

# Use of Polymeric Clip (Hem-O-Lock) for Appendiceal Stump Ligation as a Favorable Technique in Laparoscopic Appendectomy

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Received 2016 November 19; Revised 2017 January 06; Accepted 2017 January 15.

## Abstract

**Background:** Laparoscopic appendectomy (LA) has become the standard choice for acute appendicitis. Several techniques to close the appendiceal stump were investigated, and use of polymeric clips, are shown safe and cost effective.

**Objectives:** Evaluation of the efficacy and safety of appendiceal stump closure with polymeric clips in LA.

**Methods:** This is a retrospective cohort study included 35 patients who underwent LA, between April 2013 and August 2016 in Rasool-e-Akram university hospital. appendiceal stumps ligation were performed by polymeric clips. One month follow up after surgery was performed for all patients. Demographic information of patients, surgery, complications, readmission and pathological reports, were collected from medical records and data base.

**Results:** Thirty-five patients were included in this retrospective study. Nineteen patients were male and 16 patients were female (54.3% vs 45.7%). The mean age was  $28.49 \pm 9.56$  years, mean operative time was  $59.6 \pm 11.8$  minutes and mean hospitalization was  $2.54 \pm 0.7$  days. There was no intraoperative complication and intraabdominal abscess formation. Also no readmission and no perioperative death were recorded in documents. In pathologic reports, there were 15 (42.8%) suppurative and one gangrenous (2.8%) appendicitis.

**Conclusions:** Application of polymeric clips for stump ligation is safe, cost effective and time saving, and could be used as favorable technique in LA.

**Keywords:** Laparoscopic Appendectomy, Polymeric Clips, Hem-o-lock, Stump, Ligation, Appendicitis

## 1. Background

Laparoscopic procedures are performed for elective and urgent intraabdominal operations, such as acute appendicitis (1). Laparoscopic appendectomy (LA) was done by Semm in 1983 for the first time and nowadays, it is the choice and maybe the gold standard procedure in the presence of an experienced surgeon (2-6) LA especially is preferred in female, obese and old patients (2-7).

Advantages of LA, include, shorter hospitalization, faster recovery, less postoperative pain, less analgesic necessity, less surgical site infection and better cosmetic results (2, 3, 5, 7-12).

But, it has some disadvantages, such as longer duration of operation, increased cost and more incidence of intraabdominal abscess (2, 5, 11).

The most important stage of LA, maybe is stump closure, because, incomplete ligation may lead to serious complications such as intraabdominal infections, colonic fistula, postoperative peritonitis and even sepsis (13-17).

There is no standard method for appendiceal stump closure and the selected method remains controversial (5, 12, 18, 19).

The ideal method must be safe, economic, accessible, easily operated and often is selected based on the surgeon's experience and appendiceal stump situation during laparoscopy, such as its diameter and degree of its base inflammation (4, 18, 20-22).

There are some methods for appendiceal stump closure, that all are safe, such as metallic clips (1, 6, 11, 14, 16, 18, 20, 22), polymeric clips (Hem-o-lock) (4, 8, 10, 14, 18, 22, 23), endo loop (2, 5, 7, 13, 14, 16-19, 21-25), endo stapler (5, 8, 11, 13, 19-22, 24), intra corporeal knot (3, 7, 11, 20, 22) and bipolar and vessel sealing devices (15, 22, 26).

Polymeric clip is a safe, available, cost-effective and easy to apply instrument for ligation of appendiceal stump and can decrease the operating time, but it is not suitable for gangrenous or wide appendiceal stump > 10 mm, because the maximum of its XL size is 9.4 mm (4, 10, 14, 22, 27). There

is no difference in safety, between one or two clips application for stump closure (10).

The aim of this retrospective study was to evaluate the efficacy and safety of appendiceal stump closure with polymeric clips in LA at the Rasool-e-akram university hospital.

## 2. Methods

This is a retrospective cohort study and the patients with primary diagnosis of acute appendicitis that underwent laparoscopic appendectomy between April 2013 and August 2016, in Rasool-e-Akram hospital of Iran University of Medical Science, were entered to this study.

Totally, 35 patients underwent LA under general anesthesia in operating room by Minimally invasive surgery (MIS) fellows or MIS expert general surgeons, in supine position, that the surgeon and camera-surgeon was standing on patient's left side, with standard 3 ports procedure, or 4 ports in complicated cases, and all stumps were closed by XL (Gold) polymeric clips (Hem-o-lock).

All patients had follow up after surgery for one month and were visited by MIS fellows. Demographic information of patients were age and sex, also information of surgery, complications, readmission and pathological reports, were collected from medical records and data base.

## 3. Results

Thirty five patients were included in this retrospective study. Nineteen patients were male and 16 patients were female (54.3% vs 45.7%). The mean age was  $28.49 \pm 9.56$  years (14 - 55 years), mean operative time was  $59.6 \pm 11.8$  minutes and mean hospitalization time was  $2.54 \pm 0.7$  days (1 - 5 days). There was no conversion to open approach and no use of other techniques for ligation of appendiceal stump. One case (2.86%) had gangrenous appendicitis, but the base of appendix was gangrene free. There was no intraoperative complication, such as bleeding or bowel perforation, and no important complication such as stump leak and intra-abdominal abscess formation.

There are no readmission due to complications or perioperative death. Additional data are listed in Table 1.

## 4. Discussion

LA is a safe procedure and could be considered as a gold standard for acute appendicitis even in complicated cases (9). In our academic hospital, most of appendectomies are performed by residents in open technique, and only few cases are operated by MIS fellows in laparoscopic technique.

**Table 1.** Demographic, Complications and Pathological Findings of Patients

	No. (%)
<b>Male Gender</b>	19 (54.3)
<b>Female Gender</b>	16 (45.7)
<b>DM</b>	2 (5.7)
<b>Pathology</b>	
Simple	19 (54.2)
Suppurative	15 (42.8)
Gangrenous	1 (2.8)
<b>Postoperative Complications</b>	
Stump Leakage	0
I.A.A	0
Ileus	2 (5.7)
<b>Readmission</b>	0

Abbreviations: DM, Diabetes mellitus; I.A.A, intra-abdominal abscess.

The stump closure may be most important and more difficult step in LA (14, 16, 17, 27).

Advantages of polymeric clips are facility of application. Therefore using of polymeric clips is an efficient and safe way of securing the stump of appendix, compared with intra or extra-corporeal suturing especially for residents and low experienced surgeons.

In our study, our mean operation time was  $59.6 \pm 11.8$  minutes that was near to other studies that used metallic clips, endostapler and endoloop (5, 14).

Cost-effectiveness of the method is one of the selection criteria, in our country, such as many other countries, polymeric clips are available and are more cost effective in comparison with other instruments such as endostapler and endoloop, this feature adds to the choice of this method. (Table 2), and it was confirmed in two previous studies (4, 22).

**Table 2.** The Approximate Price Comparison Between Appendiceal Stump Closure Devices in Iran

Device	Approximate Cost, \$
<b>Endostapler</b>	200 - 300
<b>Endoloop</b>	20 - 40
<b>Polymeric clips</b>	10 - 20
<b>Metallic clips</b>	5 - 20
<b>Vessel sealing handle</b>	250 - 500

There was no stump leak or abdominal abscess, even in diabetic patients and in suppurative or gangrenous ap-

pendicitis that gangrene doesn't involve its base or cecum, that confirm other similar studies that use of polymeric clips for stump closure has been safe and time saving (4, 14, 18, 22, 23).

There is no difference in polymeric clips safety and complications in comparison with other techniques such as endo stapler, endo loop or suture knot (4, 7, 10, 14, 18, 22). But it should be avoided in gangrened appendiceal base or wide base more than 10 mm.

#### 4.1. Study Limitations

Our study is a retrospective study with small sample size, because most of appendectomies were performed by residents in open technique and urgent manner. Further studies are recommended in larger sample size, longer follow up and in clinical trial fashion.

#### 4.2. Conclusions

Our study confirmed the previous findings of similar studies, and as accessibility, safety, feasibility and cost effectiveness of polymeric clips (Hem-o-lock). Also consider that it can be a favorable technique for appendiceal stump closure and could simplify this step of LA specially for low experienced or in training surgeons.

#### Acknowledgments

Authors want to acknowledge Mrs. Pishgah Roudsari for statistical help and Ms. Beitollahi for English editing of the manuscript.

#### Footnotes

**Conflict of Interest:** All authors declare that they have no conflict of interest.

**Funding/Support:** This study did not receive any funding.

#### References

- Strzalka M, Matyja M, Rembiasz K. Results of laparoscopic appendectomies performed with the use of titanium clips for closure of the appendicular stump. *Pol Przegl Chir*. 2014;**86**(9):418-21. doi: [10.2478/pjs-2014-0074](https://doi.org/10.2478/pjs-2014-0074). [PubMed: 25527804].
- Mayir B, Bilecik T, Ensari CO, Oruc MT. Laparoscopic appendectomy with hand-made loop. *Wideochir Inne Tech Maloinwazyjne*. 2014;**9**(2):152-6. doi: [10.5114/wiitm.2014.41624](https://doi.org/10.5114/wiitm.2014.41624). [PubMed: 25097680].
- Ay N, Dinc B, Alp V, Kaya S, Sevuk U. Comparison of outcomes of laparoscopic intracorporeal knotting technique in patients with complicated and noncomplicated acute appendicitis. *Ther Clin Risk Manag*. 2015;**11**:1213-6. doi: [10.2147/TCRM.S88479](https://doi.org/10.2147/TCRM.S88479). [PubMed: 26316765].
- Reinke CE, Tabone LE, Fong P, Yoo JS, Park CW. Safety and Efficacy of Polymeric Clips for Appendiceal Stump Closure. *JSLs*. 2016;**20**(3) doi: [10.4293/JSLs.2016.00045](https://doi.org/10.4293/JSLs.2016.00045). [PubMed: 27493473].
- Swank HA, van Rossem CC, van Geloven AA, in't Hof KH, Kazemier G, Meijerink WJ, et al. Endostapler or endoloops for securing the appendiceal stump in laparoscopic appendectomy: a retrospective cohort study. *Surg Endosc*. 2014;**28**(2):576-83. doi: [10.1007/s00464-013-3207-x](https://doi.org/10.1007/s00464-013-3207-x). [PubMed: 24048816].
- Bozkurt MA, Unsal MG, Kapan S, Gonenc M, Dogan M, Kalayci MU, et al. Is laparoscopic appendectomy going to be standard procedure for acute appendicitis; a 5-year single center experience with 1,788 patients. *Eur J Trauma Emerg Surg*. 2015;**41**(1):87-9. doi: [10.1007/s00068-014-0411-x](https://doi.org/10.1007/s00068-014-0411-x). [PubMed: 26038171].
- Bali I, Karateke F, Ozyazici S, Kuvvetli A, Oruc C, Menekse E, et al. Comparison of intracorporeal knotting and endoloop for stump closure in laparoscopic appendectomy. *Ulus Travma Acil Cerrahi Derg*. 2015;**21**(6):446-9. doi: [10.5505/tjtes.2015.56798](https://doi.org/10.5505/tjtes.2015.56798). [PubMed: 27054634].
- Matyja M, Strzalka M, Rembiasz K. Laparoscopic Appendectomy, Cost-Effectiveness of Three Different Techniques Used to Close the Appendix Stump. *Pol Przegl Chir*. 2015;**87**(12):634-7. doi: [10.1515/pjis-2016-0015](https://doi.org/10.1515/pjis-2016-0015). [PubMed: 26963058].
- Taguchi Y, Komatsu S, Sakamoto E, Norimizu S, Shingu Y, Hasegawa H. Laparoscopic versus open surgery for complicated appendicitis in adults: a randomized controlled trial. *Surg Endosc*. 2016;**30**(5):1705-12. doi: [10.1007/s00464-015-4453-x](https://doi.org/10.1007/s00464-015-4453-x). [PubMed: 26275544].
- Lv B, Zhang X, Li J, Leng S, Li S, Zeng Y, et al. Absorbable polymeric surgical clips for appendicular stump closure: A randomized control trial of laparoscopic appendectomy with lapro-clips. *Oncotarget*. 2016;**7**(27):41265-73. doi: [10.18632/oncotarget.9283](https://doi.org/10.18632/oncotarget.9283). [PubMed: 27183915].
- Strzalka M, Matyja M, Rembiasz K. Comparison of the results of laparoscopic appendectomies with application of different techniques for closure of the appendicular stump. *World J Emerg Surg*. 2016;**11**:4. doi: [10.1186/s13017-015-0060-3](https://doi.org/10.1186/s13017-015-0060-3). [PubMed: 26740818].
- Rickert A, Kruger CM, Runkel N, Kuthe A, Koninger J, Jansen-Winkel N, et al. The TICAP-Study (titanium clips for appendicular stump closure): A prospective multicentre observational study on appendicular stump closure with an innovative titanium clip. *BMC Surg*. 2015;**15**:85. doi: [10.1186/s12893-015-0068-3](https://doi.org/10.1186/s12893-015-0068-3). [PubMed: 26185103].
- Rakic M, Jukic M, Pogorelic Z, Mrkic I, Klicek R, Druzijanic N, et al. Analysis of endoloops and endostaples for closing the appendiceal stump during laparoscopic appendectomy. *Surg Today*. 2014;**44**(9):1716-22. doi: [10.1007/s00595-013-0818-8](https://doi.org/10.1007/s00595-013-0818-8). [PubMed: 24337502].
- Gomes CA, Junior CS, de Peixoto RO, Netto JM, Gomes CC, Gomes FC. Appendiceal stump closure by metal endoclip in the management of complicated acute appendicitis. *World J Emerg Surg*. 2013;**8**(1):35. doi: [10.1186/1749-7922-8-35](https://doi.org/10.1186/1749-7922-8-35). [PubMed: 24047531].
- Gunduz UR, Karakoyun R, Ozdemir S, Cali SH, Habibi M, Oner OZ. The feasibility of bipolar tissue sealer for appendix stump closure. *Minim Invasive Ther Allied Technol*. 2015;**24**(6):377-80. doi: [10.3109/13645706.2015.1054839](https://doi.org/10.3109/13645706.2015.1054839). [PubMed: 26066621].
- Shaikh FM, Bajwa R, McDonnell CO. Management of appendiceal stump in laparoscopic appendectomy-clips or ligature: a systematic review and meta-analysis. *JLaparoendosc Adv Surg Tech A*. 2015;**25**(1):21-7. doi: [10.1089/lap.2014.0470](https://doi.org/10.1089/lap.2014.0470). [PubMed: 25548964].
- Caglia P, Tracia A, Spataro D, Borzi L, Lucifora B, Tracia L, et al. Appendix stump closure with endoloop in laparoscopic appendectomy. *Ann Ital Chir*. 2014;**85**(6):606-9. [PubMed: 25712546].
- Yildiz I, Yavuz YS. Is There An Ideal Stump Closure Technique In Laparoscopic Appendectomy?. *Surg Technol Int*. 2016;**28**:117-20. [PubMed: 27121413].
- Sohn M, Hoffmann M, Pohlen U, Lauscher JC, Zurbuchen U, Holmer C, et al. [Stump closure in laparoscopic appendectomy. Influence of endoloop or linear stapler on patient outcome]. *Chirurg*. 2014;**85**(1):46-50. doi: [10.1007/s00104-013-2549-1](https://doi.org/10.1007/s00104-013-2549-1). [PubMed: 23780410].

20. Langer M, Safavi A, Skarsgard ED. Management of the base of the appendix in pediatric laparoscopic appendectomy: clip, ligate, or staple?. *Surg Technol Int*. 2013;**23**:81-3. [PubMed: [23975448](#)].
21. Galatioto C, Guadagni S, Zocco G, Mazzilo M, Bagnato C, Lippolis PV, et al. Mesoappendix and appendix stump treatment in laparoscopic appendectomy: a retrospective study in 1084 patients. *Ann Ital Chir*. 2013;**84**(3):269-74. [PubMed: [23856524](#)].
22. Mayir B, Ensari CO, Bilecik T, Aslaner A, Oruc MT. Methods for closure of appendix stump during laparoscopic appendectomy procedure. *Ulus Cerrahi Derg*. 2015;**31**(4):229-31. doi: [10.5152/UCD.2015.2768](#). [PubMed: [26668532](#)].
23. Jenwitheesuk K, Chotikawanich E, Saeseow OT, Thanapaisal C, Panchai S, Paonariang K. Laparoscopic appendectomy: results of a new technique for stump management. *J Med Assoc Thai*. 2012;**95** Suppl **11**:S7-10. [PubMed: [23961612](#)].
24. van Rossem CC, van Geloven AA, Schreinemacher MH, Bemelman WA, snapshot appendicitis collaborative study G. Endoloops or endostapler use in laparoscopic appendectomy for acute uncomplicated and complicated appendicitis : No difference in infectious complications. *Surg Endosc*. 2017;**31**(1):178-84. doi: [10.1007/s00464-016-4951-5](#). [PubMed: [27129569](#)].
25. Naiditch J, Lautz T, Chin A, Browne M, Rowell E. Endoloop as the first line tool for appendiceal stump closure in children with appendicitis. *Eur J Pediatr Surg*. 2015;**25**(2):155-9. doi: [10.1055/s-0033-1360455](#). [PubMed: [24327215](#)].
26. Yavuz A, Bulus H, Tas A, Aydin A. Evaluation of Stump Pressure in Three Types of Appendectomy: Harmonic Scalpel, LigaSure, and Conventional Technique. *J Laparoendosc Adv Surg Tech A*. 2016;**26**(12):950-3. doi: [10.1089/lap.2015.0551](#). [PubMed: [27120107](#)].
27. Delibegovic S, Mehmedovic Z. The Influence of the Appendiceal Base Diameter on Appendix Stump Closure in Laparoscopic Appendectomy. *World J Surg*. 2016;**40**(10):2342-7. doi: [10.1007/s00268-016-3564-4](#). [PubMed: [27198997](#)].