

Efficacy of Single Hem-O-Lok Clip Versus Roeder's Knot in Securing the Appendiceal Stump: A Prospective Comparative Study

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Abstract

Background: Laparoscopic appendectomy is considered as the surgical treatment of choice for acute appendicitis and securing the closure of the appendiceal stump is essential to avoid postoperative complications like stump leak and intra-abdominal infection. There are a number of ways this is done, such as Hem-o-lock clips and Roeder knot, both having their advantages. Comparative information regarding their efficacy, safety and cost-effectiveness in a typical surgical setting is lacking, however, especially in resource challenged areas. The objective is to assess the effectiveness, safety and operative outcomes of single Hem-o-lok clip closure versus Roeder's knot for appendiceal stump closure in LA. **Material and Methods:** Prospective comparative study was done in the department of General surgery of a tertiary care center for a period of 12 months. The total number of patients who were diagnosed as uncomplicated acute appendicitis and undergoing laparoscopic appendectomy were 60. According to this, patients received two random assignments: 30 patients each in group A (Hem-o-lok clip) and group B (Roeder's knot). All surgeries were performed as a standard three-port laparoscopic appendectomy. Operative time, ease of application, intraoperative and postoperative complications, wound infection, intra-abdominal abscess, stump leak, duration of hospital stay and cost were evaluated. The statistical analysis was done by applying appropriate tests, p value < 0.05 significant. **Results:** The operative time of the Hem-o-lok group was significantly shorter than that of the Roeder's knot group (42.3 ± 6.5 min vs 50.7 ± 7.2 min, respectively, $p < 0.01$). The ease of application was favored with the Hem-o-lok clips, especially when the bases of the appendix were edematous or inflamed. There were few intra-operative complications and no significant differences among the groups. Hem-o-lok showed no stump leak and no postoperative complications and Roeder's knot showed 3 (10.0%) with no statistically significant difference between the groups ($p > 0.05$). The mean hospital stay was similar in both groups (2.4 ± 0.8 vs. 2.6 ± 0.9 days). But the Roeder's knot technique proved to be more economical than Hem-o-lok clips. **Conclusion:** Appendiceal stump closure after a laparoscopy is safe and can be done with either Hem-o-lok clip or Roeder's knot. Hem-o-lok clips have the merits of less operating time and technique; Roeder's knot is more economical. Technique may vary according to surgeon preference, surgery type, and availability of resources.

Keywords: Appendix stump closure, Hem-o-lok clip, Laparoscopic appendectomy, Roeder's knot, Surgical outcomes.

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INTRODUCTION

Laparoscopic appendectomy is widely accepted to be the gold standard treatment for acute appendicitis and has benefits such as decreased pain, less time in the hospital, earlier return to normal activity, and superior cosmetic results.^[1] However, while these merits are there, the key to the success of laparoscopic appendectomy is the sealing of the appendiceal stump, which is essential to prevent postoperative complications like stump leak, intra-abdominal abscess and peritonitis.^[2]

Hem-o-lok clips and Roeder's knot are popular methods, as they are relatively quick, secure and easy to perform and are accessible and cheap. They are especially beneficial when the bases are edematous or inflamed, making it difficult to apply a knot. But extra monetary and clip slip concerns exist particularly when they are used.^[4-6]

An extracorporeal sliding knot technique (Roeder's knot) has been well established and cost-effective alternative for appendiceal stump closure. This technique does require some surgical skill, and may add to operative time, particularly in less experienced hands or in difficult cases.^[7]

These techniques are debated and depend upon the surgeon's personal preference, availability of resources and intraoperative findings.^[8]

Cost is an important factor to consider when selecting a surgical procedure in resource-limited areas. A connector called a stapler and various commercially available loop devices are convenient but expensive to utilize in a routine fashion in many institutions, and simpler and more economical alternatives like Roeder's knot continue to be widely practised. However, Hem-o-lok clips are hygienic and easy to use in modern laparoscopic surgery.^[9-11]

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There are limited comparative data in a standardized fashion to assess efficacy, safety, and operative outcomes of both Hem-o-lok clips and Roeder's knot. Existing studies primarily have analyzed single techniques and, in part, different ones from a single school, which causes differences in practice. In addition, factors like operative times, complications, learning curve and cost considerations should be carefully evaluated in a systematic manner for evidence-based decision making.

As the importance of optimizing surgical outcomes and resources has grown, the ability to find a technique that is both safe and effective, but also practical and economical are important. Comparing Hem-o-lok clips directly with Roeder's knot can help surgeons understand each option's pros and cons, aiding their decision-making process for surgical procedures in different environments based on patient needs.

Aims and Objectives: To compare the effectiveness, safety, and operative outcomes of single Hem-o-lok clip versus Roeder's knot for appendiceal stump closure in laparoscopic appendectomy.

MATERIALS AND METHODS

The present prospective comparative study was conducted in the Department of General Surgery at SreeMookambika Institute of Medical Sciences over a period of 12 months, from January 2025 to December 2025. The study included patients admitted with a clinical and radiological diagnosis of acute appendicitis who were planned for laparoscopic appendectomy. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study, and written informed consent was obtained from all participants after explaining the nature and purpose of the study.

A total of 60 patients were enrolled in the study and were allocated into two equal groups of 30 patients each based on the technique used for appendiceal stump closure during laparoscopic appendectomy. In Group A, stump closure was performed using a single Hem-o-lok clip, while in Group B, closure was achieved using Roeder's knot. Allocation was done using a simple random sampling method. All patients underwent standard preoperative evaluation including detailed history, physical examination, routine blood investigations, urine analysis, ultrasonography of the abdomen, and other relevant investigations as required.

The inclusion criteria comprised patients aged 18–60 years diagnosed with uncomplicated acute appendicitis, including recurrent appendicitis, who were fit for laparoscopic surgery and willing to participate in the study. Patients of both sexes were included. Only those undergoing elective or emergency laparoscopic appendectomy with a healthy or mildly inflamed appendiceal base suitable for both closure techniques were considered eligible.

Exclusion criteria were: cases of complicated appendicitis who required conversion to open surgery, gangrenous appendix, which involved the base, appendicular mass, generalized peritonitis and appendicular perforation or an

appendicular abscess. Other exclusion criteria were patient's significant comorbid diseases which made laparoscopy contraindicated, pregnant women, patients with bleeding disorders, past extensive surgery in lower abdomen due to dense adhesions and patient's reluctant to consent the laparoscopy.

All surgeries were performed laparoscopically through the three-port technique and under general anaesthetic. Once the appendix has been identified and dissected, the mesoappendix is cut off with either electrocautery or an energy device. The base of the appendix was dissected to a normal level, the appendix was skeletonized and a good sized hem-o-lok clip was then placed at the base of the appendix with a laparoscopic clip applicator in Group A. Special care was taken to position the clip entirely flush to the wall of the cecum with minimal surrounding tissue, thus obtaining the tightest closure of the cecal lumen. They confirmed visually the stability of the clip before starting. The appendix was then divided laparoscopically, taking care to remove the appendix sufficiently away from the applied clip to avoid stump insufficiency and slippage.

In Group B, after the dissection of appendix, an extracorporeal knotting Roeder's sliding knot was made using absorbable suture material (usually polyglactin 2-0). The loop was placed into the abdomen via a trocar and around the base of the appendix. A knot pusher was then used and the knot was pushed up intracorporally and secured properly at the base of the appendix without causing any cut through of tissues. Sometimes, the knot was doubled (a second reinforcing knot was created) for extra security. Successful ligation was followed by transection of the appendix distal to this with adequate stump. Special efforts were made to check for hemostasis and stump closure to ensure they were secure before finalizing the procedure.

Intraoperative parameters: operative time, difficulty in stump closure, technical difficulties, and complications were recorded. The postoperative assessment consisted of pain, wound infection, fever, ileus, intra-abdominal collection, stump leak, hospital stay and return to normal activities. Patients were followed up till discharging and after discharge as an outpatient for early complications.

The data collected were analysed statistically using appropriate software and entered in a structured proforma. All continuous variables were presented as mean $\pm$ SD and frequency and percentages for categorical variables. The independent t-test and chi-square test were used for comparison between the two groups. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 60 patients were included in the study, with 30 patients each in Group A (Hem-o-lok clip) and Group B (Roeder's knot). The majority of patients were in the 18–45 years of age group (73.4%), with a male predominance (58.3%). Both groups were comparable with respect to baseline demographic characteristics. [Table 1]

The Hem-o-lok group demonstrated significantly shorter operative time and greater ease of application, highlighting

technical simplicity and efficiency. [Table 2]

Table 1: Demographic Profile

Variable	Category	Group A n (%)	Group B n (%)	Total n (%)
Age (years)	18–30	12 (20.0%)	10 (16.7%)	22 (36.7%)
	31–45	10 (16.7%)	12 (20.0%)	22 (36.7%)
	46–60	8 (13.3%)	8 (13.3%)	16 (26.6%)
Gender	Male	18 (30.0%)	17 (28.3%)	35 (58.3%)
	Female	12 (20.0%)	13 (21.7%)	25 (41.7%)

Table 2: Intraoperative Parameters

Parameter	Group A (Mean ± SD / n %)	Group B (Mean ± SD / n %)	p-value
Operative time (min)	42.3 ± 6.5	50.7 ± 7.2	<0.01*
Easy application	26 (86.7%)	20 (66.7%)	0.04*
Difficult application	4 (13.3%)	10 (33.3%)	

Postoperative complications were low and comparable in both groups, with no major complications such as stump leak, confirming safety of both techniques. No significant

association was found between type of stump closure and complications. [Table 3]

Table 3: Postoperative Complications

Complications	Group A n (%)	Group B n (%)	p value
Wound infection	1 (3.3%)	2 (6.7%)	0.64
Fever	1 (3.3%)	1 (3.3%)	
Intra-abdominal abscess	0 (0%)	0 (0%)	
Stump leak	0 (0%)	0 (0%)	
Complications present	2 (6.7%)	3 (10.0%)	
Complications absent	28 (93.3%)	27 (90.0%)	

Recovery parameters were comparable, though slightly favourable in the Hem-o-lok group, without statistical

significance. [Table 4]

Table 4: Postoperative Recovery

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	p-value
Hospital stay (days)	2.4 ± 0.8	2.6 ± 0.9	0.38
Time to oral intake (hrs)	18.2 ± 4.1	20.5 ± 5.3	0.07

Longer operative duration was significantly associated with increased complications, indicating its clinical relevance. [Table 5]

Table 5: Operative Time and Complications

Operative Time	Complications Present n (%)	Complications Absent n (%)	p-value
≤45 minutes	1 (3.3%)	25 (83.3%)	0.03*
>45 minutes	4 (13.3%)	30 (50.0%)	

DISCUSSION

The present study evaluated 60 patients undergoing laparoscopic appendectomy, equally distributed between the Hem-o-lok clip group and the Roeder's knot group. The demographic profile was comparable between the two groups, with the majority of patients belonging to the 18–30 years age group, followed by 31–45 years and >45 years. A slight male predominance was observed overall. These findings were consistent with Gandhi A et al,^[12] and Kennedy JJ et al,^[13] who also reported comparable baseline characteristics between groups with no statistically significant differences in age and gender distribution. Similarly, Dafle VD et al,^[14] observed a male predominance and a higher incidence in younger age groups, supporting the demographic pattern noted in the present study.

As far as immediate results are concerned, the present study showed that the Hem-o-lok group had a significantly shorter

operating time than the Roeder's knot group, suggesting ease of application and quickness of application. This finding corroborated the findings of Gandhi A et al,^[12] which observed that the lesser time was required in the Hem-o-lok group and more time was observed in the Roeder's knot group during the surgery. Similarly, Kennedy JJ et al,^[13] and El-Sherbeny IA et al,^[15] noted that there was a significant decrease in operative time when the clips were applied compared to knotting techniques. These findings were corroborated by Kamel AA et al,^[16] who showed that polymer clips in the stump closure technique was the most rapid of all the techniques, proving that the use of clips reduces the operative time.

In the present study, very few intra-operative complications were observed with no significant differences in the two groups. This was also in line with El-Sherbeny IA et al,^[15] and Yildirim M et al,^[17] which showed no significant difference between clip and knotting method in relation to the intraoperative complications, both of these methods were safe and reliable.

The overall rate of any complications for the patients in the present study was lower for the Hem-o-lok group than the Roeder's knot group, with the most prevalent complication being that of surgical site infection. This indicates improved results when clips are used, however some studies by Gandhi A et al,^[12] and El-Sherbeny IA et al,^[16] have shown an absence of statistically significant difference between the two techniques in terms of any postoperative complications. Likewise, Habib FM et al,^[18] found similar complication rates between groups, concluding that although clips may have a minor advantage, both methods seem to have good safety.

The present study showed that the Hem-o-lok group had shorter hospital stay which meant their recovery after surgery was quicker. The same finding is comparable to Kamel AA et al,^[16] who showed that the polymer clips group have the shortest hospital stay. Kennedy JJ et al,^[12] and Habib FM et al,^[18] did not find a significant difference between the groups regarding length of hospital stay, however, this may vary according to the various hospital practices and patient factors.

However, this study found correlation analysis that the longer the operation time the more likely the postoperative complications and the longer the hospital stays. Furthermore, the method used for the stump closure was also found to affect the outcome, as with the Roeder knot group the incidence of complications was higher. The results highlight the need for the efficiency of operation and choosing optimal surgical techniques towards better surgical outcomes.

Results of the present investigation agree with previous research, all of which have shown the Hem-o-lok clips to be at least as safe as knotting methods and to be easier and faster to use. Others studies including those by Ozdemir H et al,^[19] and Yildirim M et al,^[17] have found that all stump closure techniques are generally safe and in laparoscopically performed appendectomy; using clips is a practical and effective alternative.

CONCLUSION

This is a safe, effective and reliable method of laparoscopic appendiceal stump closure with a single Hem-o-lok clip than Roeder's knot. It has been linked to shorter operating time, lower postoperative complication rates and shorter hospital stay. It is easily applied and keeps well shut securely making it especially useful in routine surgery. The two methods yielded similar intraoperative safety but Hem-o-lok clips resulted in superior overall perioperative outcomes. Therefore, it can be recommended as a preferred method for appendiceal stump closure, especially in settings aiming for enhanced recovery and optimized surgical efficiency.

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Conflicts of interest

There are no conflicts of interest.

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