

Research Article**Evaluation of Extracorporeal Knot-Tying Sutures versus Metallic Endoclips for Appendiceal Stump Closure in Laparoscopic Appendectomy**

Bushra Tasneem¹, Saira Mahmood², Shaheen Gul Bhatti³, Raja Muhammad Adeel Khan⁴, Nouman Anees⁵, Abdul Rahim Memon⁶, Osama Fathi Abu Al-Ola⁷.

1. Associate Professor of General Surgery, Abbasi Shaheed Hospital, Karachi Pakistan. Email: ameerahmad1937@gmail.com (Corresponding author)
2. Assistant Professor of General Surgery, Rawal Institute of Health Sciences Islamabad Pakistan. Email: drsairan@yahoo.com
3. Senior Registrar of General Surgery, Indus Medical College Hospital Tando Muhammad Khan Pakistan. Email: shaheen.bhatti27@gmail.com
4. Associate Professor of General Surgery, Suleman Roshan Medical College Tando Adam Pakistan. Email: rajamakhan@gmail.com
5. Senior Registrar of General Surgery, Lahore General Hospital Lahore Pakistan. Email: nomi.anees@gmail.com
6. Assistant Professor of General Surgery, People's University of Medical and Health Sciences Nawabshah Pakistan. Email: Surg.abdulrahim@gmail.com
7. Registrar of General Surgery, Saudi German Hospital Makkah Saudi Arabia. Email: alreqep@yahoo.com

ABSTRACT**Background:**

Acute appendicitis is one of the most common causes of emergency surgery worldwide. Laparoscopic appendectomy is currently the preferred surgical approach because of its several advantages over open surgery. Various techniques are available for appendiceal stump closure during laparoscopic appendectomy, including extracorporeal knotting, intracorporeal knotting, endoloops, endostaplers, metallic endoclips, and Hem-o-lok clips. However, there is still no consensus regarding the

optimal method for appendiceal stump closure.

Objective:

To compare extracorporeal knot-tying sutures and metallic endoclips for laparoscopic appendiceal stump closure in terms of operative time, complication rate, duration of hospital stay, and cost.

Study

Randomized controlled trial.

Design:

Duration and Place of Study: This study was conducted at Abbasi Shaheed Hospital,

Karachi Pakistan from April 2025 to April 2026

Methodology:

This randomized controlled trial included 80 patients diagnosed with uncomplicated acute appendicitis who underwent laparoscopic appendectomy. Patients were randomly divided into two groups: Group A underwent appendiceal stump closure using extracorporeal knotting, while Group B underwent closure using metallic endoclips. Diagnosis was established clinically and radiologically. A standard three-port laparoscopic appendectomy technique was used in all patients. Roeder's knot with Vicryl suture was used for extracorporeal knotting, whereas titanium endoclips were applied in the endoclip group. Intraoperative and postoperative complications, operative time, duration of hospital stay, and cost were assessed. Data were analyzed using SPSS version 19.

Results:

A total of 80 patients were included in the study, with 38 patients (47.5%) in Group A and 42 patients (52.5%) in Group B. The study population comprised 43 males and 37 females. No statistically significant difference was observed between the two groups regarding age and duration of

hospital stay. However, a significant difference was noted in operative time, which was shorter in the metallic endoclip group compared to the extracorporeal knotting group (41.1 ± 7.4 minutes vs 47.9 ± 8.5 minutes).

Conclusion:

Both extracorporeal knotting and metallic endoclips are safe and effective methods for appendiceal stump closure during laparoscopic appendectomy. Although the metallic endoclip technique is relatively more expensive, it is associated with a shorter operative time.

Keywords:

Laparoscopic appendectomy, Acute appendicitis, Extracorporeal knotting, Metallic endoclips, Appendiceal stump closure

INTRODUCTION

Acute appendicitis is one of the most common causes of emergency surgery worldwide. Consequently, appendectomy is considered one of the most frequently performed surgical procedures in general surgery. It is also among the first surgical procedures taught to surgeons during training [1]. Laparoscopic appendectomy was introduced nearly 30 years ago, and with advancements in surgical techniques

and equipment, it has become widely accepted and commonly practiced worldwide [2]. Compared with open appendectomy, laparoscopic appendectomy is associated with less postoperative pain, faster recovery, shorter hospital stay, and earlier return to daily activities and work [3,4].

Despite its advantages, laparoscopic appendectomy presents certain technical challenges, particularly regarding secure closure of the appendiceal stump, which may be associated with a higher incidence of postoperative intra-abdominal infections [5]. Several techniques are currently available for appendiceal stump closure during laparoscopic appendectomy [6]. These include extracorporeal knotting, intracorporeal knotting, endoloops, endostaplers, metallic endoclips, and Hem-o-lok clips. Numerous retrospective and prospective studies have been conducted to determine the most effective and safest technique for appendiceal stump closure [7,8,9]. However, there is still no clear consensus regarding the optimal method. Kazemier et al. conducted a meta-analysis demonstrating that stapling may be superior to loop ligatures in reducing postoperative infections [10].

Since its introduction, laparoscopic appendectomy has remained controversial because of concerns regarding increased healthcare costs. The development and use of newer techniques for appendiceal stump closure have further increased the overall cost of the procedure [11]. Therefore, many experienced laparoscopic surgeons prefer intracorporeal or extracorporeal knot-tying techniques because of their safety and reliability, particularly in cases with an inflamed or friable appendiceal base [12]. On the other hand, newer techniques are technically easier to perform and may reduce operative time.

Cristalli first reported the use of metallic endoclips for appendiceal stump closure in 1991 [13]. Metallic endoclips are already widely used in laparoscopic surgery, particularly for ligation of the cystic duct, due to their simplicity, safety, and rapid application. To the best of our knowledge, no local study has compared the efficacy of different appendiceal stump closure techniques in our country. Therefore, the aim of this study was to compare extracorporeal knot-tying sutures and metallic endoclips for laparoscopic appendiceal stump closure in terms of

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complication rate, operative time, duration of hospital stay, and cost.

METHODOLOGY

This randomized controlled trial was conducted among patients undergoing laparoscopic appendectomy for acute appendicitis. A total of 80 patients were included in the study and were randomly divided into two groups: the metallic endoclip group and the extracorporeal knotting group. The diagnosis of acute appendicitis was established on the basis of clinical findings, ultrasonography, and laboratory investigations. Written informed consent was obtained from all patients before inclusion in the study. The study protocol was approved by the Institutional Ethical Review Committee.

Exclusion Criteria:

Patients with perforated appendix, generalized peritonitis, or friable appendiceal base were excluded from the study. Patients diagnosed with pelvic inflammatory disease were also excluded. In addition, cases requiring conversion to open appendectomy and patients with an alternative intraoperative diagnosis were not included in the study.

All patients underwent standard three-port laparoscopic appendectomy under general anesthesia with prophylactic antibiotic coverage. After dissection of the mesoappendix, the appendiceal stump was secured either by extracorporeal Roeder's knot using Vicryl suture or by metallic endoclips, depending on the assigned group. The appendix was then excised, followed by peritoneal washout when required.

Postoperatively, patients were prescribed oral medications and discharged according to their clinical condition. Follow-up was performed after 8 to 10 days for wound assessment and stitch removal.

A structured data collection sheet was prepared for each patient after obtaining consent. Demographic variables, intraoperative findings, operative time, duration of hospital stay, cost, and

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postoperative complications were recorded. All collected data were entered and analyzed using SPSS version 19. Continuous variables were analyzed using the independent sample t-test, while categorical variables were analyzed using the chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 80 patients diagnosed with uncomplicated acute appendicitis were included in this study. The patients were randomly divided into two groups: Group A (metallic endoclip group), which included 38 patients, and Group B (extracorporeal knotting group), which included 42 patients. The overall study population consisted of 43 males (53.75%) and 37 females (46.25%). The mean age of patients in Group A was

23.1 ± 7.3 years, whereas in Group B it was 24.0 ± 7.8 years. No statistically significant difference was observed between the two groups regarding age ($p = 0.90$).

A statistically significant difference was observed in operative time between the two groups. The mean operative time was shorter in Group A compared to Group B (41.1 ± 7.4 minutes vs 47.9 ± 8.5 minutes; $p = 0.002$). However, no statistically significant difference was observed regarding duration of hospital stay between the two groups ($p = 0.17$).

Intraoperative and postoperative complications were also compared between the two groups. No statistically significant difference was observed in the rates of bleeding, readmission, postoperative ileus, surgical site infection, or intra-abdominal infection.

Table 1: Gender Distribution of the Study Population

Gender	Frequency (N)	Percentage (%)
Male	43	53.75
Female	37	46.25
Total	80	100

Table 2: Comparison of Mean Values Between the Two Groups

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Variables	Group A (n=38)	Group B (n=42)	P-value
Age (years)	23.1 ± 7.3	24.0 ± 7.8	0.90
Operative time (minutes)	41.1 ± 7.4	47.9 ± 8.5	0.002
Cost	Higher	Lower	—
Hospital stay duration (hours)	28.9 ± 29.5	22.1 ± 13.6	0.17

Table 3: Comparison of Intraoperative and Postoperative Complications

Complications	Group A (n=38)		Group B (n=42)		P value
	N	%	N	%	
Intraoperative Complications					
Bleeding	2	5.2	1	2.3	0.58
Postoperative Complications					
Readmission	1	2.6	1	2.3	1.00
Postoperative ileus	2	5.2	1	2.3	0.58
Surgical site infection	2	5.2	2	4.7	1.00
Intra-abdominal infection	2	5.2	0	0.0	0.46

DISCUSSION

Laparoscopic appendectomy has gained wide acceptance because of its advantages, including better visualization, reduced postoperative pain, faster recovery, shorter hospital stay, and improved cosmetic outcomes [14]. However, the procedure is associated with increased cost, longer

operative time in some cases, and the need for specialized surgical expertise. One of the most important aspects of laparoscopic appendectomy is secure closure of the appendiceal stump in order to prevent complications such as intra-abdominal infection, fecal fistula formation, and surgical site infection. Various techniques

are currently available for appendiceal stump closure; however, there is still no conclusive evidence suggesting the superiority of one technique over another [15].

In the present study, we compared extracorporeal knotting with metallic endoclips for appendiceal stump closure during laparoscopic appendectomy. Our findings demonstrated comparable results between the two techniques regarding both intraoperative and postoperative complications. Complications such as intra-abdominal abscess and postoperative ileus appeared to be more closely related to the severity of inflammation and disease process rather than the stump closure technique itself. Similarly, the rate of superficial surgical site infection was comparable between the two groups.

Our findings are generally consistent with previously published studies. Gonenc et al. reported lower rates of postoperative ileus, with incidences of 1.6% in the clipping group and 4.3% in the knotting group [16]. Likewise, Beldi et al. observed even lower rates of ileus in patients managed with staplers (0.7%) and endoloops (0.5%) [17]. In contrast, studies conducted by Di Saverio et al. and Arcovedo et al. reported no cases

of postoperative ileus in patients undergoing extracorporeal knotting [18,19]. The relatively higher complication rates observed in our study, including ileus and infections, may be attributed to the smaller sample size and the severity of inflammation in some patients.

Despite these variations, no statistically significant difference was observed between the two techniques regarding surgical complications in our study. These findings are in agreement with previous literature demonstrating comparable safety profiles among different appendiceal stump closure techniques [20]. Therefore, neither extracorporeal knotting nor metallic endoclips appear to be significantly superior in terms of surgical safety and postoperative outcomes.

In the present study, metallic endoclips were associated with a shorter operative time compared to extracorporeal knotting, although the cost of the endoclip technique was relatively higher. The shorter operative time associated with endoclips may be explained by their ease of application and technical simplicity during laparoscopic procedures.

The main limitations of the present study include the relatively small sample size and

short follow-up duration. Further multicenter studies with larger sample sizes and longer follow-up periods are recommended to better evaluate the long-term outcomes and cost-effectiveness of these techniques.

CONCLUSION

Both metallic endoclips and extracorporeal knotting techniques were found to be safe and effective methods for appendiceal stump closure during laparoscopic appendectomy. Both techniques showed comparable outcomes with similarly low rates of intraoperative and postoperative complications. However, although the metallic endoclip technique was relatively more expensive, it was associated with a shorter operative time compared to extracorporeal knotting.

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This study was conducted without any financial support or funding from external sources.

Conflict of Interest

The authors declare that there was no conflict of interest regarding the conduct and publication of this study.

Ethical Permission

Ethical approval was obtained from the Institutional Ethical Review Committee prior to the commencement of the study to ensure compliance with ethical standards and guidelines.

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