.png)

*Figure 2. (Unadjusted mean overall, number and steps of surgeries with surgeon volume category according to dry and wet laparoscopic workshop attended and not attended).*

At FY post of the total 6 residents, all residents were confident to hold retractor & camera as they had assisted more than 15 surgeries in their previous posts. 60% of resident at FY post were confident to introduce port as they had assisted more than 20 surgeries.
83% FY were confident in assisting Laparoscopic Appendicectomy after 15 Surgeries, assisting Diagnostic Laparoscopy after 10 Surgeries & assisting Laparoscopic Cholecystectomy after 20 Surgeries with workshop. Rest of the residents who were not subjected to workshops gained confidence after 20, 15 and 30 surgeries respectively. Similarly, 67% FY were confident in performing Laparoscopic Appendectomy individually after 5 Surgeries, Diagnostic Laparoscopy individually after 5 Surgeries & Laparoscopic Cholecystectomy individually after 5 Surgeries with workshop. Rest of the residents who were not subjected to workshops gained confidence after 20, 10 and 20 surgeries respectively. FY who were subjected to Dry & Wet lap workshops helped them to gain confidence as number of surgeries & exposure increases. At FY resident level to manage intra operative suturing & intra operative bleeding.

At Young Tutor post of the total 10, all were confident to hold retractor & camera as they have assisted more than 15 surgeries in their previous posts. 100 % were confident to introduce port & to create pneumoperitoneum as they had assisted more than 20 surgeries. 100% were confident in assisting as first assistant in Laparoscopic Appendectomy after 15 Surgeries, Diagnostic Laparoscopy after 10 Surgeries & Laparoscopic Cholecystectomy after 20 Surgeries with workshop. Similarly, 100% were confident in performing Laparoscopic Appendectomy individually after 5 Surgeries, Diagnostic Laparoscopy individually after 5 Surgeries & Laparoscopic Cholecystectomy individually after 5 Surgeries with workshop.
Hence, we also evaluated the minimum no. of surgeries in various steps of basic laparoscopic surgery that are required for maximum no. of surgeons considered to be >70%, to gain confidence. To hold the retractor MINIMUM of 10 surgeries required for >70% of surgeons. To hold the camera MINIMUM of 15 surgeries required for >70% of surgeons. To put ports under vision MINIMUM of 20 surgeries...
required for >70 % of surgeons. To put 1st port & create pneumoperitoneum MINIMUM of 20 surgeries required for >70 % of surgeons. The purpose of doing this was to evaluate a subjective criterion for defining basic steps in laparoscopic surgery in knowing the dexterity and competence of the surgeon by both surgeon himself & their mentors.

**DISCUSSION**

Laparoscopy is now a standard procedure for various surgeries like cholecystectomy, appendectomy & Diagnostic laparoscopy. Present Study was introduced to evaluate the steps that are required for a resident /surgeon in acquiring basic laparoscopic skills. There is not a single study where the surgeons are evaluated for their Basic Laparoscopic Skills. Only after the basics are formed, we can build a curve for higher advanced surgery.

Comparison of our study & different studies were taken into consideration learning curve

1. **Measures of learning that were analyzed in other surgeries to determine the learning curve & How learning curves can affect trial results Statistical evaluation of learning curve effects in surgical trials**[^11].

Under the mandate of the Educational Committee of the European Association of Endoscopic Surgery (E.A.E.S.), three consensus development conferences (CDCs) were performed in order to assess the current status of the endoscopic surgical approaches for the treatment of cholelithiasis, appendicitis, and inguinal hernia[^2]. Following discussions final consensus statements were formulated to provide specific answers for each topic to a minimum of the following questions:

1. What stage of technological development is the endoscopic surgical procedure at (in September 1994)?
2. Is endoscopic surgery safe and feasible?
3. Is it beneficial to the patients?
4. Who should undergo endoscopic surgery?
5. What are the training recommendations?

The difficulties that learning curve effects can cause for the interpretation of surgical trials can be illustrated through an example from the literature. The primary outcome of interest in previous studies analyzing the consensus statement from the education committee of the European Association of Endoscopic Surgery states that Laparoscopic Appendectomy (LA) should be part of the resident's curriculum and recommends that at least 20 cases are needed for accreditation in general surgery. Meinke AK, Kossuth T[^3]. Neugebauer E, et al[^21]. Therefore, we focused our analyses on outcomes related to resource use viz. dry and wet lab workshops. Comparison with previous studies, our data demonstrated number of surgeries required to attain basic lap skills by trainee residents in association with dry and wet lab workshops were less.

An audit suggests that, at least in the introductory period, laparoscopic cholecystectomy is associated with an overall bile duct injury rate higher than that reported previously after open cholecystectomy, Time to plateau-3 years. Richardson et al[^9]. In our study Surgeons after gaining confidence in Basic Laparoscopic Skills were directed towards performing laparoscopic surgeries- laparoscopic appendectomy, laparoscopic cholecystectomy, diagnostic laparoscopy which required 15, 20, 5 respectively.

2. **Evaluation of the learning curve in laparoscopic colorectal surgery: comparison of right-sided and left-sided resections was done by Tekkis et al[^5,6].**

Conversion rates for laparoscopic colectomy are dependent on a multitude of factors that require appropriate adjustment including the learning curve (operative experience) for individual surgeons. The laparoscopic model described can be used as the basis for performance monitoring between or within institutions Previous publications have suggested that the learning curve in laparoscopic colorectal surgery ranges from 30 to 70 cases with the exception of Simons et al[^7] who reported a learning curve of 11 to 15 cases in a series of 144 patients. Schlachta et al[^8] in a series of 461 patients, reported a learning curve of 30 cases, Bennet et al[^9] reported a learning curve of 40 cases among 1194 patients, and Dincler et al[^10] suggested that 70 to 80 cases may represent the learning curve for sigmoid colectomy. Although these estimates may seem high for most trainee surgeons, these should only be used as guidance as the series began in the early 1990s at the time when technology and operative efficiency was inferior by
today's standards, and these limiting factors may not be applicable in the modern era of laparoscopic surgery. In a recent multi-institutional randomized controlled trial of open versus laparoscopic colorectal surgery,[11] the participating surgeons had performed at least 20 laparoscopically assisted colectomies with a conversion rate of 21%.

Laparoscopic surgery requires a high degree of special resolution, dexterity, and technical skills. The aim of our study is to provide an initial training period which is usually required for the majority of surgeons to become proficient in these complex procedures by continuous repetition of these tasks. Our analyses similarly implied number of surgeries that were required for basic steps in laparoscopy.

Similarly, there has been learning curve for advanced laparoscopy surgery like D2 Gastrectomy Parikh et al[12] outcome taken into consideration-Morbidity, mortality, LN harvest, Time or number of cases to plateau- 18–24 months, 15–25 cases concluding D2 Gastrectomy should be restricted to specialist centres where adequate training and supervision can be provided during the learning curve. Oesophagectomy, Sutton et al[13] showed a continuing improvement in a surgeon's performance over a 7-year period. With the current trend to shorter training periods there is a case for continuing supervision of the 'fully trained' surgeon within highly specialist units. Our consideration was on improvement in surgeons performance over prolonged period where adequate training and supervision can be provided during the learning curve.

There has been curve defined for laparoscopic cholecystectomy, laparoscopic appendectomy, laparoscopic colorectal surgeries, laparoscopic hernia repair. However, there has been no curve defined for learning basic laparoscopic surgical skills Present study emphasis was on evaluating a surgeon to develop skills in performing a basic laparoscopic surgery during surgical training.

CONCLUSION
Hence, dry & wet lab workshops should be introduced in early residency to all trainee surgeons. They should be exposed to it so that holding camera and holding retractor becomes easy. As the number of surgeries & exposure increases resident becomes more confident. Mentorship helps in early gain of proficiency. A structured teaching programme for learning basic laparoscopic skills in surgical residents is need of hour in all university hospitals.

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