

Closure of the appendix stump with two different suture materials in laparoscopic appendectomy in children

Çocuklarda laparoskopik apendektomide iki farklı suture materyali ile apendiks güdüğünün kapatılması

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Abstract

Purpose: To evaluate the outcomes of the closure of the appendix base using two different suture materials that we used in our clinic with those published in the literature.

Materials and methods: The study retrospectively reviews 36 cases of children who underwent laparoscopic appendectomies. The patients were divided into two groups: The Vicryl suture group and the silk suture group. Laboratory results, diagnostic algorithms, surgical techniques, and complications were investigated.

Results: Sixteen (44%) of the cases were male, and twenty (56%) were female. All patients' mean hospital admission time was 2.22 ± 1.6 days (range: 1-7 days). The mean WBC and CRP levels were $14.67\pm 5.8\times 10^9/L$, 139.3 ± 120 mg/L in the vicryl group and $15.36\pm 6.4\times 10^9/L$ and 86 ± 80 mg/L in the silk group. Small bowel obstruction was observed in nine patients in the vicryl group and six patients in the silk group. Ultrasonography was performed in 31 of the cases, the appendix was visualized in 21 cases (67%). Intravenous contrast-enhanced CT imaging was applied in 25 cases. At laparoscopic exploration, 20 cases were classified as complicated—17 due to perforation, and 3 due to gangrene. All cases were treated with broad-spectrum antibiotics. The mean follow-up period was 43 months (range: 10-117 months); none of the patients experienced intraoperative complications, and only two patients had minor complications in the postoperative period.

Conclusion: In all circumstances and regardless of the appendix's diameter, the appendix stump can be securely closed with both silk and vicryl suture material.

Key words: Laparoscopic appendectomy, child, stump closure, complications.

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Öz

Amaç: İki farklı dikiş materyali kullanılarak apendiks güdüğünün kapatılması sonuçlarının literatür verileri ile karşılaştırılması.

Gereç ve yöntem: Bu çalışmada laparoskopik apendektomi uygulanan 36 çocuk vakası retrospektif olarak incelendi. Hastalar iki gruba ayrıldı: Vicryl suture grubu ve ipek suture grubu. Laboratuvar sonuçları, tanı algoritmaları, cerrahi teknikler ve komplikasyonlar araştırıldı.

Bulgular: Olguların 16'sı (%44) erkek, 20'si (%56) kız idi. Tüm hastaların ortalama hastaneye başvuru süresi $2.22\pm 1,6$ gün (1-7 gün) idi. Ortalama WBC ve CRP seviyeleri vicryl grubunda $14.67\pm 5.8\times 10^9/L$, 139.3 ± 120 mg/L ve ipek grubunda $15,36\pm 6,4\times 10^9/L$ ve 86 ± 80 mg/L idi. Vicryl grubunda 9, ipek grubunda 6 hastada ince barsak obstrüksiyonu görüldü. Olguların 31'ine ultrasonografi yapıldı, 21'inde (%67) apendiks görülebildi. 25 olguya intravenöz kontrastlı BT uygulandı. Laparoskopik eksplorasyonda 20 vaka komplike olarak sınıflandırıldı - 17'si perforasyon ve 3'ü gangrenöz. Tüm olgular geniş spektrumlu antibiyotiklerle tedavi edildi. Ortalama takip süresi 43 aydı (10-117 ay); hiçbir hastada intraoperatif komplikasyon görülmedi ve sadece iki hastada postoperatif dönemde minör komplikasyon gelişti.

Sonuç: Her koşulda ve apendiksın çapından bağımsız olarak apendiks güdüğü hem ipek hem de vikril suture materyali ile güvenli bir şekilde kapatılabilir.

Anahtar kelimeler: Laparoskopik apendektomi, çocuk, güdük kapatılması, komplikasyonlar.

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Introduction

The most frequent intra-abdominal surgical operation in children is an appendectomy [1]. The laparoscopic appendectomy has become a gold standard method for acute appendicitis cases. The base of the appendix is secured with many different methods, techniques, and equipment [2-6]. The best strategy for securing the appendix's base has not yet been agreed upon in a standard manner. The most crucial step in this operation is to seal the appendiceal stump securely, that is why research on the subject is still being done [7]. The base of the appendix can be secured using a variety of techniques, including energy-based devices, metallic or plastic clips, staplers, or suture materials (extracorporeal or intracorporeal) [8]. All method has advantages and disadvantages of their own. The purpose of this study was to evaluate the outcomes of the closure of the appendix base using two different suture materials that we used in our clinic and compare with those published in the literature.

Materials and methods

At our clinic, 36 cases of acute appendicitis were treated laparoscopically between March 2017 and July 2019. Laparoscopic surgery was our first choice of treatment in all appendicitis cases and surgical procedure was performed by a single surgeon in all cases. In the early years of our surgical approach, the base of the appendix was secured with vicryl sutures; however, in the following years, silk sutures were chosen. The patients were divided into two groups: The Vicryl suture group and the silk suture group. Ethical approval for this study was obtained from University Ethics Committee.

Diagnosis of acute appendicitis

The diagnosis of acute appendicitis was based on clinical history, physical examination, laboratory results, and radiological evaluation. Cases pre-defined as appendicitis were subsequently scanned by routine radiological examinations. Abdominal radiography and abdominal ultrasonography (US) were the initial radiologic evaluations. In the US findings, an appendix diameter of longer than six millimeters, an uncompressible appendix, and echogenicity of tissue around the appendix confirmed acute appendicitis. Computed abdominal tomography

(CT) was applied to late-admitted and obese patients and cases where US failed to confirm appendicitis.

Surgical procedure

Laparoscopic appendectomy was performed using a standard three-port technique. A 10-millimeter 30° port for the camera was used for abdominal exposure, placed transumbilical using the open technique. After carbon dioxide insufflation (maximum pressure: 10-12 mmHg), an additional two working ports were inserted from the suprapubic and left lower quadrants. The mesentery of appendix was sectioned using a surgical energy device and hook cautery. An intracorporeal suturing technique with 1-0 silk or vicryl suture material secured the base of the appendix and the appendectomy was performed. Removal of appendix specimens was accomplished through the first port site without any retrieval bags. The peritoneal cavity was irrigated and aspirated with saline solution and dried.

Statistical analysis

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 22.0 (SPSS Inc. Chicago, IL). The Kolmogorov-Smirnov test was performed to assess normal distribution. The homogeneity of variance was determined by the Levene test. Parametric variables were analyzed by independent *t*-test and non-parametric variables by Mann-Whitney *U* test. To compare qualitative variables Chi-square test with Fisher exact test correction was used. The level of statistical significance for descriptive statistics was set at $p < 0.05$.

Results

Sixteen (44%) of the cases were male, and twenty (56%) were female. The male-to-female ratio was 0.8. All patients' mean hospital admission time was 2.22 ± 1.6 days (range: 1-7 days). The mean admission time for the 15 vicryl group was 1.94 ± 1.2 days (range: 1-5 days), and the mean admission time for the 21 silk group was 2.5 ± 1.9 days (range: 1-7 days). Admission time in the groups was not significant ($p = 0.077$). Mean WBC and CRP levels were $14.67 \pm 5.8 \times 10^9/L$, 139.3 ± 120 mg/L in the vicryl group and $15.36 \pm 6.4 \times 10^9/L$ and 86 ± 80 mg/L in the silk group. Small bowel

obstruction was observed in nine patients in the vicryl group and six patients in the silk group (Table 1). Ultrasonography was performed in 31 of the cases, the appendix was visualized in 21 cases (67%), all of which presented acute appendicitis. The mean appendix diameter was 9.6 ± 3 mm (range: 7-15 mm). No cases presented additional abdominal pathologies (e.g, tuba-ovarian pathology). Intravenous contrast-enhanced CT imaging was applied in 25 cases. In four cases, the appendix could not be identified due to its perforated structure. In

the 21 cases where the appendix was identified, it appeared inflamed, and enlarged, peri appendiceal fat stranding was observed, and the mean appendix diameter was 10.3 ± 2 mm (range: 7-16 mm). At laparoscopic exploration, 20 cases were classified as complicated - 17 due to perforation, and 3 due to gangrene. All cases were treated with broad-spectrum antibiotics. All patients were discharged with an oral antibiotic regimen of amoxicillin, clavulanic acid and metronidazole.

Table 1. General characteristics of vicryl and silk group

	Vicryl group n:16	Silk group n:20	<i>p-value</i>
Symptom duration (day)	1.94±1.2	2.5±1.9	0.077
WBC x10 ⁹ /L	14.67±5.8	15.36±6.4	0.739
CRP mg/L	139.3±12.0	86±80	0.132
Ileus sign (x-ray) n (%)	9 (56)	6 (30)	0.001*
LOS (day)	5.31±2.2	5.9±2.7	0.498

LOS: Length of hospital stay, WBC: White blood cell, CRP: C-reactive protein, * $p < 0.05$ is significant

The mean follow-up period was 43 months (range: 10-117 months); none of the patients experienced intraoperative complications, and only two patients had minor complications in the postoperative period. An intra-abdominal abscess occurred 15 days after surgery in one of these cases, and a surgical site infection (transumbilical port insertion site) occurred in the other. The case which had intraabdominal abscess was managed conservatively by antibiotic therapy.

Discussion

In both children and adults, laparoscopic appendectomy is one of the most common surgical procedures. The increase in scientific and technological advancements since the first description has led to changes in the surgical procedure's use [9]. The mesentery of appendix is generally dissected in a standard manner using energy-based instruments, however, there are many techniques for securing the base of the appendix [3, 6]. Due to the potential for serious postoperative complications, such as postoperative peritonitis, sepsis, fistulas, and reoperations, associated with the appendiceal stump's improper management, the secure closure of the stump is believed to be the most crucial step of the procedure [10-12].

In open surgery, the method for securing the appendix base is standard, whereas laparoscopic methods' approaches (devices, materials, etc.) depend on the surgeon's preference and level of skill [4]. In experimental studies, techniques for securing the base of the appendix, including energy-based devices, clips, and suturing techniques, have been investigated [12, 13]. Though these devices are not always accessible, they are expensive, and their use is not always feasible in all circumstances, there is adequate experimental and clinical research on the closure of the appendix base with energy devices [4, 14].

According to reports, the usage of energy devices, clips, and staplers throughout the healing process may lead to complications including intestinal obstruction, abscess, and clip migration [15, 16]. In our study, we observed no complications such as intestinal obstruction, fistula, leakage, reoperation, etc. over the period of the mean 43-month follow-up period.

Recent studies have shown that stump leaking was not detected during laparoscopic appendectomies performed using various techniques; in our research, we also used two different suture materials and reported no leakage [3, 14, 17].

It is crucial for leakage and local infection to seal the stump closed, particularly in the inflammatory and perforated structure of the appendix. Despite the fact that 50% of the cases in our study had perforations, both the vicryl suture and the silk suture material had no issues with stump closure. The suture materials did not differ significantly from one another.

Among the factors that significantly affect stump closure are the appendix's diameter and its degree of inflammation. Use of staplers is advised, particularly in cases of inflamed or appendicitis with a diameter of more than 10 mm [10, 18]. The stump closure technique was carried out safely using the conventional method even though the appendix diameter was greater than 10 mm in 52% (19/36) of the cases in our study.

The choice of stump closure is known to be influenced by the surgeon's experience and the cost of the materials [3, 4, 7]. The intracorporeal suturing technique's main drawback is that it necessitates prior surgical training and experience. One of the most fundamental applications of laparoscopic surgery training is an appendectomy, and this study demonstrates that both suture materials can be used in this procedure safely (especially for surgeons who are in the training phase). The retrospective, non-randomized, small sample size and the fact that the surgeries were performed by a single surgeon with experience in minimally invasive surgery are among the study's limitations.

In conclusion; It is well known that laparoscopic surgery reduces the length of hospital stays, dependence on pain medication, and many other complications. In fact, laparoscopic appendectomy is the main therapeutic approach for appendicitis. We propose that, in all circumstances and regardless of the appendix's diameter, the appendix stump can be securely closed with both silk and vicryl suture material.

Conflict of interest: No conflict of interest was declared by the authors.

References

1. Akhtar Danesh GG, Doumouras AG, Flageole H, Hong D. Geographic and socioeconomic predictors of perforated appendicitis: a national Canadian cohort study. *J Pediatr Surg* 2019;54:1804-1808. <https://doi.org/10.1016/j.jpedsurg.2018.10.065>
2. 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;84:27-32. <https://doi.org/10.4174/jkss.2013.84.1.27>
3. Mayir B, Bilecik T, Ensari C, Oruc M. Laparoscopic appendectomy with hand-made loop. *Videosurgery and Other Miniinvasive Techniques*. 2014;9:152-156. <https://doi.org/10.5114/witm.2014.41624>
4. 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. *Surg Laparosc Endosc Percutan Tech* 2013;23:255-258. <https://doi.org/10.1097/SLE.0b013e31828b8382>
5. Gemici E, Dönmez T, Sürek A, et al. Comparison of three techniques for appendiceal stump closure during laparoscopy. *J Surg Med* 2020;4:618-622. <https://doi.org/10.28982/josam.781614>
6. 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. *Surg Laparosc Endosc Percutan Tech* 2012;22:226-231. <https://doi.org/10.1097/SLE.0b013e31824f25cd>
7. Agalar C, Derici S, Çevlik AD, et al. Do the stump knotting technique and specimen retrieval method effect morbidity in laparoscopic appendectomy? *Ulus Travma Acil Cerrahi Derg* 2019;25:34-38. <https://doi.org/10.5505/tjtes.2018.90382>
8. Gupta V, Chauhan SPS, Gupta M, Verma R, Singh SP, Panday A. Efficacy and safety of ligasure in laparoscopic sutureless appendectomy. *Cureus* 2022;14:24764. <https://doi.org/10.7759/cureus.24764>
9. Semm K. Endoscopic appendectomy. *Endoscopy* 1983;15:59-64. <https://doi.org/10.1055/s-2007-1021466>
10. Kliuchanok K, Keßler W, Partecke I, et al. A comparison of non-absorbable polymeric clips and staplers for laparoscopic appendiceal stump closure: analysis of 618 adult patients. *Langenbecks Arch Surg* 2019;404:711-716. <https://doi.org/10.1007/s00423-019-01814-w>
11. 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;8:35. <https://doi.org/10.1186/1749-7922-8-35>
12. Juan HL, Nicolas AM, Daniela CL, et al. Use of a bipolar device (LigaSure) to seal the appendiceal stump in pediatric laparoscopic appendectomy: 10-year Latin-American experience. *J Pediatr Surg* 2022;11:1-5. <https://doi.org/10.1016/j.jpedsurg.2022.10.005>
13. Aslan A, Karaveli C, Elpek O. Laparoscopic appendectomy without clip or ligature. An experimental study. *Surg Endosc* 2008;22:2084-2087. <https://doi.org/10.1007/s00464-007-9712-z>

14. Mayir B, Ensari CÖ, Bilecik T, Aslaner A, Oruç MT. Methods for closure of appendix stump during laparoscopic appendectomy procedure. *Ulus Cerrahi Derg* 2015;31:229-31. <https://doi.org/10.5152/UCD.2015.2768>
15. Kuehnel F, Marusch F, Koch A, Gastinger I. Retained loose linear cutter staples after laparoscopic appendectomy as the cause of mechanical small bowel obstruction. *Int J Colorectal Dis* 2007;22:717-718. <https://doi.org/10.1007/s00384-005-0759-9>
16. Soll C, Wyss P, Gelpke H, Raptis DA, Breitenstein S. Appendiceal stump closure using polymeric clips reduces intra-abdominal abscesses. *Langenbecks Arch Surg* 2016;401:661-666. <https://doi.org/10.1007/s00423-016-1459-3>
17. Ozdemir H, Sunamak O. Comparison of the non-absorbable polymer clips, knot-tying, and loop ligature appendiceal stump closure methods in laparoscopic appendectomy. *Cir Cir* 2022;90:193-196. <https://doi.org/10.24875/CIRU.20001419>
18. Partecke LI, Kessler W, Patrzyk M, Heidecke CD, Bernstorff WV. Comparison among different closure methods of the appendicular stump in laparoscopic appendectomy. *Surg Technol Int* 2011;21:85-91.

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