Journal of Bangladesh College of Physicians and Surgeons
Vol. 44, No. 1, January 2026

Safety and Efficacy of Nonabsorbable Hem-o-lok Polymer Clips for Laparoscopic Appendiceal Stump Closure in Acute Appendicitis

A MAHMUD[a], ASA HASAN[b], MMR KHAN[c], GG UDDIN[d], S RAHMAN[e], SU KHAIR[f], MA RAHMAN[g], MMR SHIKDER[h]

Abstract

Background: *Adequate closure of the appendiceal stump is vital to minimize intraabdominal complications and surgical site infections in laparoscopic appendectomy. There are various techniques for the closure of base of the appendix while performing a laparoscopic appendectomy like endoloop, extracorporeal (Roeder's knot) or intracorporeal knotting, clips and endo stapler.*

Objective: *To assess the safety and efficacy of nonabsorbable hem-o-lock polymer clips for laparoscopic appendiceal stump closure in acute appendicitis.*

Methodology: *This is a descriptive observational study carried out at Brahmanbaria Medical College Hospital from January 2017 to August 2023. Patients, who underwent laparoscopic appendectomy with nonabsorbable hem-o-lok polymer clips appendiceal stump closure, were included in the study. Data on patients' demography, intraoperative and postoperative complications, operative time and hospital stay were collected for statistical analysis.*

Result: *A total of 42 patients who underwent laparoscopic appendectomy with nonabsorbable hem-o-lok polymer clips stump closure, were included in this study. Among them 62% were female and 38% male. Mean age was 23±4.042 years. The mean operative time was 38.40±8.709 minutes. Mean hospital stay was 2.5±0.707 days. No major intraoperative and postoperative complications observed.*

Conclusion: *The use of nonabsorbable hem-o-lock polymer clips for the closure of appendiceal stump in laparoscopic appendectomy is feasible, safe, fast and effective technique. Due to simplicity of the technique it may be a useful alternative to the other methods of laparoscopic appendiceal stump closure.*

Key Words: *Laparoscopic appendectomy, Extracorporeal (Roeder's knot) knot, Intracorporeal knot, endoloop, endo stapler, hem-o-lok polymer clip, metallic clip.*

(J Bangladesh Coll Phys Surg 2026; 44: 33-39)
DOI: https://doi.org/10.3329/jbcps.v44i1.87332

Introduction:

Acute appendicitis is the most common cause of intraabdominal surgical emergency.[1] Hence appendectomy is the most common surgical procedure performed in the department of surgery globally.[2,3] It is usually the first procedure performed by a resident to learn surgery.[4] Laparoscopic appendectomy was first described 30 years ago.[5] With the advancing cutting edge technology laparoscopic appendectomy has become an established surgical technique which offers better cosmesis, less pain, faster recovery and earlier return to work.[6-8] The laparoscopic technique is usually preferred in cases of diagnostic uncertainty, female and obese patients.[4,9-11]

a. Dr. Ashik Mahmud, Associate Professor, Department of Surgery, Brahmanbaria Medical College, Brahmanbaria, Bangladesh.
b. Dr. Ahmed Sami-Al-Hasan, Associate Professor of Surgery, Dhaka Medical College & Hospital, Dhaka, Bangladesh.
c. Dr. Md. Mohiur Rahman Khan, Junior Consultant of Urology, BIRDEM General Hospital, Shahbag, Dhaka, Bangladesh.
d. Dr. Gazi Gias Uddin, Registrar, Department of Surgery, Bangladesh Medical College, Dhanmondi, Dhaka, Bangladesh.
e. Dr Saima Rahman, Associate Professor of Gynae and Obst., Brahmanbaria Medical College, Bangladesh.
f. Dr. Syeda Ummul Khair, Assistant Professor, Obst. & Gynae, Dhaka Medical College, Dhaka, Bangladesh.
g. Dr. Md. Azharur Rahman, Senior Consultant (Surgery), 250 Bedded General Hospital, Brahmanbaria, Bangladesh.
h. Dr Md Mizanur Rahman Shikder, Assistant Professor, Department of Surgery, Brahmanbaria Medical College Hospital, Bangladesh.

Address of Correspondencea: Dr. Ashik Mahmud, Associate Professor, Department of Surgery, Brahmanbaria Medical College, Brahmanbaria, Bangladesh. E-mail: drashik.bm17@gmail.com, Mobile: 01754383940

Received: 17 October, 2024 **Accepted:** 30 October, 2025

One of the most important steps in appendectomy is the adequate closure of appendiceal stump. There are various techniques used to secure the appendix base while performing laparoscopic appendectomy – extracorporeal knotting, intracorporeal knotting, endoloop, endo stapler, metallic clips and hem-o-lok polymer clips. These techniques have been compared in many prospective and retrospective studies without reaching a consensus for prioritizing one particular technique over the other.[12-25] Experienced surgeons usually prefer intracorporeal or extracorporeal knotting to secure the appendiceal stump and consider those safer in cases of inflamed and friable bases of the appendix.[26,27] Laparoscopic appendectomy with hem-o-lok polymer clips stump closure technique on the other hand save operative times as it is easy to apply and have lesser learning curve issues.[20,28] The use of metallic clip in the closure of appendiceal base was described by Cristalli et al for the first time in 1991.[29] Application of metallic or polymeric clip is an easier time saving alternative to close the base of the appendix in laparoscopic appendectomy. [23]

This study was conducted to assess the safety and efficacy of nonabsorbable hem-o-lock polymer clips in laparoscopic appendiceal stump closure in acute appendicitis.

Materials and Methods

This is a descriptive observational study carried out from January 2017 to August 2023, at Brahmanbaria Medical College Hospital. Informed written consent was taken from all the patients after explaining the risks, benefit and alternatives of the procedure.

A total of 42 patients who underwent laparoscopic appendectomy with nonabsorbable hem-o-lok polymer clips appendiceal stump closure, were included in this study. Patients were diagnosed as having acute appendicitis on the basis of clinical findings, ultrasound scan, and laboratory results and Alvarado scoring was done. Two patients were evaluated with CT scan of abdomen.

Inclusion criteria: All patients who were diagnosed as cases of acute appendicitis with Alvarado score e" 6 were included in this study.

Exclusion criteria: Patients diagnosed as cases of acute appendicitis but having diffuse peritonitis, gangrenous and friable appendix base, diameter of the base of the appendix > 10 mm, evidence of pelvic inflammatory disease and appendicular lump were excluded from the study.

All patients were operated by a group of surgeons having different level of experience in laparoscopic surgery. Variables considered in this study were-patients' demography, operative time, intraoperative findings, intraoperative and postoperative complications and hospital stay. Data of the patients were collected by the residents and surgeons for statistical analysis. Follow up period was six months.

Surgical Technique

After establishing diagnosis, written informed consent was taken from all patients. Then patients were given general anesthesia with ETT and put in trendelenburg position with right side tilted slightly up. Inj ceftriaxone 1 gm I/V was given at the time of induction of anesthesia and the skin was prepared with10%povidone iodine solution in all cases. Three ports were used in all cases. Initial entry in to abdominal cavity was achieved by direct trocar insertion (DTI) method in 34 cases and open Hasson technique in eight cases through a 12 mm (aprox) infraumbilical incision and pneumoperitoneum created. 10 mm infraumbilical port was used for camera. Two other ports –one 5mm port in right lower quadrant and one 10 mm port in left lower quadrant, were made. Initial laparoscopy was done and intraoperative diagnosis was established. All seropurulent collections were sucked out. Then the inflamed appendix was released from surrounding tissues and structures and held hanging with grasping forceps under clear vision. The base of appendix was then cleared off by dissecting away the meso-appendix with appendicular artery which was negotiated with laparoscopic bipolar vessel sealing technology in maximum cases and monopolar diathermy or metallic clips in few cases. Then two nonabsorbable hem-o-lok polymer clips of large (L) size were applied close to the base of the appendix apposing each other

and one metallic clip was applied 8-10 mm away from the polymer clips. Then the appendix was amputated between the distal hem-o-lok polymer and metallic clips. In eight cases, single nonabsorbable hem-o-lok clip was applied at the base of the appendix and appendix was amputated between metallic and hem-o-lok clips. Exposed mucosa of the appendix base was electro fulgurated with monopolar diathermy. Excised appendix was retrieved through 10 mm left lower quadrant port.

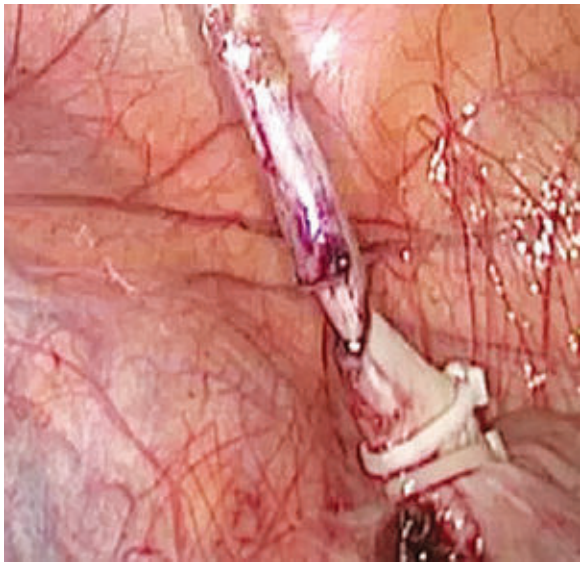

Figure 1: *Two Hem-o-lok clips and one metallic clip were deployed at the base of the appendix*

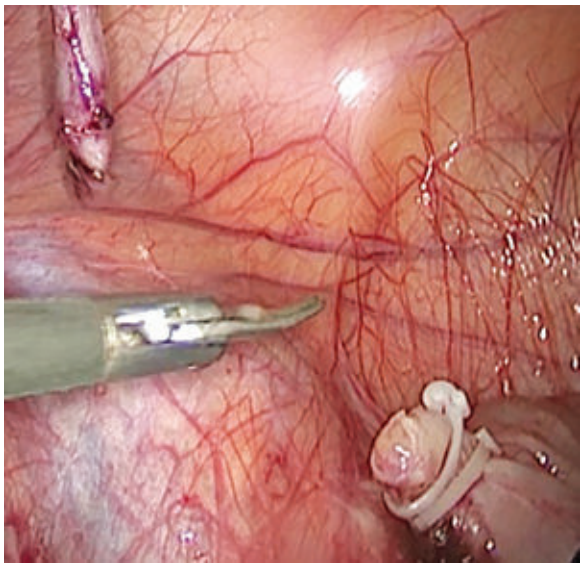

Figure 2: *Appendix was cut between the distal hem-o-lock and metallic clips*

Severely inflamed appendix and inflamed appendix with segmental gangrene were retrieved with modified endobag made from surgical glove.

Normal saline irrigation of around 250 ml was given and sucked out in the cases of segmental gangrenous appendicitis with purulent collection in the RIF. Pelvic drains were kept in six patients as there was oozing from raw surface of marked adhesiolysis. Final laparoscopy was done in all cases and found all right. Skin incisions were closed using 2-0 vicryl suture. Inj Ceftriaxone 1 gm I/V bid and Inj Metronidazole 500mg tds for 24 hours was given and then switched over to oral cefixime 200mg bid and metronidazole 500 mg tds for 3 to 5 days more as deemed necessary. Patients were discharged on 2nd to 5th POD and called for follow up. Stitches were removed on 8th POD.

Result:

A total of 42 patients of either sex, who underwent Laparoscopic appendectomy with nonabsorbable hem-o-lok polymer clips appendiceal stump closure were included in this study.

Table-I

Patient's age, operative time and hospital stay (n=42)

Variables	Value	Range
Age (Years)	Mean 23±4.042 years	18-35 years
Operative time (Minute)	Mean 38.40±8.709 minutes	25-60 minutes
Hospital stay (Days)	Mean 2.5 ±0.707 days	2-5 days

Fig 3 showed the sex distribution of patients in this study. This study comprises 16 (38%) male and 26 (62%) female patients. Male female ratio was 1:1.6.

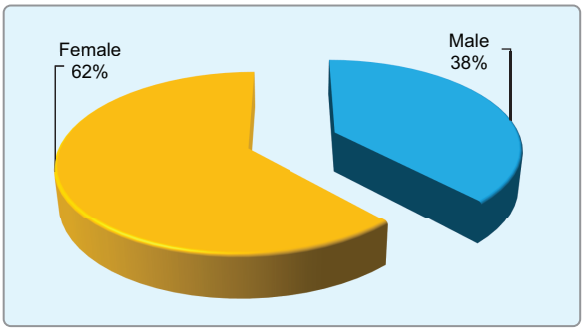

Figure 3: *Sex distribution of patients (n=42)*

Table-II

Intraoperative findings (n=42)

Findings	Frequency	Percentage (%)
Acute catarrhal Appendicitis	10	23.81
Acute suppurative appendicitis	23	54.76
Acute appendicitis with distal segmental gangrene	03	07.15
Acute gangrenous (distal segmental) appendicitis with perforation	02	04.76
Ruptured right ovarian cyst with normal appendix	02	04.76
Appendicitis with marked adhesions in RIF	02	04.76
Total	42	100.00

Table-III

Intraoperative complications

Complications	Frequency	Percentage (%)
Hemorrhage in RIF	02	4.76
Visceral injury (bowel and others)	nil	00
Vascular injury	nil	00
Peritoneal drainage	06	14.28
Conversion to open	nil	00

Table-IV

Postoperative Complications (n=42)

Variables	Frequency	Percentage (%)
Intraabdominal abscess	nil	00
Postoperative ileus	1	2.38
Superficial wound infection (port site)	1	2.38
Stump blowout/Faecal fistula	nil	00
Readmission and reoperation	nil	00
Clip migration	nil	00
Mortality	nil	00
Total	02	4.76

Discussion:

The safety and efficacy of laparoscopic appendectomy compared with open appendectomy for the management of acute appendicitis have been demonstrated in the multiple studies. [8-11,19] Advantages of laparoscopic appendectomy over open appendectomy are clear; mitigation of diagnostic uncertainty in female and obese patients, better visualization of peritoneal cavity, less pain, faster recovery and better cosmetic results. [19] But at the same time it is associated with longer learning curve, expensive instruments and the need of technical expertise. [20] Closure of appendix base is a decisive step in the incidence of post-operative intraabdominal infections, fecal fistula formation and surgical site infection both in cases of open and laparoscopic appendectomies -especially in cases of perforated and gangrenous appendicitis. [10, 11, 26]

In this Study, maximum no of cases were acute suppurative appendicitis, 23 (54.76%) followed by acute catarrhal appendicitis 10 (23.81%). Acute appendicitis

with distal segmental gangrene with or without perforation were found in two (4.76%) and in three (7.15%) patients respectively. However bases of these gangrenous appendices were found healthy and polymeric clips could be applied. In two female patients (4.76%), ruptured right ovarian cyst with normal appendix was found. Here are the advantages of laparoscopic appendectomy over open appendectomy in cases of female patients. For this reason laparoscopic appendectomy is preferred in female patients of child bearing age, obese and in patients with diagnostic uncertainity.[9-11]

The use of non-absorbable hem-o-lok polymer clips for the laparoscopic closure of the appendix stump was first reported by Hanssen et al and Delibegoviæ et al.[18,24] Polymeric clips are made of nonconductive, inert, nonabsorbable material and are capable of securing vessels and tissue bundles up to 16 mm in thickness. The polymer clips have a hinged locking mechanism with integrated teeth, which prevent slippage once engaged. As the polymer clips are nonconductive, it is safe to use electrocautery near the clip without the risk of transmitting current. In this series, nonabsorbable hem-o-lok polymer clips were used in double at the base of the appendix having diameter d" 10 mm in 34 (80.95%) cases like other studies.[16, 19,26] Single nonabsorbable hem-o-lok polymer clip was used in eight (19.05%) cases consisted with other prospective study.[27] Though single clip was used to close the appendiceal stump in eight (19.05%) cases but no difference in terms of surgical outcome observed in this series.

Important variables considered in this study were-intraoperative and postoperative complications, operative time and hospital stay. Mean operative time taken in this series was 38.40±8.709 minutes (range 25-60 minutes) which is comparable to other studies.[16, 19, 30] No major visceral, vascular or other intraoperative complications encountered in this series except moderate hemorrhage in the RIF encountered in two (4.76%) patients during dissection of marked adhesions in the vicinity. Pelvic drains were kept in six patients (14.28%) for peritoneal drainage due to oozing from large raw surface of extensive adhesiolysis, which is comparable to other study.[16]

Postoperative complication rate was 4.76% in this series comparable to other studies.[14, 23] One patient (2.38%) developed superficial wound infection in the infraumbilical port site and managed with regular dressing and antibiotic. Reinke et al reported 4% suture abscess in the umbilical port site in their study.[16] No incidence of post operative intra abdominal abscess and faecal fistula formation observed in this series. Krisher et al and Gupta et al in their study reported intra abdominal abscess 6.4% and 1.4% respectively.[31,32] Gomes et al in their study reported 5.08% intraabdominal infections.[22] One (2.38%) patient in this series, developed post operative paralytic ileus as he had ample purulent collection in RIF due to severely inflamed appendix with distal segmental gangrene and perforation. However paralytic ileus in this patient was subsided on 3rd POD with conservative treatment. Gonenc et al in their study have reported 1.6% incidence of paralytic ileus.[23] Beldi et al in their retrospective review have reported an ileus rate of 0.7% with stapler closure and 0.5% with endoloops.[28] Mean hospital stay was 2.5±0.707 days, the range being 2-5 days in this series, which is comparable to other studies.[16,24]

Clip migration is the most commonly reported complication in the literature in cases of laparoscopic cholecystectomy and radical prostatectomy, though it has not been reported after laparoscopic appendectomy.[16,33-34] Other theoretical complications related particularly to this technique include chronic pain, or foreign body granulomas, due to the nonabsorbable nature of the hemo-o-lok polymer clips.[16] We did not observed any such complications with the nonabsorbale polymer clips within six months follow up period in this series. 4 (9.5%) patient identified PID during intra-operative time and cooperation of the Department of Obstetric & Gynaecology was taken for further follow-up.

Limitations of this study

The most important limitation of this study was its small sample size. However the sample size is comparable to other studies. [19, 26, 30] another limitation of this study is short duration of follow up of six months only. There were complications like clip migration which might have been observed if the follow up time was long.

Recommendation

A further prospective comparative study incorporating more patients in the study sample and long of follow up time is required to reach a consensus for prioritizing

polymeric clip appendiceal stump closure technique over the others in terms of safety, efficacy and cost.

Conclusion:

The use of nonabsorbable hem-o-lock polymer clips for the closure of appendiceal stump in laparoscopic appendectomy is feasible, safe, fast and effective technique. Due to simplicity of the technique this may be a useful alternative to the other methods of appendiceal stump closure in laparoscopic appendectomy, especially by the surgeons who are in learning phase of laparoscopic surgery. Cooperation of others department like Obstetric & Gynaecology is undeniable for female patient who had dual pathology like PID.

Conflict of interest: None

References

1. Sahm M, Pross M, Lippert H. Acute appendicitis - changes in epidemiology, diagnosis and therapy. Zentralblatt fur Chirurgie. Feb 2011; 136(1):18-24.
2. Gomes CA, Junior CS, Costa Ede F, et al. Lessons learned with laparoscopic management of complicated grades of acute appendicitis. Journal of clinical medicine research. Aug 2014;6(4):261-266.
3. Boomer LA, Cooper JN, Deans KJ, et al. Does delay in appendectomy affect surgical site infection in children with appendicitis? Journal of pediatric surgery. Jun 2014;49(6):1026-1029. 4. P. Ronan O'Connell, Norman S. Williams, Andrew W. Mc Caskie. Bailey & Love's Short Practice of Surgery. 25th edition. London: Hodder Arnold;2008
5. Semm K. Endoscopic appendectomy.Endoscopy. Mar 1983;15(2):59-64.
6. Kiudelis M, Ignatavicius P, Zviniene K, Grizas S. Analysis of intracorporeal knotting with invaginating suture versus endoloops in appendiceal stump closure. Vedio surgery and other minimal invasive technique. Mar 2013; 8(1):69-73.
7. Sauerland S, Jaschinski T, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. The Cochrane database of systematic reviews. 2010(10):CD001546.
8. Tuggle KR, Ortega G, Bolorunduro OB, et al. Laparoscopic versus open appendectomy in complicated appendicitis: a review of the NSQIP database. The Journal of surgical research. Oct 2010;163(2):225-228.
9. Ciarrocchi A, Amicucci G. Laparoscopic versus open appendectomy in obese patients: A meta analysis of prospective and retrospective studies. Journal of minimal access surgery. Jan 2014; 10 (1):4-9.
10. Macarulla E, Vallet J, Abad JM, Hussein H, Fernandez E, Nieto B. Laparoscopic versus open appendectomy: a prospective randomized trial. Surgical laparoscopy & endoscopy. Aug 1997;7(4):335-339.
11. Hart R, Rajgopal C, Plewes A, et al. Laparoscopic versus open appendectomy: a prospective randomized trial of 81 patients. Canadian journal of surgery. Dec 1996; 39(6):457-462.
12. Rakic M, Jukic M, Pogorelic Z, et al. Analysis of endoloops and endostaples for closing the appendiceal stump during laparoscopic appendectomy. Surgery today. Dec 2013;44: 1716-1722.
13. Bozkurt MA, Unsal MG, Kapan S, Kankaya B, Kalayci MU, Alis H. Two Different Methods for Appendiceal Stump Closure: Metal Clip and Hem-o-lok Clip. Journal of laparoendoscopic& advanced surgical techniques. Part A. Aug 2014;24(8):571-573.
14. Beldi G, Muggli K, Helbling C, Schlumpf R. Laparoscopic appendectomy using endoloops: a prospective, randomized clinical trial. Surgical endoscopy. May 2004;18(5):749-750.
15. Swank HA, van Rossem CC, van Geloven AA, et al. Endostapler or endoloops for securing the appendiceal stump in laparoscopic appendectomy: a retrospective cohort study. Surgical endoscopy. Feb 2014;28(2):576-583.
16. Reinke CE, Tabone LE, Fong P, Yoo JS, Park CW. Safety and efficacy of polymeric clips for appendiceal stump closure. *JSLS.* 2016; 20:0.
17. Jenwitheesuk K, Chotikawanich E, Saeseow OT, Thanapaisal C, Punchai S, Paonariang K. Laparoscopic appendectomy: results of a new technique for stump management. Journal of the Medical Association of Thailand. Nov 2012; 95 Suppl 11:S7-10.
18. Hanssen A, Plotnikov S, Dubois R. Laparoscopic appendectomy using a polymeric clip to close the appendicular stump. JSLS. 2007; 11:59–62.
19. Colak E, Kement M, Ozlem N, et al. A comparison of nonabsorbable polymeric clips and endoloop ligatures for the closure of the appendicular stump in laparoscopic appendectomy: a prospective, randomized study. Surgical laparoscopy, endoscopy & percutaneous techniques. Jun 2013;23 (3):255-258.
20. Ates M, Dirican A, Ince V, Ara C, Isik B, Yilmaz S. Comparison of intracorporeal knot-tying suture (polyglactin) and titanium endoclips in laparoscopic appendiceal stump closure: a prospective randomized study. Surgical laparoscopy, endoscopy & percutaneous techniques. Jun 2012;22 (3):226-231.
21. Partecke LI, Kessler W, Patrzyk M, Heidecke CD, Bernstorff WV. Comparison Among Different Closure Methods of the Appendicular Stump in Laparoscopic Appendectomy. Surgical technology international. Dec 1 2011;XXI:85-91.

22. Gomes, C.A., Junior, C.S., de Peixoto, R.O. *et al*. Appendiceal stump closure by metal endoclip in the management of complicated acute appendicitis. *World J EmergSurg* 8, 35 (2013).

23. Gonenc M, Gemici E, Kalayci MU, Karabulut M, Turhan AN, Alis H. Intracorporeal knotting versus metal endoclip application for the closure of the appendiceal stump during laparoscopic appendectomy in uncomplicated appendicitis. Journal of laparoendoscopic & advanced surgical techniques. Part A. Apr 2012;22(3):231-235.

24. Delibegoviæ, S., Matoviæ, E. Hem-o-lok plastic clips in securing of the base of the appendix during laparoscopic appendectomy. *Surg Endosc* 23, 2851 (2009).

25. Kazemier G, in't Hof KH, Saad S, Bonjer HJ, Sauerland S. Securing the appendiceal stump in laparoscopic appendectomy: evidence for routine stapling? Surgical endoscopy. Sep 2006;20(9):1473-1476.

26. Hue CS, Kim JS, Kim KH, Nam SH, Kim KW. The usefulness and safety of Hem-o-lok clips for the closure of appendicular stump during laparoscopic appendectomy. J Korean Surg Soc. 2013 Jan;84 (1):27-32.

27. Partecke LI, Kessler W, Bernstorff WV. *et al.* Laparoscopic appendectomy using a single polymeric clip to close the appendicular stump. *Langenbecks Arch Surg* 395, 1077–1082 (2010).

28. Beldi G, Vorburger SA, Bruegger LE, Kocher T, Inderbitzin D, Candinas D. Analysis of stapling versus endoloops in appendiceal stump closure. The British journal of surgery. Nov 2006;93(11):1390-1393.

29. Cristalli BG, Izard V, Jacob D, Levardon M. Laparoscopic appendectomy using a clip applier. Surgical endoscopy. 1991;5(4):176-178.

30. Akbiyik F, Senel E, Bayram-Kabacam G, Demirkan H, Atayurt H, Tiryaki T. A comparison of polymer clips and endoloop applications for securing the appendiceal stump during laparoscopic surgery in children. Surgical laparoscopy, endoscopy & percutaneous techniques. Oct 2011;21(5):349-352.

31. Krisher SL, Browne A, Dibbins A, Tkacz N, Curci M. Intra abdominal abscess after laparoscopic appendectomy for perforated appendicitis. *Arch Surg*. 2001; 136 (4):438–441.

32. Gupta R, Sample C, Bamehriz F, Birch DW. Infectious complications following laparoscopic appendectomy. *Can J Surg*.2006;49(6):397– 400.

33. Tsumura H, Ichikawa T, Kagawa T, Nishihara M, Yoshikawa K, Yamamoto G. Failure of endoscopic removal of common bile duct stones due to endo-clip migration following laparoscopic cholecystectomy. Journal of hepato-biliary-pancreatic surgery. 2002;9(2):274-277.

34. Mora ER, Gali OB, Garin JA, Arango O. Intravesical migrationand spontaneous expulsion of a Hem-o-lok polymer ligating clip after laparoscopic radical prostatectomy. *Urology*. 2010;75(6):1317.