# *Laparoscopic appendectomy using a linear endostapler to appendicular stump closure*

# Laparaskopik apendektomide apendisiyel güdüğün kapatılmasında linear endostapler kullanımı

Özgür Albuz, Hakan Buluş, Mustafa Doğan, Arzu Boztaş

Keçiören Training and Research Hospital, Department of General Surgery, Ankara, Turkey

Geliş Tarihi: 02.03.2017 Kabul Tarihi: 10.03.2017 Doi: 10.21601/ortadogutipdergisi.295949

## Abstract

**Aim:** Laparoscopic appendectomy is increasingly accepted as the operation of choice in patients with suspected or confirmed acute appendicitis. The aim of the current study was to evaluate the effectiveness of appendiceal stump closure using stapler.

**Material and Method:** 24 patients with acute appendicitis who underwent laparoscopic appendectomy between April 2016 - June 2016 were included in the study. It was a retrospective reviewed. Informed consent of each subject and approval of the Local Ethics Committee was obtained. The patients who had signed the informed consent form were included in the study. Patients with immuno suppression, diabetes mellitus, using steroid medications, under the age of 18, over 65 were excluded. Additionally, cases diagnosed as plastrone appendicitis, who had history of abdominal surgery and negative appendectomy proven macroscopically and histopathologically were excluded.Medical records were screened retrospectively, in terms of hospitalization time, duration of operation, return to work, rate of return, stump leak, wound infection rate and cost.

**Results:** Laparoscopic appendectomy was performed in 24 patients that is 16 males and 8 females (mean age of 33.1 years; range of 16 to 65 years). Mean hospital stay was 2,8 days (range 2–6 days). Only one patient had post-operative wound infections (4%). Conversion rate was 0%. No appendiceal stump leaks or intra-abdominal abscess occurred. Mean operative time was 13 (7-21) minute . In addition, time to the onset of oral feeding and normal daily activity were recorded and were 16 (12-26) hours, 3.8 (3-9) days respectively. Use of stapler for closure of the appendicular stump increased the current cost of 320$(total 940$).

**Conclusion:** Our study showed that appendectomy with a stapler can be done as a fast, safe and comfortable procedure due to its advantages of low morbidity, early oral intake and return to daily activities. However, use of stapler for closure of the appendicular stump increase the current cost .

**Keywords:** Laparoscopic appendectomy, linear stapler, appendiceal stump, cost

## Öz

**Amaç:** Akut apandisit şüphesi veya doğrulanmış hastalarda laparoskopik apandisit ameliyatı giderek artan bir tercihtir. Bu çalışmanın amacı stapler kullanımının appendiks güdüğünün kapatılmasındaki etkinliğini değerlendirmektir.

**Gereç ve Yöntem:** Akut apandisit tanısıyla Nisan 2016- Haziran 2016 tarihleri laparoskopik apandektomi uygulanan 24 hasta çalışmaya dahil edilmiştir. Çalışma retrospektif olarak planlanmıştır. Her bir konunun bilgilendirilmiş onayı ve Yerel Etik Komitesi onayı alındı. Bilgilendirilmiş onam formunu imzalayan hastalar çalışmaya dahil edildi. İmmün baskılama, diabetes mellitus, 18 yaş altı steroid ilaçları, plastrone apandisit tanısı alan, karın cerrahisi öyküsü olan ve makroskopik ve histopatolojik olarak kanıtlanmış negatif appendektomi yapılan hastalar hariç tutuldu. Hastanede kalış süresi, çalışma süresi, işe geri dönüş, geri dönüş oranı, güdük sızıntısı, yara enfeksiyon hızı ve maliyet açısından tıbbi kayıtlar retrospektif olarak tarandı.

**Bulgular:** 16 erkek ve 8 kadın olan 24 hastaya laparoskopik apandektomi uygulandı. (ortalama yaş 33.1 – yaş aralığı 15-65 arasıdır) 24 hastada stapler kullanılarak laparoskopik appendektomi uygulamıştır. Ortalama hastane yatış süresi 2,8 gündür(2-6 gün aralığında). Sadece 1 hastada postoperatif yara yeri enfeksiyonu olmuştur (%4). Dönüşüm oranı %0 'dır. Appendiks güdüğünün açılması veya abse formasyonu vuku bulmamıştır (%4). Ameliyat süresi ortalama 13 (7-21) dakika, ilk oral gıdaya ve normal günlük aktiviteye başlama zamanı ise sırasıyla; 16 (12-26) saat, 3,8 (3-9) gün olarak bulunmuştur. Bunlara ek olarak mevcut maliyet 320 USD artırmıştır.

**Sonuç:** Çalışmamız, stapler ile yapılan appendektominin , düşük morbidite, erken oral alım ve günlük aktivitelere dönme avantajlarından dolayı, hızlı, güvenli ve konforlu bir prosedür olarak yapılabileceğini göstermiştir. Bununla birlikte, appendiks güdüğünün kapatılması için stapler kullanımı mevcut masrafı arttırır.

**Anahtar Kelimeler:** Laparoskopik appendektomi, düz stapler, appendiks güdüğü, maliyet

## Introduction

Acute appendicitis is the most common cause of acute abdomen in adults and appendectomy is the most frequently performed surgical procedure. Despite the use of laparoscopic appendectomy in recent years increasingly, there are still controversial issues when it is compared to open surgery. Laparoscopic appendectomy was first published in 1983 by Semm [1]. One of these is the appendix stump leakage and intraabdominal complication risk. So, many different techniques have been used for laparoscopic appendectomy. Also, the closure of the appendicular stump varies greatly. Recently, the division of the appendix base can be performed successfully using a stapler, a clip, or endoloops [2-3]. Published literature on this topic demonstrates the pros and cons of appendiceal stump closure. The use of a stapler is safe and quick but is much more expensive than the use of endoloops [4]. Aim of this study is to show a new laparoscopic appendectomy technique performed with a mechanical linear stapler (ATW 35 Ethicon, Cincinnati Ohio) with a direct approach to appendix basis.

## Material and Method

24 patients with acute appendicitis who underwent laparoscopic appendectomy between April 2016 - June 2016 were included in the study. It was a retrospective reviewed. Informed consent of each subject and approval of the Local Ethics Committee was obtained. The patients who had signed the informed consent form and who had been operated by the same surgeon were included in the study. Patients with immunosuppression, diabetes mellitus, using steroid medications, under the age of 18, over 65 were excluded. Additionally, cases diagnosed as plastrone appendicitis, who had history of abdominal surgery and negative appendectomy proven macroscopically and histopathologically were excluded.

Patients' demographic data, hospitalization time, operative time, return to work, conversion rate to open surgery, stump leakage, wound infection and cost were evaluated. Cost was calculated as the bill for the patient's social security institution. Operative time was the time between the incision and suturation. All patients were called 7 days later and examined by the same surgeon. Surgical Technique Laparoscopic appendectomy was standardized and used for all of the patients. Standard three port technique was used and 10 mm trocar was placed just below the umbilicus for camera. 5mm port was placed 10 cm below the umbilicus and 10 mm port was placed 10 cm above the umbilicus, all on the midline. After creating pneumoperitoneum,

appendix vermiformis was hold on the distal end by a grasper and suspended. Without separating appendix from mesoappendix like it is performed on standard open or laparoscopic technique, we used 3.5 mm linear stapler to transect the appendiceal stump from caecum with a safety margin. (Ethicon Endosurgery Johnson & Johnson, Cincinnati, OH, USA) (Figure 1).

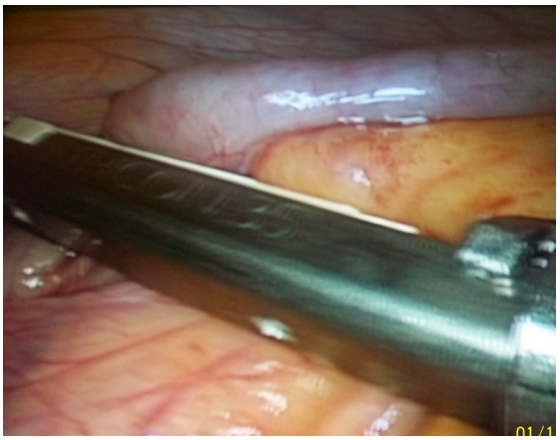

**Figure 1.** Without separating appendix from mesoappendix like it is performed on standard open or laparoscopic technique, we used 3.5 mm linear stapler to transect the appendiceal stump from caecum with a safety margin.

Then, the resected appendix stump was evaluated for bleeding and inadequate incision (fig 2). After the bleeding control, stump was scrubbed with povidone–iodine in all cases. Appendectomy specimen was removed through the 10 mm port in an endobag. Intravenous metronidazole was administered to all of the patients preoperatively. If the appendix is perforated 2x1 1 gr ceftriaxone was added to the treatment for 3 days. One hemovac drain was placed through the 5 mm trocar to patients with perforated appendicitis and the procedure was finalized after hemostasis. The 10 mm port entry holes were not sutured routinely.

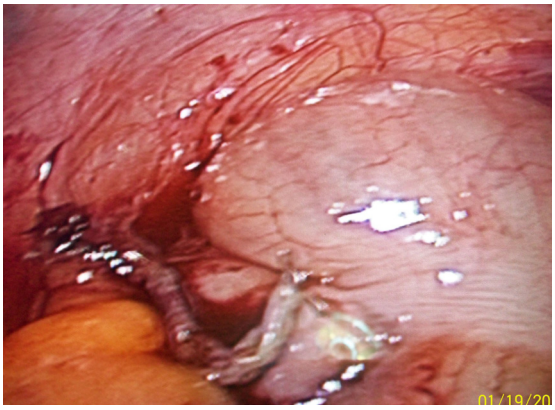

**Figure 2.** After resection of the appendix stump linear stapler line view.

## Results

Laparoscopic appendectomy with stump closure using a stapler in 24 patients were detected ,between April 2016 and June 2016 at our institution. 16 males and 8 females (mean age of 33.1 years;range of 16 to 65 years) In 24 patients, the appendicular stump was closed by staplers. Mean hospital stay was 2,8 days (range 2–6 days). Only one patient had post-operative wound infections (4%). Wound infections were treated with wound opening, drainage, and dressing. Conversion rate was 0%. No appendiceal stump leaks or intra-abdominal abscess occurred. So relaparatomy or laparascopy was not required. Mean operative time was 13 (7-21) minutes because only selected cases were operated by an experienced surgeon. In addition, time to the onset of oral feeding and normal daily activity were recorded and were 16 (12-26) hours, 3.8 (3-9) days respectively (Table 1). Use of stapler for closure of the appendicular stump increased the current cost of 320$ (total 940$).

**Table 1.** Outcomes of laparoskopic appendectomy using a linear stapler to appendicular stump closure

| **Laparascopic Appendectom** | **N=24** |
|---|---|
| Gender F/M | 8/16 |
| Age Average* | 33.1 |
| Mean Hospital Stay** | 2,8 (2–6 ) |
| Time To Start Of Diet*** | 16 (12-26) |
| Operation Times**** | 13 (7-21) |
| Wound İnfections Rat | 4 % |
| Conversion Rate | 0% |
| Start Of Daiily Activity* | 3.8 (3-9) |
| Additional Cost | 320$( 940$) |

* as a year
** as a day
*** as a hours
**** as a minute

## Discussion

Appendicitis is the most common cause of acute abdomen. Appendectomy has become the gold standard surgical intervention for appendicitis since its first description by McBurney [5] in 1894. Appendectomy is associated with significant morbidity [8]. Acceptance and the rate of laparoscopic appendectomy are increasing. Despite this, open appendectomy is the standard method of treatment in some centers up to 50%.

Laparoscopic appendectomy is safe, offers fewer postoperative complications and a faster recovery than open surgery [6–7]. Ortega et al. [8] showed the advantages of

laparoscopic appendectomy with respect to pain, hospital stay, and return to full activities. The risk of an intra-abdominal abscess after laparoscopic appendectomy is still a matter of debate. Studies show various results, from no difference in the rate of postoperative intra-abdominal abscess between laparoscopic and open appendectomy to an increase in the incidence of intra-abdominal abscess after laparoscopic appendectomy [9,10]. In the current study, we could show that a single clip applied to the appendicular stump was as safe as the use of staplers. Furthermore, the double clipping will lead to a longer appendicular stump behind the first clip. This longer stump might become necrotic and could be the origin of a local abscess. In our study, we used a linear stapler for this reason and there was no intra – abdominal complications.

Kazemier et al. [11] of 427 patients in four randomized controlled trials on appendix stump closure favored the routine use of endoscopic staplers. Superficial wound infections and postoperative ileus were obviously less frequent when the appendix stump was secured with staplers, but there was no significant difference with respect to intra-abdominal abscess. Koch et al. [12] already showed in 2002, in a prospective multicenter clinical observational study of 34 German hospitals, that 66.4% of laparoscopic appendectomies were performed with a stapler for stump closure. The definition of a standard procedure in a hospital is the basis for surgery with lower postoperative morbidity.

Operative time varies significantly due to the technique used in the operation and the surgeon's experience. In our study, mean operative time was 13 minutes, quite short when it is compared to the literature. The reason for this is transecting appendix and mesoappendix from the stump with a stapler without making any dissection like the standard laparoscopic appendectomy. Furthermore, avoiding dissection shortens the operative time, prevents future adhesions and provides early oral intake as the bowel movements start earlier (16 hours).

Postoperative data showed an almost similar time of hospital stay in the stapler and the clip group. Postoperative morbidity was the same in both groups with a highly acceptable rate of surgical complications[13]. Similar to the literature, in our study, hospital stay was short and return to daily activities has been fairly quick; 2.8, 3.8 days, respectively.

Many studies have demonstrated significantly higher costs for laparoscopic appendectomies compared to open surgery [14]. The higher costs of the laparoscopic approach are mainly due to the use of staplers and specimen bags [15]. Kazemier and Beldi [3,11] showed a striking increase of cost when using a stapler from €248 to €300. On a recent study, total costs for simple laparoscopic appendectomies were reduced by 336.49 € if a clip instead of a stapler was applied without increasing the rate of complications [6]. In the current study the total cost was increased 320$ compared to the standard appendectomy.

Conclusion; ; Although, use of stapler for closure of the appendicular stump increase the current cost, the use of linear mechanical stapler seems to be associated with a severe drop in complications on appendicular stump. In many publications the routine use of an endoscopic stapler is favored but should be preferred for noncomplicated selected cases. Our study showed that appendectomy with a stapler can be done as a fast, safe and comfortable procedure due to its advantages of low morbidity, early oral intake and return to daily activities.

## Declaration of conflicting interests

The author declared no conflicts of interest with respect to the authorship and/or publication of this article.

## References

1. Semm K. Endoscopic appendectomy. Endoscopy 1983;15:59-64.
2. Beldi G, Vorburger SA, Bruegger LE, Kocher T, Inderbitzin D, Candinas D. Analysis of stapling versus endoloops in appendiceal stump closure. Br J Surg 2006;3:1390-3.
3. Beldi G, Muggli K, Helbling C, Schlumpf R. Laparoscopic appendectomy using endoloops: a prospective, randomized clinical trial. Surg Endosc 2004;18:749-50
4. Faiz O, Clark J, Brown T, et al. Traditional and laparoscopic appendectomy in adults: outcomes in English NHS hospitals between 1996 and 2006. Ann Surg 2008;248:800-6.
5. McBurney C The incision made in the abdominal wall in case of appendicitis with a description of a new method of operating. Ann Surg 1894;20:38-43.
6. Wolfram von Bernstorff & Stephan Diedrich & Claus-Dieter Heidecke & Maciej Patrzyk Laparoscopic appendectomy using a single polymeric clip to close the appendicular stump. Langenbecks Arch Surg 2010;10:671-9.

1. Horstmann R, Tiwisina C, Classen C, Palmes D, Gillessen A. Laparoscopic versus open appendectomy: which factors influence the decision between the surgical techniques? Zentralbl Chir 2005;130:48-54.
2. Ortega AE, Hunter JG, Peters JH, Swanstrom LL, Schirmer B. A prospective, randomized comparison of laparoscopic appendectomy with open appendectomy. Laparoscopic Appendectomy Study Group. Am J Surg 1995;169:208-12.
3. Piskun G, Kozik D, Rajpal S, Shaftan G, Fogler R. Comparison of laparoscopic, open, and converted appendectomy for perforated appendicitis. Surg Endosc 2001;15:660-2.
4. Hirano Y, Ishikawa N, Omura K, et al. Robotic intragastric surgery: a new surgical approach for the gastric lesion. Surg Endosc 2007;21:2112-4.
5. Kazemier G, in't Hof KH, Saad S, Bonjer HJ, Sauerland S. Securing the appendiceal stump in laparoscopic appendectomy: evidence for routine stapling? Surg Endosc 2006;20:1473-6.
6. Koch A, Marusch F, Schmidt U, Gastinger I, Lippert H. Appendicitis in the last decade of the 20th century-analysis of two prospective multicenter clinical observational studies. Zentralbl Chir 2002; 127:290-6.
7. Binnebosel M, Otto J, Stumpf M, et al. Acute appendicitis. Modern diagnostics–surgical ultrasound. Chirurg 2009;80:579-87.
8. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. Ann Surg 2005;242:439-48.
9. Partecke LI, von Bernstorff W, Karrasch A, et al. Unexpected findings on laparoscopy for suspected acute appendicitis: a pro for laparoscopic appendectomy as the standard procedure for acute appendicitis. Langenbecks Arch Surg 2010 Nov;395:1069-76.

Corresponding Author: Hakan Buluş, Keçiören Training and Research Hospital, Department of General Surgery, Pınarbaşı Mah, Sanatoryum Cad, Ardahan Sok. No:1 Keçiören 06310, Ankara, Turkey

E-mail: hakan_bulus6@hotmail