# Long-term cosmetic results of single-incision vs. conventional laparoscopic appendectomy

## A prospective observational cohort study

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Tugan Tezcaner, M. İlker Arer, Mahir Kidnap, Feza Y. Karakayali, Gökhan Moray

*Department of General Surgery, Bas¸kent University, Faculty of Medicine, Ankara, Turkey*

**Long-term cosmetic results of single-incision vs. conventional laparoscopic appendectomy. A prospective observational cohort study**

AIM: *The purpose of this study was to compare cosmetic, along with surgical, results between single incision laparoscopic appendectomy (SILA) and conventional laparoscopic appendectomy (CLA), particularly from patients' points of view.*
MATERIALS AND METHODS: *All of the patients who underwent surgery for suspected acute appendicitis and were eligible for laparoscopic surgery were evaluated prospectively in our center between June 2013 and January 2015. Patients were underwent CLA or SILA were compared for operative results and cosmetic outcomes by Body Image Questionnaire. Non-parametric tests were used in the intergroup comparisons of quantitative data. Chi-square test was used in the comparison of qualitative data.*
RESULTS: *A total of consecutive 166 patients were underwent SILA (55) or CLA (111) were included to the study. There was no conversion to another procedure. Duration.of operation was significantly longer in SILA group (36.69±12.79 vs. 42.64±15.15; p= 0.009). There were no significant differences in length of stay, complications. SILA patients had more postoperative pain at first day after operation (p=0.002). After 12 months, body image and cosmetic appearance were excellent for both groups and indistinguishable by most measures (55.79±2.31 vs. 55,76±2,13; p= 0,937).*
CONCLUSIONS: *SILA resulted in more pain and longer operative times without improving short-term recovery or complications. Long-term body image and cosmetic appearance were similar and excellent in both groups.*

KEY WORDS: Acute appendicitis, Cosmesis, Emergency surgery Minimally invasive.

## Introduction

The appendectomy is one of the most commonly performed surgical procedures [1]. The predominant use of the standard open appendectomy technique for nearly a century was recently challenged by the introduction of the laparoscopic appendectomy (LA) [2]. The use of LA has rapidly become widespread, and most appendectomy procedures are now performed laparoscopically [3]. The benefits of LA include a decreased rate of postoperative wound infections, decreased pain, reduced hospital length of stay, and improved cosmetic results with less scarring and adhesions [4]. With the three-trocar technique and trocar insertions, which have become a standard in LA, postoperative pain and wound site infections are further reduced, and cosmetic results are improved [5,6].

In an effort to develop even less invasive techniques, some surgeons have developed a single-incision endoscopic surgical technique. The single-incision LA (SILA) method, which was suggested to achieve better results, has disadvantages that include a prolonged learning curve, a higher cost, and increased postoperative pain [7]. Previous studies demonstrated that the results of SILA are similar to those of conventional LA (CLA)[8]. While

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*Correspondence to: Tugan Tezcaner, MD, 5.sokak No 28 Bahçelievler Çankaya Ankara,Turkey (e-mail: tugantezcaner@gmail.com)*

the cosmetic results of SILA have been suggested to be better[9], the existing data on this technique are not sufficient to evaluate these results objectively and from the patient's point of view.
We hypothesized that SILA has better cosmetic outcomes, particularly from that patient's point of view, than CLA, with a similar efficacy and safety profile. The purpose of this study was to compare SILA and CLA in terms of cosmetic acceptability of outcome, as measured by a patient satisfaction survey (Body Image Ideals Questionnaire [BIQ]) and surgical results such as postoperative pain, length of hospital stay and complication rate.

## Materials and Methods

All patients who required surgery for suspected acute appendicitis and were eligible for laparoscopic surgery were evaluated prospectively at our center between June 2013 and January 2015. Patients who had a contraindication for laparoscopy, a mental illness, dementia, an inability to provide informed consent, or a history of major lower abdominal surgery; or who were pregnant, or refused to participate in the study or undergo laparoscopic surgery, were excluded from the study. The contraindications for laparoscopy were a severely compromised cardiopulmonary function that precluded general anesthesia, and septic shock. Laparoscopic surgery was also planned for patients with generalized peritonitis, perforated appendicitis, and periappendicular abscess. Due to the nature of the health insurance system in our country, the SILA or CLA option could not be randomized. The Government Health Insurance System, which is the most widely used system, covers standardized payments for particular diseases. Patients were preoperatively fully informed about both treatment options, and the possible advantages and limitations of the two techniques. Both of the techniques were mentioned to all patients even if their insurance did not cover them. Due to adequate experience with both procedures, there was no surgeon preference for one procedure over the other. All patients underwent a single-port or laparoscopic appendectomy based on their choice of operation type and the above-mentioned health insurance restrictions. This study was therefore designed as a prospective, naturalistic, observational cohort study. This study was approved by the Institutional Ethical Committee for Clinical Research (Project No. KA12/07). The study design is in accordance with the Helsinki Declaration, conforms the committee on publication ethics (COPE) guidelines. All the design, analysis, interpretation of data, drafting and revisions followed the strengthening the reporting of observational studies in epidemiology (STROBE) statement.
Group characteristics that were compared included sex, age, body mass index (BMI), and American Society of Anesthesiologists (ASA) score are all classed as demographic characteristics; and that onset of complaint, white blood cell count, and radiographic findings all relate to medical history of appendicitis.
The primary outcome of this study was patient satisfaction with the cosmetic result of the procedure, which was assessed using the Body Image Ideals Questionnaire [BIQ]. Secondary parameters included operative time, complication rate, postoperative hospital stay, and postoperative pain after either technique.

### Surgical Procedure

All CLA and SILA surgical procedures were performed by or under the supervision of two surgeons with experience in laparoscopy and single-port laparoscopy. All patients received general anesthesia and preoperative antibiotics (ceftriaxone and metronidazole) as prophylaxis. The CLA and SILA procedures were performed as previously described [10].
The duration of surgery was established as the time between skin incision and closure. Oral nutrition with liquids was initiated for all patients 8 hours after the operation. In the absence of any discomfort, the amount of oral nutrition was gradually increased. Single-dose meperidine (1 mg/kg intramuscularly) and metamizole (100 mg intravenously) were administered to all patients as postsurgical analgesia. If additional analgesia was needed, metimazole was administered. Length of hospital stay was measured as the time from admission to discharge. Normal vital signs, the absence of discomfort after oral nutrition, and the ability to walk without help were considered indications for discharge. Wound complications were defined as gross discharge, dehiscence, or a fluid collection at the wound site. Discomfort, abdominal distention, and ileus that continued after the first postoperative day were classified as postoperative ileus. Postoperative pain was evaluated using a numeric analog scale ranging from 1 to 10, 12 hours (VAS 1) and 7 days (VAS 2) after surgery. Patients were scheduled for 7-day clinical follow-up in the event that they had no post-discharge complaints.

### Body Image Questionnaire

A year after the operation, patients were invited to undergo a physical examination and asked to complete questionnaires to evaluate body image, cosmetic results, and patient satisfaction. These were modified from surveys originally detailed by Dunker et al [11]. This modified questionnaire was previously used and tested for ileocolic resection, donor nephrectomy, restorative proctocolectomy and appendectomy [11-14]. The questionnaire consists of items that assess the attitude of patients toward their bodily appearance (BIS, items 1-5) and their degree of

satisfaction with the appearance of their scar (cosmesis scale, items 6–8). The reliability coefficients (Cronbach $\alpha$ values) for body image and cosmetic scales were 0.81 and 0.74, respectively. Items 9 and 10 evaluate patient satisfaction before and after surgery. A higher score indicates better body image and greater satisfaction with the cosmetic result of the scar.

### Statistical Analyses

The Number Cruncher Statistical System 2007 Statistical Software (Kaysville, Utah, USA) program was used for the statistical analyses. When the study data were evaluated, definitive statistical methods (mean, standard deviation, median, frequency, and ratio) and suitability of variants to normal distribution were evaluated by using the Kolmogorov-Smirnov test. The independent samples test was used for intergroup comparisons of variants with normal distribution. The Mann-Whitney *U* test was used for intergroup comparisons of variants with an abnormal distribution. The Wilcoxon signed-rank test was used for the intergroup comparisons of visual analogue scale (VAS) scores. The Pearson chi-square test, Yates continuity correction test, and Fisher exact test were used in the comparison of qualitative data. The results were evaluated in a 95% confidence interval and a $p<0.05$ significance level.

## Results

Appendectomies for acute appendicitis were performed on 196 patients in our clinic between the study dates. Eighteen of the patients underwent an open appendectomy in accordance with their preferences and laparoscopic contraindications. Eight of the patients who underwent CLA and four of the patients who underwent SILA could not be contacted and were thus excluded from the study. In total, 111 patients were included in the CLA group and 55 patients were included in the SILA group. The number of patients who could only choose CLA due to insurance coverage was 88. The demographic characteristics of the patients are shown in separate groups on Table I. Age, sex, ASA score distribution, and BMI did not show statistically significant differences between the groups ($p<0.05$).

Preoperative clinical and laboratory features are shown in Table II. The radiographic evaluations required to make the diagnosis were similar between both groups.

Table I - *Demographic and clinical characteristics of study patients by group.*

| Characteristics | | Group | | |
|---|---|---|---|---|
| | | CLA (n=111) | SILA (n=55) | p* |
| Age° | | 30.0 (46.0) | 30.0 (45.0) | [a]0.735 |
| BMI°° | | 23.33±2.07 | 23.63±2.68 | [a]0.419 |
| Sex; n(%) | Female | 49 (44.1) | 29 (52.7) | [b]0.297 |
| | Male | 62 (55.9) | 26 (47.3) | |
| ASA; n(%) | ASA 1 | 98 (88.3) | 45 (81.8) | [b]0.256 |
| | ASA 2 | 13 (11.7) | 10 (18.2) | |

CLA= Conventional laparoscopic appendectomy; SILA= Single incision laparoscopic appendectomy
°median(range); °°mean± standard deviation; [a]Independent Samples Test; [b]Pearson Chi-square Test; *p<0.01

Table II - *Preoperative laboratory and radiologic features of patients by group.*

| Characteristics | | Group | | |
|---|---|---|---|---|
| | | CLA (n=111) | SILA (n=55) | p |
| Duration of complaints° | | 24.0 (107.0) | 24.0 (84.0) | [a]0.929 |
| Leucocytes°° (n/dL) | | 14939.10±3666.58 | 14983.45±3864.59 | [a]0.943 |
| Preoperative US | Yes | 100 (90.1) | 48 (87.3) | [c]0.776 |
| | No | 11 (9.9) | 7 (12.7) | |
| Preoperative CT scan | Yes | 46 (41.4) | 22 (40.0) | [c]0.992 |
| | No | 65 (58.6) | 33 (60.0) | |

CLA= Conventional laparoscopic appendectomy; SILA= Single incision laparoscopic appendectomy US=ultrasonography CT=computerized tomography scan
°median(range); °°mean±Sd; [a]Independent Samples Test; [c]Yates Continuity Correction Test

Ultrasonography was performed on 90.1% and 87.3% of the patients in the CLA and SILA groups, respectively. Computed tomography was performed on 41.4% and 40.0% of the subjects in the CLA and SILA groups, respectively (p=0.992).

No intraoperative complications occurred in either group (Table III). No patients required a conversion to an open procedure. In the CLA patients, no additional ports were needed. Four SILA patients (7.2%) required an additional 5-mm port because of intra-abdominal abscess/perforation or retraction difficulties due to inflammation of the appendix. Operation time was significantly lower in the CLA group (median, 35 minutes; p=0.009). A retrocecal appendix localization was higher in the SILA group, but the difference was not significant (p=1.000). The rates of perforation or periappendiceal abscess were statistically similar (Table III).

Postoperative VAS1 scores in the CLA group were significantly lower than those in the SILA group (p=0.002; p<0.01), whereas no statistically significant differences were observed in postoperative VAS2 scores (p>0.05) (Table IV). In the CLA group, a change of 1.44 ± 1.17 units was observed in VAS2 scores, which was statistically significant (p<0.01). In the SILA group, a change of 2.14 ± 1.11 units was observed in VAS2 scores, which was also statistically significant (p<0.01). When the two degrees of change were compared to each other, the difference in the VAS scores in the SILA cases was significantly higher than that in the CLA cases (p<0.01).

The groups did not differ significantly in terms of postoperative complications (Table V). Wound infection rates were slightly higher in the CLA group, but the difference was not significant (p=1.000). An intra-abdominal abscess was noted postoperatively in 1 case each in the CLA and SILA groups. A patient with an intra-abdominal abscess in the CLA group was not responsive to antibiotics and was treated with percutaneous drainage. Both patients with ileus in the CLA and SILA groups were treated conservatively. They were discharged from the hospital without any treatment beyond oral and intravenous fluid-electrolyte replacement. One patient underwent an operation to correct an incisional hernia 8 months after SILA. No significant difference in the incisional hernia rate was found between the two groups (p=1.000). Other postoperative complications included prolonged postoperative pain, a urinary tract infection, and urinary retention, which occurred in 2 patients after SILA and in 3 patients after CLA (p=1.000).

TABLE III - *Surgery related outcomes*

| | | Group | | |
|---|---|---|---|---|
| | | **CLA (n=111)** | **SILA (n=55)** | **p** |
| Duration of operation (minutes)° | | 36,69±12,79 | 42,64±15,15 | [a]0,009* |
| Perforation | Present | 13 (11.7) | 7 (12.7) | [e]1.000 |
| | Absent | 98 (88.3) | 48 (87.3) | |
| Abscess | Present | 6 (5.4) | 3 (5.5) | [d]1.000 |
| | Absent | 105 (94.6) | 52 (94.5) | |
| Localization of appendix | Normal | 90 (81.1) | 44 (80.0) | [e]1.000 |
| | Retroceacal | 21 (18.9) | 11 (20.0) | |
| Drain | | 6 (5.4) | 4 (7.3) | [d]0.732 |
| Length of hospital stay°, (hours) | | 14.0 (12.0- 110.0) | 14.0(11.0-108.0) | [a]0.991 |

CLA= Conventional laparoscopic appendectomy; SILA= Single incision laparoscopic appendectomy
°median(minimum-maximum); [a]Independent Samples Test; [d]Fisher's Exact Test; [e]Yates Continuity Correction Test; *p<0,05

TABLE IV - *Postoperative pain scores by group*

| | | Group | | |
|---|---|---|---|---|
| | | **CLA (n=111)** | **SILA (n=55)** | **p** |
| Postoperative pain score | VAS 1 | 2.59±1.34 (3.0) | 3.35±1.42 (3.0) | [c]0.002** |
| | VAS 2 | 1.15±0.70 (1.0) | 1.20±0.68 (1.0) | [c]0.523 |
| | [c]p | 0.001** | 0.001** | |
| | Difference | 1.44±1.17 (2) | 2.14±1.11 (2) | 0.001** |

CLA= Conventional laparoscopic appendectomy; SILA= Single incision laparoscopic appendectomy;
VAS1= 12 hour postoperative pain score; VAS2 = 7 day postoperative pain score at; [c]Mann Whitney U Test; [e]Wilcoxon Signed Rank test; **p<0.01

TABLE V - *Postoperative complications*

| | Group | | |
|---|---|---|---|
| | CLA (n=111) | SILA (n=55) | p |
| Complication, n (%) | 13 (11.7) | 6 (10.9) | d1.000 |
| Wound infection, n(%) | 8 (7.2) | 2 (3.6) | d1.000 |
| Postoperative ileus, n(%) | 1 (0.9) | 1 (1.8) | d1.000 |
| Intrabdominal collection, n(%) | 1 (0.9) | 1 (1.8) | d1.000 |
| Incisional hernia, n(%) | – | 1 (1.8) | d1.000 |

CLA= Conventional laparoscopic appendectomy; SILA= Single incision laparoscopic appendectomy; [d]Fisher's Exact Test

BODY IMAGE QUESTIONNAIRE

Results of the BIQ evaluation conducted 12 months after the operation are shown in Table VI. The body image overall score, the single-item scores of body image (items 1–5) and cosmetic outcomes were comparable between the patients who underwent SILA and those who underwent CLA. Preoperative and postoperative satisfaction (items 9 and 10) were also similar between the two groups.

## Discussion

Minimally invasive procedures have become standard treatment methods, notable for minimizing post-operative scars. While abdominal surgery is performed less invasively through laparoscopic methods, concealing the scars formed is still not possible. Although scarless appendectomy has been made possible with transumbilical SILA, the superiority of this technique over CLA has not been demonstrated in patient-reported outcome studies [8,15]. In one of the largest series available in the literature, SILA was found to be safe and effective in terms of optimizing early postoperative outcomes [16]. In our study, in addition to similar surgical results, there was no superiority in patient-perceived cosmetic outcomes and physical appearance of SILA over CLA.

No patient selection was performed between the CLA and SILA groups according to BMI or disease history. Although some authors think that overweight individuals are not eligible to undergo a single-incision laparoscopy [17], in our experience the patient's BMI is not an effective indicator of the appropriate choice of surgical method. Of our patients, 17% were overweight (BMI≥25 kg/m$^2$). While the SILA method is to be avoided in complicated appendicitis, recent studies have demonstrated that it can be used in the treatment of perforated and complicated appendicitis with satisfactory safety and efficacy [18,19].

Although many surgeons consider SILA to be a difficult procedure with a challenging learning curve, increased surgeon experience has made this surgery more widely available. In a systematic review and meta-analysis, Markar et al. [15] observed that the incidence of postoperative complications was not increased with SILA. The incidence of wound site infections, intra-abdominal collections, and postoperative ileus was similar between both groups in our study. These findings demonstrate that SILA is safe to use in the treatment of acute appendicitis. While there is a concern about minimally invasive surgery in complicated appendicitis, Galatioto et al.[20] have demonstrated that it can be used in the treatment of perforated and complicated appendicitis with satisfactory safety and efficacy

While incisional or port-site hernias are expected complications due to the prolonged umbilical incision in SILA, in our study this complication occurred in one patient in the SILA group, and no significant difference was observed in the rates of incisional hernias between the two groups (p = 1.000). Although no published data are available that compare SILA and CLA in this respect, a previous study reported that the risk of hernia is higher in a laparoscopic cholecystectomy than in a single-incision laparoscopic cholecystectomy [21].

The most important advantages of laparoscopic surgery are rapid healing and a short hospital stay. The smaller incision might have increased these advantages. When SILA was first introduced, supporters claimed that it would ensure a shorter hospital stay, reduced postoperative pain, and better cosmesis [22]. In this study, the mean hospital stay was similar in both groups. These postoperative results are similar to those of previous studies, although significantly longer hospital stay after CLA was reported in one study [15]. This longer hospital stay could have been caused by the characteristics of the centers, or the study parameters [10].

Postoperative pain has been examined in many studies using various methods, and controversial results have been reported. A meta-analysis of randomized controlled studies revealed that such reports are often confounded by the myriad methods of postoperative pain assessment in included studies [15]. This did not allow for a meaningful pooled analysis. Based on the studies that were examined in this meta-analysis, SILA was not superior to CLA and produced worse results with regard to pain.

More recently, a randomized controlled study conducted by Carter et al. [10] had to be terminated because of significantly higher pain scores in the SILA group than in the CLA group. In our study, we similarly observed that postoperative pain was significantly higher in the SILA group in the early period (p = 0.002). However, pain scores were similar between the two groups (p = 0.523) at the time of the 7-day follow-up examination. Cosmetic results and patient satisfaction with scarring are the major driving forces of research and development in the field of single-port surgery. With regard to long-term cosmetic outcomes, we have noted that the results of both CLA and SILA were outstanding. According to BIQ; body appearance score, cosmetic score, and satisfaction score of all patients were close to perfect, without significant differences between the two groups. The choice of an incision is significant to the patients, as it leaves a long-lasting reminder of their operation. When patients are shown options for incision placement, patients prefer techniques that leave no visible scars [23]. Based on this expected opinion, SILA would have been expected to be superior to CLA. However, results were found to be equivocal in multiple prior publications. Lee and coworkers [24] used a 5-point patient cosmetic satisfaction scale and demonstrated similar scores for both groups (4-0 for SILA versus 3-3 for CLA; p = 0·128). Similarly, Park et al. [25] used a 4-point scale to assess patient cosmetic satisfaction and showed no significant difference between the groups. Teoh and colleagues [26] used a 100-point scale and demonstrated that SILA was associated with significantly improved wound cosmetic and patient satisfaction scores. Long-term cosmetic evaluations were not performed in all these studies.

As expected, surgical time was significantly prolonged in the SILA group, but this difference was consistent with that reported in the literature. A systematic review and meta-analysis revealed that surgical time was longer in SILA than in CLA [15]. While the weighted mean difference was 6.96 minutes between the two methods, this difference was 5.95 minutes in our study. This might be due to a few reasons. Naturally, the surgery duration will be longer while surgeons are learning the technique. The surgeons in this study had already developed competence in both procedures before the trial began. The difficulty of SILA is another important reason for the increased duration of surgery; SILA violates the principles of laparoscopic surgery, as it does not allow instrument triangulation. Finally, the longer fascial incision could take more time to close.

The main limitations of this study are that the patients were not randomly assigned to the surgical procedure they received, and the total number of included patients was relatively small in both groups. This was not a randomized trial, but our study was a prospective study for which a cohort was enrolled and informed consent given by the participants. Even though no patient selection was done according to BMI, age or the possibility of complicated appendicitis, a potential source of bias was still the preference for one procedure created by the patients' insurance coverage. The two groups were similar according to age, BMI and complicated appendicitis. This could support our conclusions in spite of potential selection bias. Cosmesis is a relatively subjective decision and absolutely case dependent. A tool that can objectively measure the results of these methods, which had close to perfect cosmetic results, and that can reveal subtle differences, if any exist, has not yet been developed. This may suggest that future studies in this area should use more sophisticated cosmetic and patient-satisfaction assessment tools if subtle differences between SILA and CLA are to be identified.

## Conclusions

The present study demonstrated that patients who underwent either CLA or SILA were satisfied with their cosmetic results after being allowed sufficient time to heal. Further studies to compare cosmetic results are required so our measurement methodology can improve. Despite similar cosmetic and postoperative results, CLA may still be accepted as safer and more effective than SILA when postoperative pain, learning cure, and costs are considered.


## Riassunto

Questo studio è finalizzato a paragonare i risultati cosmetici, oltre che chirurgici tra la incisione singola per l'esecuzione della appendicectomia laparoscopica (SILA) e la appendicectomia laparoscopica convenzionale (CLA), ed in particolare dal punto di vista del paziente.

Sono stati inclusi nello studio prospettico tutti i pazienti valutati proponibili per una appendicectomia laparoscopica nel nostro centro tra Giugno 2013 e Gennaio 2015.

Il paragone per risultati operatori e cosmetici è stato effettuato mediante un Questionario per l'Immagine Corporea sottoposto agli operati con CLA e con SILA. Nel paragonare i dati quantitativi tra i gruppi sono stati usati test non parametrici, mentre il test -quadro è stato usato per paragonare i dati qualitativi.

Sono stati inclusi nello studio 166 pazienti sottoposti consecutivamente a SILA (n°55) o a CLA (111), e nessun intervento è stato convertito ad altra procedura.

La durata dell'intervento è risultato significativamente maggiore nel gruppo SILA (36.69±12.79 vs. 42.64±15.15; p= 0.009). Non si è registrata nessuna differenza nella durata della degenza, né per le complicazioni.

I pazienti del gruppo SILA janno lamentato maggiori dolori postoperatori al primo giorno (p=0.002). dopo 12 mesi l'immagine corporea e l'aspetto cosmetico è risul-

tato eccellente in entrambi i gruppi e indistinguibile per la maggior parte delle misura 55.79±2.31 vs. 55,76±2,13; p= 0,937).
In conclusione SILA ha dato maggiori dolori e più lungo tempo operatorio senza accorciamento della degenza postoperatoria. L'immagine corporea a lungo termine e il risultato cosmetico sono risultati egualmente eccellenti in entrambi i due gruppi.

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