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Research Article

Decreasing Trend of Open Surgical Experience- A Drawback for Surgery Residents

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Abstract
Introduction: The first minimally invasive surgery (MIS) was attempted by Georg Kelling in 1901. However, we had to wait for the development of the computer chip television in the late 1980s to make the first successful laparoscopic cholecystectomy. The laparoscopic cholecystectomy rapidly grew in popularity but there were many questions about its safety compared with the "gold standard" of open cholecystectomy. The same pictures were seen in other general surgery procedures including appendectomy, colectomy, and herniorrhaphy. With additional experience, training, and improvement of surgical instruments, the early "learning curve" injuries were decreased.
Materials and methods: A Prospective studywas conducted at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shimoga from January 2022-December 2024. Based on questionnaire method for all the General surgery residents performing both open and Laparoscopic surgeries. 40 collective feedbacks were obtained and were subjected for data analysis. A retrospective review of the questionnaire based on post graduates done at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shimoga was performed. The retrospective review was based on the medical research department (MRD) -resident case log statistical reports from academic years 2016–2022. This study is based on publicly available data and therefore was exempted from institutional review board approval. Cases were chosen for analysis based on availability of both open and laparoscopic data, and to encompass a broad scope of general surgery: anti-reflux surgery, appendectomy, colectomy, splenectomy, and inguinal hernia repair. These case logs were evaluated for trends in the number of cases performed by General Surgery residents at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shimoga.
Results: The average number of cases in five categories performed by graduating residents increased from 254 in 2016 to 278 in 2022 (8.6%). The average number of laparoscopic cases increased from 58 to 128 (54.6%), whereas the number of open cases decreased from 196 to 150 (30.6%), depicted in Figure 1. An increase in the number of laparoscopic cases was seen in all five procedures: anti-reflux 6.2 to 8 (22.5%), appendectomy 18 to 28 (35.7%), colectomy 4 to 7 (42.8%), splenectomy 1 to 1.2 (20%), and hernia repairs 29 to 84 (65.4%). This corresponded to a decrease in the amount of open procedures performed: anti- reflux 4 to 0.8 (80%), appendectomy 31 to 11 (64.5%), colectomy 45.8 to 33 (27%), splenectomy 3.2 to 1.3 (59%), all hernias 51 to 47.3 (7%).
Conclusion: The number of open procedures performed by general surgery residents continues to decline despite an increase in total cases reported. However the advent or the practice of basic and laparoscopic procedures aren't disregarded as they are the future of surgical practices but the reduction in open surgical experience may result in surgeons lacking technical skills to safely and competently perform open procedures. Therefore, a shift in the educational paradigm can produce competent, confident, surgeons and will be worth the effort.

Keywords: laparoscopic cholecystectomy, appendectomy, colectomy, and herniorrhaphy.

INTRODUCTION

The first minimally invasive surgery (MIS) was attempted by Georg Kelling in 1901. However, we had to wait for the development of the computer chip television in the late 1980s to make the first successful laparoscopic cholecystectomy.[1] The laparoscopic cholecystectomy rapidly grew in popularity but there were many questions about its safety compared with the "gold standard" of open cholecystectomy. The same pictures were seen in other general surgery procedures including appendectomy, colectomy, and herniorrhaphy.[2] With additional experience, training, and improvement of surgical instruments, the early "learning curve" injuries were decreased. Now a days, MIS offers patients several benefits, such as smaller incisions, fast recovery times, and reduced pain/scarring. Each general surgery training center should verify that their residents have adequate knowledge and skills to perform both open and laparoscopic surgery safely.[3]

There was a decline in open surgical experience for general surgery residents from 2000 to 2017 in the United States. Faculty staff should be concerned that residents may be insufficiently exposed to open and laparoscopic techniques in some procedures.[4]

Complications during the early adoption of other general surgery procedures, resulted in safety concerns. With further experience and training, these complication rates decreased, and laparoscopic surgery became a preferred technique because of improved short-term outcomes. The rise in the proportion of MIS procedures has now led to concerns that residents may not be adequately exposed to open techniques. Advent of advanced Laparoscopic surgeries has led to the decline in open surgical experience for surgery residents, which is impacting the confidence level of budding surgeons.[5]

Aim: To examine the relationship in trends for open and laparoscopic procedures performed/assisted by general surgery residents.

Objective: Quantitative assessment and variability of open and Laparoscopic procedures performed/assisted by the general Surgery residents during the study period.

MATERIALS AND METHODS

Study Design: A Prospective study.

Study Period: January 2022-December 2024.

Study Centre: Department of General Surgery, Shivamogga Institute of Medical Sciences, Shimoga**.**

Source of Data: Based on questionnaire method for all the General surgery residents performing both open and Laparoscopic surgeries. 40 collective feedbacks were obtained and was subjected for data analysis.

A retrospective review of the questionnaire based on post graduates done at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shimoga in Karnataka was performed.

The retrospective review was based on the medical research department (MRD) -resident case log statistical reports from academic years 2016–2022.

This study is based on publicly available data and therefore was exempted from institutional review board approval.

Cases were chosen for analysis based on availability of both open and laparoscopic data, and to encompass a broad scope of general surgery: anti-reflux surgery, appendectomy, colectomy, splenectomy, and inguinal hernia repair.

These case logs were evaluated for trends in the number of cases performed by General Surgery residents at Department of General Surgery, Shivamogga Institute of Medical Sciences, Shimoga.

Statistical Analysis: Students t test was used to compare changes in the average number of cases between periods. A 'p' value of < 0.05 determined significance. Stata 15.1 software was utilized for statistical analysis.

RESULTS

The average number of cases in five categories performed by graduating residents increased from 254 in 2016 to 278 in 2022 (8.6%).

The average number of laparoscopic cases increased from 58 to 128 (54.6%), whereas the number of open cases decreased from 196 to 150 (30.6%), depicted in Figure 1.

An increase in the number of laparoscopic cases was seen in all five procedures: anti-reflux 6.2 to 8 (22.5%), appendectomy 18 to 28 (35.7%), colectomy 4 to 7 (42.8%), splenectomy 1 to 1.2 (20%), and hernia repairs 29 to 84 (65.4%). This corresponded to a decrease in the amount of open procedures performed: anti- reflux 4 to 0.8 (80%),

appendectomy 31 to 11 (64.5%), colectomy 45.8 to 33 (27%), splenectomy 3.2 to 1.3 (59%), all hernias 51 to 47.3 (7%).

	Aug-2016-Aug 2017	SD	Aug 2017-18		P	Aug 2018-19			Aug 2019-20			Aug 20-21			Aug 21-Dec 22			
Open average	19.675	1.65	18.525	1.52	0.0017	15.6	1.13	<0.0001	13.4	0.89	<0.0001	11.575	0.96	<0.0001	9.15	0.75	<0.0001	<0.0001
Lap average	6.45	0.89	7.45	0.98	<0.0001	9.375	1.23	<0.0001	12.61	1.36	<0.0001	14.9	1.86	<0.0001	18	1.95	<0.0001	<0.0001
Total	26.125		25.975			24.975			26.01			26.475			27.15			

TABLE 1: Overall Average of open and Laparoscopic surgeries for the surgery Residents during the study period

	Year 1	SD	Year2	SD	Year3	SD	Year4	SD	Year5	SD	Year6	SD
Anti-reflux surgery	**0.15**	**0.02**	**0.125**	**0.02**	**0.1**	**0.02**	**0.1**	**0.02**	**0.075**	**0.01**	**0.05**	**0.01**
Lap Anti reflux surgery	**0.05**	**0.01**	**0.05**	**0.01**	**0.1**	**0.01**	**0.1**	**0.01**	**0.15**	**0.01**	**0.2**	**0.01**
Appendectomy	**6**	**1.01**	**5.5**	**0.98**	**5.12**	**0.46**	**4.9**	**0.06**	**4.65**	**0.24**	**4.5**	**0.21**

Lap Appendectomy	**2.5**	**0.56**	**3**	**0.65**	**3.375**	**0.68**	**3.8**	**0.87**	**4.25**	**0.96**	**5.5**	**0.95**
Colectomy	**1.125**	**0.32**	**1.02**	**0.04**	**0.8**	**0.21**	**0.8**	**0.21**	**0.6**	**0.16**	**0.5**	**0.16**
Lap Colectomy	**0.5**	**0.12**	**0.5**	**0.12**	**0.5**	**0.12**	**0.6**	**0.24**	**0.9**	**0.28**	**1.2**	**0.32**
Splenectomy	**3.2**	**0.56**	**2.9**	**0.52**	**2.6**	**0.45**	**2.1**	**0.56**	**1.8**	**0.45**	**1.3**	**0.36**
Lap Splenectomy	**0.6**	**0.06**	**0.8**	**0.04**	**0.9**	**0.042**	**1.1**	**0.2**	**2.4**	**0.25**	**3.5**	**0.31**
Hernia	**4.3**	**1.21**	**3.7**	**1.16**	**3.1**	**1.17**	**2.4**	**0.89**	**2.1**	**0.24**	**1.8**	**0.51**
Lap Hernia	**0.8**	**0.19**	**1.1**	**0.21**	**1.5**	**0.28**	**2.1**	**0.27**	**3.2**	**0.32**	**4.6**	**0.21**

TABLE 2: Average of individual open and Laparoscopic cases for the surgery residents during the study period

	Anti reflux surgery	**Lap Anti reflux surgery**	**Appendectomy**	**Lap Appendectomy**	**Colectomy**	**Lap Colectomy**	**Splenectomy**	**Lap Splenectomy**	**Hernia**	**Lap Hernia**	**Open**	**Laparoscopic**
P1	**0.15**	**0.05**	**6**	**2.5**	**1.125**	**0.5**	**3.2**	**0.6**	**4.2**	**0.8**	**19.675**	**6.45**
P2	**0.125**	**0.05**	**5.5**	**3**	**1.1**	**0.5**	**3**	**0.8**	**3.8**	**1.1**	**18.525**	**7.45**
P3	**0.1**	**0.1**	**5.3**	**3.375**	**0.8**	**0.5**	**2.8**	**0.9**	**3.6**	**1.5**	**15.6**	**9.375**
P4	**0.1**	**0.01**	**5**	**3.8**	**0.8**	**0.6**	**2.1**	**1.1**	**2.4**	**2.1**	**13.4**	**12.61**
P5	**0.075**	**0.15**	**4.9**	**4.25**	**0.6**	**0.9**	**1.8**	**2.4**	**2.2**	**3.2**	**11.575**	**14.9**
P6	**0.05**	**0.2**	**4.5**	**5.5**	**0.5**	**1.2**	**1.3**	**3.5**	**1.8**	**4.6**	**9.15**	**18**

TABLE 3: Average of individual open and Laparoscopic cases for the surgery residents during the study period

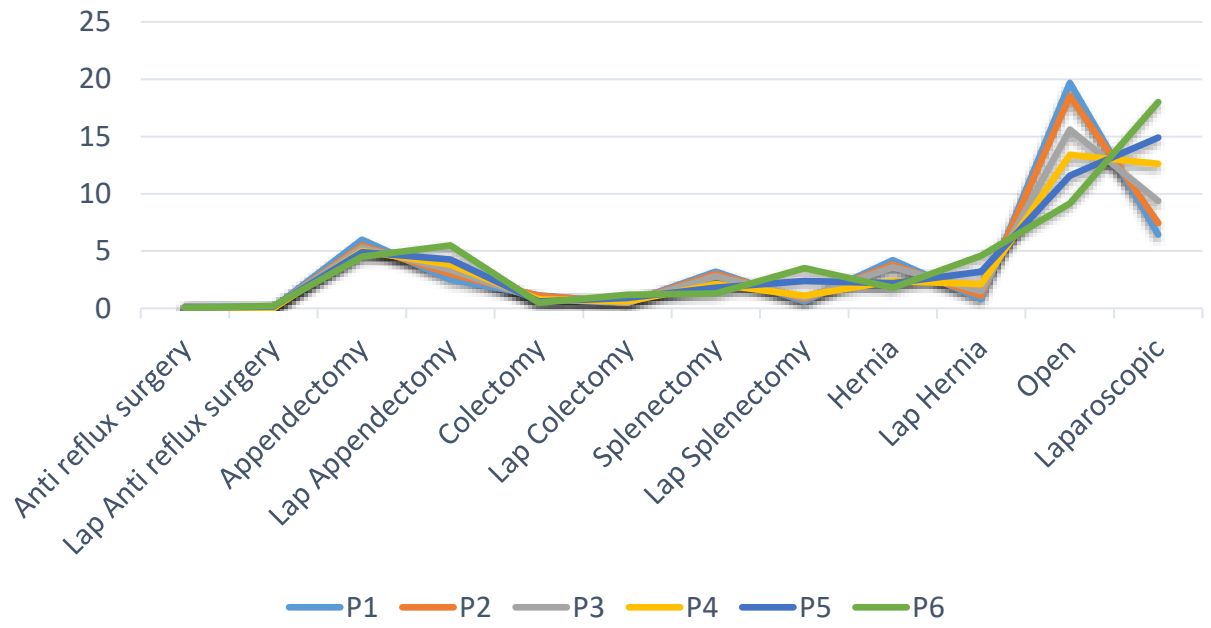


Figure 1: Line diagram of average of individual open and Laparoscopic cases for the surgery residents during the study period

	P1 (2016-17)		P2 (2017-18)		P Value	P3 (2018-19)		P Value	P4 (2019-20)		P Value	P5 (2020-21)		P Value	P6 (2021-22)		P Value
	Mean	SD	Mean	SD	P1-p2	Mean	SD	p2-p3	Mean	SD	p3-p4	Mean	SD	p4-p5	Mean	SD	p5-p6
Anti reflux surgery	0.15	0.02	0.125	0.02	<0.0001	0.1	0.02	<0.0001	0.1	0.02	1	0.075	0.01	<0.0001	0.05	0.01	<0.0001
Lap Anti reflux surgery	0.05	0.01	0.05	0.01	1	0.1	0.01	<0.0001	0.1	0.01	1	0.15	0.01	<0.0001	0.2	0.01	<0.0001
Appendectomy	6	1.01	5.5	0.98	0.0275	5.12	0.46	0.0293	4.9	0.06	0.0036	4.65	0.24	<0.0001	4.5	0.21	0.0039
Lap Appendectomy	2.5	0.56	3	0.65	0.0004	3.375	0.68	0.0137	3.8	0.87	0.0172	4.25	0.96	0.031	5.5	0.95	<0.0001
Colectomy	1.125	0.32	1.02	0.04	0.04	0.8	0.21	<0.0001	0.8	0.21	1	0.6	0.16	<0.0001	0.5	0.16	0.0065
Lap Colectomy	0.5	0.12	0.5	0.12	1	0.5	0.12	1	0.6	0.24	0.029	0.9	0.28	<0.0001	1.2	0.32	<0.0001
Splenectomy	3.2	0.56	2.9	0.52	0.015	2.6	0.45	0.0072	2.1	0.56	<0.0001	1.8	0.45	0.01	1.3	0.36	<0.0001

Lap Splenectomy	**0.6**	**0.06**	**0.8**	**0.04**	**<0.0001**	**0.9**	**0.042**	**<0.0001**	**1.1**	**0.2**	**<0.0001**	**2.4**	**0.25**	**<0.0001**	**3.5**	**0.31**	**<0.0001**
Hernia	**4.3**	**1.21**	**3.7**	**1.16**	**0.026**	**3.1**	**1.17**	**0.0239**	**2.4**	**0.89**	**0.0039**	**2.1**	**0.24**	**0.042**	**1.8**	**0.51**	**0.001**
Lap Hernia	**0.8**	**0.19**	**1.1**	**0.21**	**<0.0001**	**1.5**	**0.28**	**<0.0001**	**2.1**	**0.27**	**<0.0001**	**3.2**	**0.32**	**<0.0001**	**4.6**	**0.21**	**<0.0001**

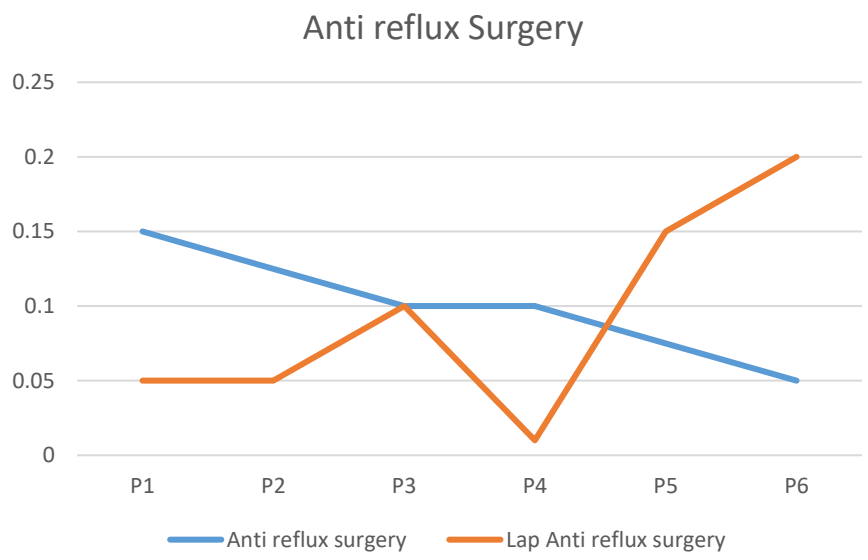
TABLE 4: Annual average of open and Laparoscopic cases during the study period

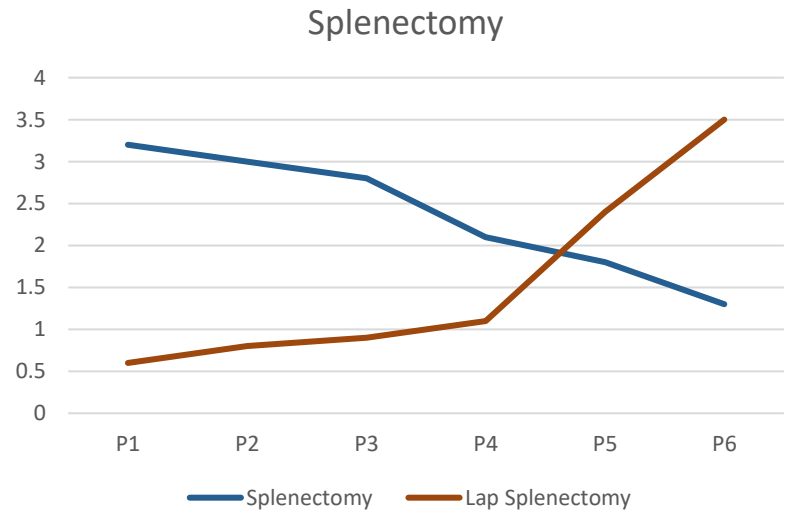
	P1		**P6**		**P value**
	mean	**SD**	**mean**	**SD**	**p1-p6**
Anti reflux surgery	**0.15**	**0.02**	**0.05**	**0.01**	**<0.0001**
Lap Anti reflux surgery	**0.05**	**0.01**	**0.2**	**0.01**	**<0.0001**
Appendectomy	**6**	**1.01**	**4.5**	**0.21**	**<0.0001**
Lap Appendectomy	**2.5**	**0.56**	**5.5**	**0.95**	**<0.0001**
Colectomy	**1.125**	**0.32**	**0.5**	**0.16**	**<0.0001**
Lap Colectomy	**0.5**	**0.12**	**1.2**	**0.32**	**<0.0001**
Splenectomy	**3.2**	**0.56**	**1.3**	**0.36**	**<0.0001**
Lap Splenectomy	**0.6**	**0.06**	**3.5**	**0.31**	**<0.0001**
Hernia	**4.3**	**1.21**	**1.8**	**0.51**	**<0.0001**
Lap Hernia	**0.8**	**0.19**	**4.6**	**0.21**	**<0.0001**

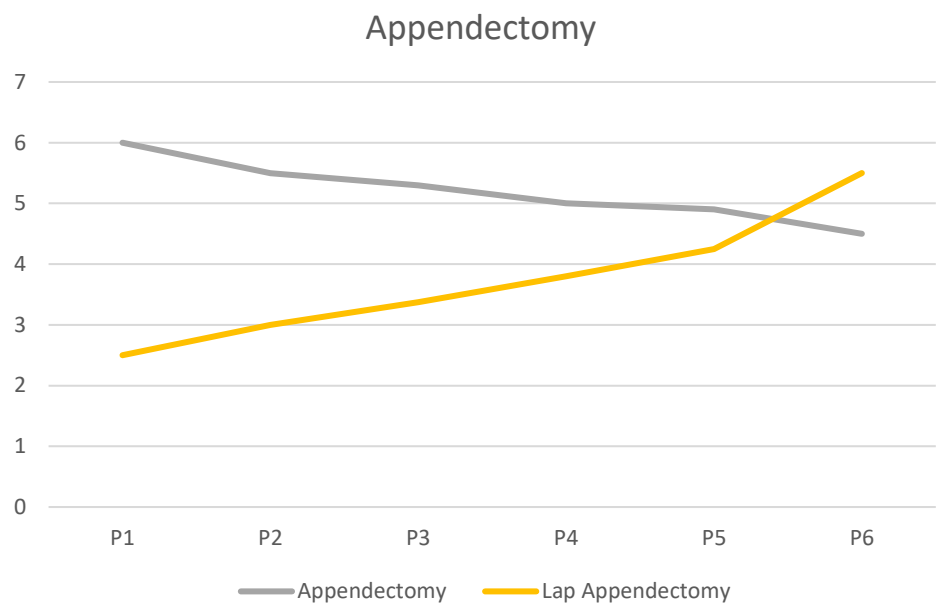
TABLE 5: Comparison of average of individual open and laparoscopic surgeries in 2016 and 2022 with respective statistical significance value

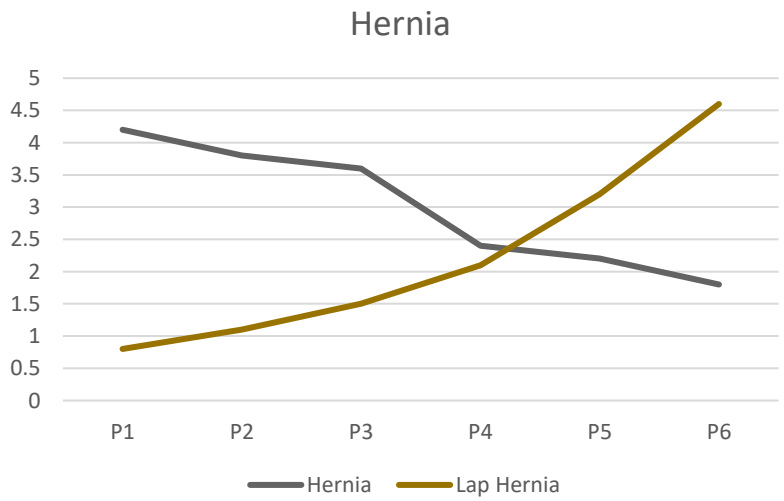
	P1 (2016-17)		**P2 (2017-18)**		**P Value**	**P3 (2018-19)**		**P Value**	**P4 (2019-20)**		**P Value**	**P5 (2020-21)**		**P Value**	**P6 (2021-22)**		**P Value**	**P value**
	Mean	**SD**	**Mean**	**SD**	**P1-p2**	**Mean**	**SD**	**p2-p3**	**Mean**	**SD**	**p3-p4**	**Mean**	**SD**	**p4-p5**	**Mean**	**SD**	**p5-p6**	**P1-P6**
Open average	**19.675**	**1.65**	**18.525**	**1.52**	**0.0017**	**15.6**	**1.13**	**<0.0001**	**13.4**	**0.89**	**<0.0001**	**11.575**	**0.96**	**<0.0001**	**9.15**	**0.75**	**<0.0001**	**<0.0001**
Lap average	**6.45**	**0.89**	**7.45**	**0.98**	**<0.0001**	**9.375**	**1.23**	**<0.0001**	**12.61**	**1.36**	**<0.0001**	**14.9**	**1.86**	**<0.0001**	**18**	**1.95**	**<0.0001**	**<0.0001**
Total	**26.125**		**25.975**			**24.975**			**26.01**			**26.475**			**27.15**			

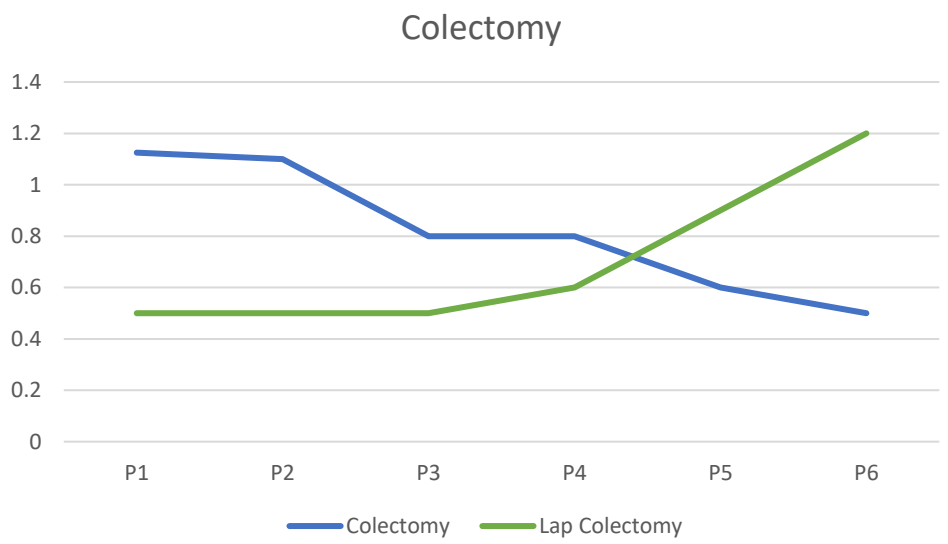
TABLE 6: Comparison of average of individual open and laparoscopic surgeries from 2016 to 2022 with respective statistical significance value

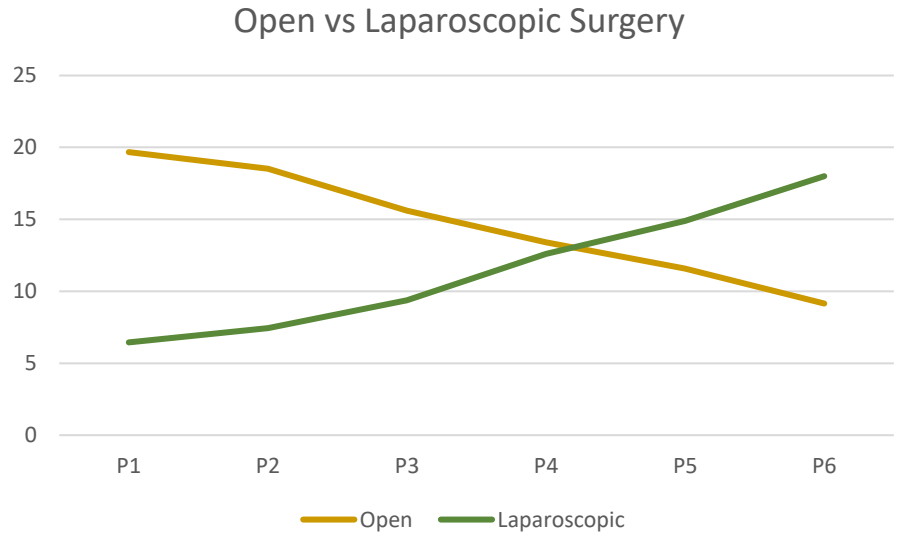

Anti reflux Surgery
0.25
0.2
0.15
0.1
0.05
0
P1
P2
P3
P4
P5
P6
Anti reflux surgery
Lap Anti reflux surgery


Splenectomy
4
3.5
3
2.5
2
1.5
1
0.5
0
P1
P2
P3
P4
P5
P6
Splenectomy
Lap Splenectomy


Appendectomy
7
6
5
4
3
2
1
0
P1
P2
P3
P4
P5
P6
Appendectomy
Lap Appendectomy


Hernia
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
P1
P2
P3
P4
P5
P6
Hernia
Lap Hernia


Colectomy
1.4
1.2
1
0.8
0.6
0.4
0.2
0
P1
P2
P3
P4
P5
P6
Colectomy
Lap Colectomy


Open vs Laparoscopic Surgery
25
20
15
10
5
0
P1
P2
P3
P4
P5
P6
Open
Laparoscopic

	Anti reflux surgery	% of total	Lap Anti reflux surgery	% of total	Appendectomy	% of total	Lap Appendectomy	% of total	Colectomy	% of total	Lap Colectomy	% of total	Splenectomy	% of total	Lap Splenectomy	% of total	Hernia	% of total	Lap Hernia	% of total	Open	% of total	Laparoscopic	% of total	Total
P1	0.15	0.5741626279	0.05	0.19138756	6	22.96650718	2.5	9.569377999	1.125	4.306220096	0.5	1.91387559 8	3.2	12.24880383	0.6	2.296650718	4.2	16.07655502	0.8	3.062200957	19.675	75.31100478	6.45	24.68899522	26.125
P2	0.125	0.4812319154	0.05	0.19249278 2	5.5	21.17420597	3	11.54956689	1.1	4.234841193	0.5	1.92492781 5	3	11.54956689	0.8	3.079884504	3.8	14.62945144	1.1	4.234841193	18.525	71.31857555	7.45	28.68142445	25.975
P3	0.1	0.4000400 04	0.1	0.40040 04	5.3	21.22122122	3.375	13.51351351	0.8	3.203203203	0.5	2.00200200 2	2.8	11.21121121	0.9	3.603603604	3.6	14.41441441	1.5	6.006006006	15.6	62.46246246	9.375	37.53753754	24.975
P4	0.1	0.3846467512	0.01	0.03844675 1	5	19.23375562	3.8	14.60976547	0.8	3.07574 01	0.6	2.30680507 5	2.1	8.073817762	1.1	4.229142637	2.4	9.227222 03	2.1	8.073817762	13.4	51.51864667	12.61	48.48135333	26.01
P5	0.075	0.2832861 19	0.15	0.56657223 8	4.9	18.50802644	4.25	16.05288008	0.6	2.266288952	0.9	3.39943342 8	1.8	6.798866856	2.4	9.065155807	2.2	8.309726157	3.2	12.08687441	11.575	43.72049103	14.9	56.27950897	26.475

P6	0.05	0.18416 2063	0.2	0.73664 825	4.5	16.5745 8564	5.5	20.2578 2689	0.5	1.84162 066	1.2	4.41988 9503	1.3	4.78821 3628	3.5	12.8913 4438	1.8	6.6298 3425 4	4.6	16.94290 976	9.15	33.70165746	18	66.2983 4254	27.15

TABLE 7: Annual Proportion of individual open and laparoscopic surgeries from 2016 to 2022

DISCUSSION

Indian general surgery residents had a significant increase in the number of laparoscopic cholecystectomy experiences. It slightly increased the rate of laparoscopic cholecystectomy experience from 65% to 70%. The rate of laparoscopic cholecystectomy in the United States resident remains stable at around 90%. Although laparoscopic cholecystectomy has several benefits and can be performed safely by general surgery residents. Being able to convert from a laparoscopic approach to open surgery is very important for a competent surgeon. As a training center, we have to make sure that our general surgery residents are also comfortable doing open cholecystectomies.[6]There has a been a significant decrease in the number of open procedures and an increase in the number of laparoscopic procedures over the last 6 years.[7]

A Fundamentals of Open Surgery course has not been explored and can be one way to ensure proficiency in open surgical technique.[7,8]

Similarly, it may be reasonable to shift to a competency based assessment rather than numerical goals at the institutional level and is already embraced in some aspects by the ACGME [22, 23].

The reduction in open experience will require evaluation by bodies governing resident training.[22]

CONCLUSION

The number of open procedures performed by general surgery residents continues to decline despite an increase in total cases reported. However the advent or the practice of basic and laparoscopic procedures aren't disregarded as they are the future of surgical practices but the reduction in open surgical experience may result in surgeons lacking technical skills to safely and competently perform open procedures. Therefore, a shift in the educational paradigm can produce competent, confident, surgeons and will be worth the effort.

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