

# Roeder's Knot in Laparoscopic Appendicectomy and Cholecystectomy: Socio-Demography, Hospital Stay and Complications

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## Abstract

**Introduction:** The preferred method for several abdominal operations, such as cholecystectomy and appendicectomy, is now laparoscopic surgery. The advancement in laparoscopic techniques has led to the exploration of different knot-tying methods, among which Roeder's knot has gained attention for its simplicity and efficiency. This research aims to investigate the analysis of Roeder's knot in laparoscopic appendicectomy and laparoscopic cholecystectomy, focusing on its clinical outcomes and early complications.

**Methods and Materials:** From January 2020 to December 2021, the Department of Surgery at Jahurul Islam Medical College & Hospital in Kishoreganj, Bangladesh, conducted an experimental investigation. Purposively, 100 patients who were hospitalized in the Surgery ward and were undergoing laparoscopic appendicectomy and cholecystectomy were included in this study. SPSS Version 23.0 and MS Office programs were used for data analysis.

**Results:** Among 100 patients, 55% were male, and 45% were female; 64 were from the lower class, and 36 were from the middle class. Of the seventy patients who had laparoscopic appendicectomy, ninety-four percent recovered without any complications, and five percent experienced complications. Infections in the wounds were the most frequent consequences. Patients undergoing laparoscopic cholecystectomy were found to stay in the hospital much longer than patients undergoing laparoscopic appendicectomy ( $p < 0.05$ ), even though the median length of stay for both types of operations was the same.

**Conclusion:** Our study on the application of Roeder's knot in laparoscopic appendicectomy and cholecystectomy has provided valuable insights into its impact on socio-demographic factors, hospital stay, and early complications. Roeder's knot demonstrated promising results in both procedures, contributing to a more comprehensive understanding of its potential benefits in contemporary laparoscopic surgery.

**Keywords:** Laparoscopic, appendicectomy, cholecystectomy, Roeder's knot, complications

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## I. Introduction

Roeder's knot, a relatively novel knot-tying technique, has shown promise in enhancing the efficiency of laparoscopic surgeries. Laparoscopic surgeries have made present-day surgery safer, with fewer chances of infection, less postoperative recovery period, and minimal scarring [1]. At the same time, the approach through tiny incisions poses many challenges to the technique. Intra-abdominal knot tying is an increasing concern for laparoscopic surgeons as the knot is the weakest link in the surgical suture [2]. When a knotted suture fails to perform its functions, the consequences may be disastrous, and the suture loop around vascular breaks or unties, and massive bleeding may take place [3-5].

There are various types of extracorporeal knots, non-sliding (static knots such as Revo knot, square knot, and half hitches) and sliding knots (such as Duncan or Hangman's knot, Roeder knot, Lieurance Modified Roeder knot, Tennessee Slider, Meltzer's knot, Tayside's knot, Weston slip knot) [6-8]. Roeder's knot among these was the first knot described in laparoscopic surgery. It is inspired by the hangman's knot and was first used by Albert Hans Roeder, who used it in 1931 during a tonsillectomy [9].

Sufficient appendiceal stump closure is essential to reduce intra-abdominal and surgical site infections. During a laparoscopic appendicectomy, the base of the appendix can be closed using a variety of methods, including staplers, endoloops, knotting, and clips [10-11]. A comparison study by Nadeem M et al. concluded that using metallic endoclips for appendix stump closure is safe and less time-consuming but costs more [12]. Because of the simplicity of the technique, it's a valuable alternative to extracorporeal knotting, especially for learners [13]. Another prospective study was done by Ates M et al. on 61 patients. They concluded no statistically significant differences between the groups regarding hospital stay, follow-up time, and preoperative and postoperative complications were detected [14]. Using a titanium endoclip for optimizing and controlling the appendiceal stump closure is safe and is associated with shorter operation times [15].

A study was done in Bangladesh by Saha. P et al. showed that intracorporeal separate knotting of artery and duct is easy to learn and does not increase the operating time if the surgeon is expert enough regarding intracorporeal knot to secure both cystic duct and artery [16]. Separate knotting of artery and duct is a feasible, cost-effective, and safe alternative method to block cystic artery and duct in LC [17-18]. This study aims to assess the application of Roeder's knot in laparoscopic appendicectomy and laparoscopic cholecystectomy and analyze the associated early complications.

## **II. Methods and Materials**

This clinical trial was conducted in the Department of Surgery at Jahurul Islam Medical College & Hospital in Kishorgonj, Bangladesh, from January 2020 to December 2021. One hundred patients who were admitted to the hospital's Surgery ward and had laparoscopic appendicectomy and cholecystectomy were included in the study. The sample was chosen using a technique known as purposeful sampling.

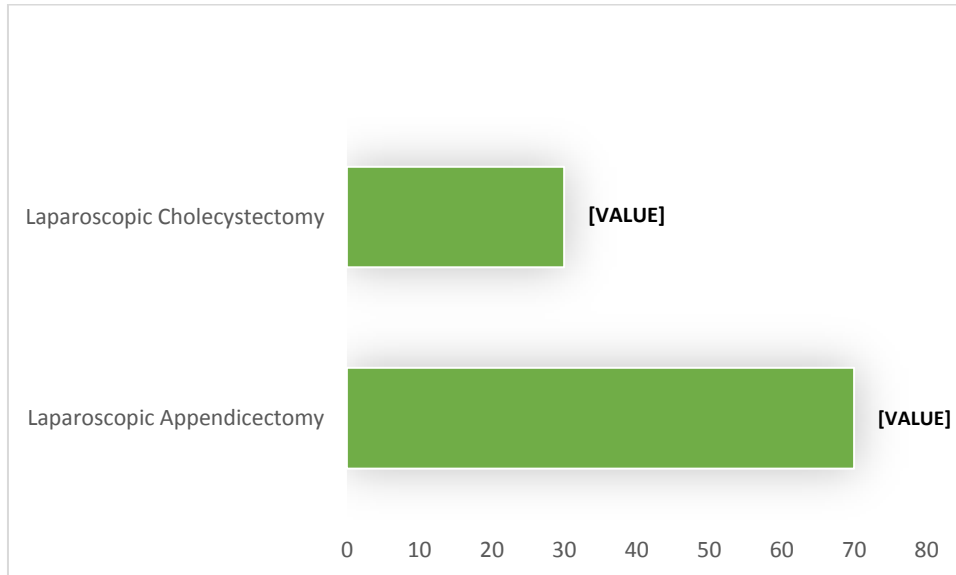
All patients underwent medical checks and investigations to confirm their diagnoses after admission. Every patient received comprehensive information regarding the purpose, goals, advantages, and risks of the research. In addition, relevant data and sociodemographic factors were gathered while interviewing the patients. Additionally, the frequency of problems was later recorded.

The hospital's ethical committee approved the study, as well as data and participant anonymity were preserved. The study's inclusion criteria were individuals who had cholecystectomy and laparoscopic appendectomy, with the stump being secured with a Roeder's knot. Patients with acute appendicitis with peritonitis, patients with empyema gall bladder, and patients who had not used Roeder's knot were excluded.

The participants' clinical and demographic data were carefully documented, and MS Excel and SPSS version 23.0 were used for data analysis where necessary. Statistical significance was defined at a 5% allowable error level and a 95% confidence level. The characteristics of the patients were expressed as mean  $\pm$  standard deviation or as percentages.

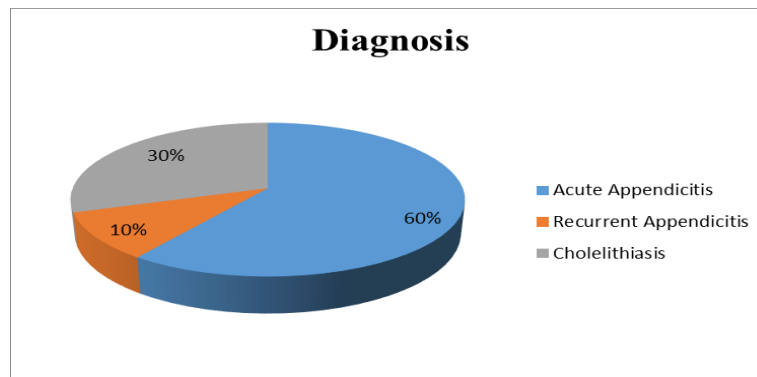
## **III. Results**

In this study of 100 patients, 70% underwent laparoscopic appendicectomy, while the remaining 30% underwent laparoscopic cholecystectomy. The diagnoses among these patients were distributed as follows: 60% were diagnosed with acute appendicitis, 30% with cholelithiasis (gallstones), and 10% with recurrent appendicitis. The mean age of all the patients in the study was 34.42 years, with a standard deviation of 13.80 years. The patients' ages varied from eighteen to sixty at the oldest. In this study, it was observed that among all the patients, 55% were male, and 45% were female. When broken down by surgical procedure, in the laparoscopic appendicectomy group, males constituted 65.7%, while females made up 34.3%. In the laparoscopic cholecystectomy group, 30% were male, and 70% were female. Among the 70 patients who underwent laparoscopic appendicectomy, 94.3% had a smooth recovery without complications, while 5.7% experienced complications. Among the 30 patients who underwent laparoscopic cholecystectomy, 90% had an uneventful recovery, and 10% experienced complications. This difference in complication rates between the two procedures was statistically significant ( $p < 0.05$ ). Our current study noted that the most common complication in both surgical groups was wound infection. The distribution of other complications was similar between the two types of operations. Regarding the time required to perform Roeder's knot, the mean duration for laparoscopic appendicectomy was  $50 \pm 3.40$  seconds, while for laparoscopic cholecystectomy, it was  $125 \pm 7.90$  seconds.



**Figure 1: Distribution of patients according to operation done (n=100)**

A total of 100 patients were chosen for either a cholecystectomy or laparoscopic appendicectomy where 30% had a laparoscopic cholecystectomy and 70% had a laparoscopic appendicectomy.



**Figure 2: Distribution of patients according to diagnosis (n=100)**

In the 100 patients, Figure 2 demonstrates that 60 per cent had an acute appendicitis diagnosis, 30 per cent had cholelithiasis, and 10 per cent had recurrent appendicitis.

Age groups	Laparoscopic Appendicectomy n=70 (%)	Laparoscopic Cholecystectomy n=30 (%)	Total
16-25	42 (60)	0	42
26-35	7 (10)	9 (30)	16
36-45	11 (15.7)	9 (30)	20
46-55	7 (10)	6 (20)	13
56-65	3 (4.3)	6 (20)	9

**Table-1: Distribution of patients according to age (n=100)**

The patients' mean age was  $34.42 \pm 13.80$  years. The patients' maximum age was 60 years old, while their minimum age was 18. 60% of patients undergoing laparoscopic appendicectomy were between the ages of 16 and 25.

Sex	Laparoscopic Appendicectomy n=70 (%)	Laparoscopic Cholecystectomy n=30 (%)	Total
Male	46 (65.7)	9(30)	55
Female	24 (34.3)	21(70)	45

**Table-2: Distribution of patients according to sex (n=100)**

According to the table, out of 100 patients, 45% were female and 55% were male. Of those undergoing laparoscopic appendicectomy, 65.7% were men and 34.3% were women. 30% of patients undergoing laparoscopic cholecystectomy were men, and 70% were women.

Occupations	Laparoscopic Appendicectomy n=70 (%)	Laparoscopic Cholecystectomy n=30 (%)	Total
Service	4(5.7)	0	4
Business	0	6(20)	6
Day labor	15(21.4)	0	15
Students	21(30)	0	21
House wife	24(34.3)	21(70)	45
Others	6(8.6)	3(10)	9

**Table-3: Distribution of patients according to occupation (n=100)**

Based the data in the table, out of 100 patients, housewives represented the majority (45%) and students made up the second-most common occupational group (21%).

Economic Background	Laparoscopic Appendicectomy n=70 (%)	Laparoscopic Cholecystectomy n=30 (%)	Total
Lower class	46 (65.7)	18 (60)	64
Middle class	24 (34.3)	12 (40)	36

**Table-4: Distribution of patients according to economic background (n=100)**

Above table indicates that out of 100 patients, 36 belonged to the middle class and 64 to the lower class. Of the 64 patients in the lowest class, 46 underwent laparoscopic appendicectomy, while the remaining 18 underwent laparoscopic cholecystectomy.

Outcomes	Operations		p-value
	Laparoscopic Appendicectomy n=70 (%)	Laparoscopic Cholecystectomy n=30 (%)	
Recovery	66 (94.3)	27 (90)	<0.001
Complication	04 (5.7)	03 (10)	

**Table-5: Distribution of outcome in relation to operation done (n=100)**

Among 70 patients who had laparoscopic appendicectomy, ninety-four percent recovered without any complications, and five percent experienced complications. There is a statistically significant difference (p<0.05).

Complications	Operation		p-value
	Laparoscopic Appendicectomy n=70 (%)	Laparoscopic Cholecystectomy n=30 (%)	
Wound infection	4(5.71)	3(10)	0.287
Port hernia	0	0	
Postoperative ileus	0(0)	1(3.33)	0.270
Stump leakage	1(1.42)	2(6.66)	0.175
Peritonitis	1(1.42)	1(3.33)	0.270
Fecal fistula	1(1.42)	0(0)	0.270
Basal atelectasis	2(2.85)	2 (6.66)	0.190
Sepsis	3(4.28)	1(3.33)	0.340
Pneumonia	2(2.85)	2(6.66)	0.190

**Table-6: Distribution of complications in relation to operation done (n=100)**

Referring to the table, wound infection was the most frequent consequence. The distribution of additional complications was comparable for both kinds of procedures.

	Laparoscopic Appendicectomy Median (min-max)	Laparoscopic Cholecystectomy Median (min-max)	P-Value
Hospital Stay	3 (2-15)	3 (3-15)	0.011

\*p - value obtained by Mann-Whitney U test

**Table-7: Association of hospital stay with operation done (n=100)**

Table 7 illustrates how the type of procedure performed and hospital stay are related. Patients undergoing laparoscopic cholecystectomy were found to stay in the hospital much longer than patients undergoing laparoscopic appendicectomy ( $p < 0.05$ ), despite the fact that the median length of stay was the same for both types of operations.

#### IV. Discussion

The final analysis of this study includes a total of 100 population. Out of the 100 patients, 60% had an acute appendicitis diagnosis, 30% had cholelithiasis, and 10% had recurrent appendicitis. In a study involving 6317 people under 50 years old experiencing stomach discomfort, 32% were found to have appendicitis, while only 6.3% had acute cholecystitis as their diagnosis. Only 15.2% of the 2406 individuals over 50 years old had appendicitis recorded, while 20.9% had acute cholecystitis. These results corroborate the study's findings, which showed a prevalence of acute appendicitis [19].

Thirty percent had a laparoscopic cholecystectomy, and seventy percent had an appendectomy. This may be because appendicitis is more common than cholecystitis among Bangladeshi people. Bhasin et al.'s study, Major Surgical Procedures in an Urban Population of East Delhi, found that appendicectomy prevalence was 0.95% compared to 0.92% for cholecystectomy, corroborating the study's findings, which showed that appendicectomy was common [20].

65% of the 100 patients who had laparoscopic appendicectomy were in the 16–25 age range. 15.7% of the population was 36–45 years old, 10% was 46–55, 10% was 26–35, and 4.3% was 56–65. Additionally, 30% of patients undergoing laparoscopic cholecystectomy were between the ages of 26 and 35, 30% were between the ages of 36 and 45, 20% were between the ages of 46 and 55, and 20% were between the ages of 56 and 65. The patient's average age was  $34.42 \pm 13.80$  years. The patients' maximum age was 60, while the minimum was 18. Ages 16 to 25 accounted for 65 percent of the 100 patients who underwent laparoscopic appendicectomy. 15.7% of people were in the 36–45 age range, 10% in the 46–55 age range, 10% in the 26–35 age range, and 4.3% in the 56–65 age range. Furthermore, ages 26 to 35 accounted for 30% of patients having a laparoscopic cholecystectomy, followed by 36 to 45 for 30%, 46 to 55 for 20%, and 56 to 65 for 20% of patients. The mean age of the patients was  $34.42 \pm 13.80$  years. The patients had a minimum age of eighteen and a maximum of sixty [21].

Of the 100 patients in this study, 45% were women and 55% were men. Of those undergoing laparoscopic appendicectomy, 65.7% were men and 34.3% were women. 30% of patients undergoing laparoscopic cholecystectomy were men, and 70% were women. According to Nshuti et al., the male-to-female appendicitis ratio was 1.6:1. According to Elizabeth et al., women are 1.5 times more likely than men to have acute cholecystitis. These results corroborate those of the study, which showed that patients getting laparoscopic appendicectomy were predominantly male, whereas patients undergoing laparoscopic cholecystectomy were primarily female. Seventy of the one hundred patients who had a laparoscopic appendicectomy were housewives (34.3%), students (30%), day laborers (21.4%), people in various occupations (8.6%), and service providers (5.7%) [22]. Thirty percent of the patients who had laparoscopic cholecystectomy were homemakers, twenty percent had a company, and ten percent had another vocation. In the context of Bangladesh, where the majority of women are homemakers, these findings may be explained by the prevalence of females among those who had laparoscopic cholecystectomy procedures. The fact that laparoscopic procedures are more expensive than open procedures may impact the study's conclusions.

Of the 100 patients, 70 had a laparoscopic appendicectomy; of those, 94.3% recovered without any complications, and 5.7% experienced some problems. Ten percent of the thirty patients who had laparoscopic cholecystectomy developed complications, whereas 90% of them healed without any issues. There is a statistically significant difference ( $p < 0.05$ ). According to research by Ashraf et al., laparoscopic appendicectomy resulted in superior outcomes, including reduced blood loss, 0% death, a minimum wound infection incidence of 8.3%, and a reported intraabdominal abscess rate of 6.8% [21].

Wound infections were the most common type of infection among the 100 patients. Pneumonia at 2.85%, basal atelectasis at 2.85%, stump leaking, peritonitis, fecal fistula at 1.42% each, and wound infection at 5.71% were observed during laparoscopic appendectomy. Furthermore, 10% of patients who had laparoscopic cholecystectomy experienced wound infection, 3.3% had postoperative ileus, 6.66% had stump leaking, 3.3% had peritonitis, 6.66% had basal atelectasis, and 6.6% had pneumonia. The distribution of additional

complications was comparable for both kinds of procedures. Just three patients—two cases of intra-abdominal abscesses and one wound infection—had postoperative severe infectious complications, according to Gupta et al.'s analysis of 175 patients [22]. Al-Mulhim et al. studied the consequences of laparoscopic cholecystectomy in 968 patients. The study found that 0.31% of the patients experienced wound hematomas, 0.41% experienced atelectasis, 1.7% experienced wound infections, 0.31% experienced epigastric port site hernias, 0.31% experienced bile leaks, and 1.9% professional collection in the Morrison pouch. The results of this study differ from these findings [23].

Patients undergoing laparoscopic cholecystectomy were found to stay in the hospital significantly longer than patients undergoing laparoscopic appendicectomy ( $p < 0.05$ ). However, the median hospital stay was the same for both types of operations in this study of 100 patients. According to different research by Kassem et al., laparoscopic appendicectomy patients had an average hospital stay of  $5.3 \pm 2.1$  days [23]. Hospital stay following laparoscopic cholecystectomy was reported by Al-Mulhim et al. to be 1–13 days [24]. These results differ from the study's findings, possibly due to postoperative management and care variations. Our study used 1.0 RB vicryl cost for 220 Taka since it is more affordable and efficient than titanium endoclips.

## V. Conclusion

The application of Roeder's knot in laparoscopic appendicectomy and cholecystectomy holds potential benefits in terms of socio-demography, hospital stay, and early complications. This research contributes to the growing body of evidence supporting the integration of Roeder's knot into laparoscopic surgical techniques, paving the way for improved patient outcomes and the continued evolution of minimally invasive surgical practices.

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