



# Single-incision laparoscopically assisted appendectomy performed by residents is safe and feasible: A single institution, retrospective case series



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## HIGHLIGHTS

- Single-incision laparoscopically assisted appendectomy could be performed with acceptable morbidity by the residents.
- Single-incision laparoscopically assisted appendectomy performed by residents under the guidance of a staff surgeon is safe and feasible.

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## ABSTRACT

**Introduction:** To confirm the safety and feasibility of single-incision laparoscopically assisted appendectomy (SILA) performed by resident doctors.

**Materials and methods:** We retrospectively analyzed 86 consecutive patients who underwent SILA between August 2010 and August 2016 at Kinki Central Hospital. During this period, 9 residents and 6 board-certified attending surgeons performed SILA. Data on the patients' characteristics and perioperative complications were collected from their medical records.

**Results:** Resident doctors operated on 55% (47/86) of patients undergoing SILA. There were no significant differences between the groups with regard to patient characteristics. Mean operative time in the resident and staff surgeon groups was 74 min and 71 min, respectively ( $p = 0.5$ ). Median blood loss in both the resident and staff surgeon groups was 0 mL ( $p = 0.3$ ). The rate of conversion to a different operative procedure was 4% (2/47) in the resident group and 3% (1/39) in the staff surgeon group ( $p = 1$ ). All three above-mentioned procedures, two (4%, 2/47) in the resident group and one (3%, 1/39) in the staff surgeon group, were converted to multi-port laparoscopic appendectomy. The mean postoperative hospital stay was 5 days for both the resident and staff surgeon groups ( $p = 0.7$ ). Perioperative complications developed in 9% (4/47) of the patients in the resident group and 21% (8/39) of the patients in the staff surgeon group ( $p = 0.1$ ).

**Conclusions:** SILA performed by residents under the guidance of a staff surgeon is safe and feasible.

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## 1. Introduction

Appendectomy is one of the most commonly performed general surgical procedures. In recent years, laparoscopic appendectomy has been widely performed, and gradually, single-incision laparoscopically assisted appendectomy (SILA) has been implemented as a procedure with more favorable cosmetic outcomes than

conventional laparoscopic appendectomy. However, resident training in single-incision laparoscopic surgery (SILS) techniques has been limited because of the specific difficulties of SILS, such as in-line positioning of the laparoscope, close proximity of the working instruments with limited triangulation, and limited range of motion of the laparoscope and instruments. Although there are some previous reports regarding resident training for conventional laparoscopic appendectomy [1–3], there are few reports regarding resident training for SILA [4,5]. The aim of the present study was to evaluate the safety and feasibility of resident doctor-performed SILA, by comparing the outcomes with those of procedures

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performed by staff doctors.

## 2. Materials and methods

### 2.1. Study design

This study was designed as a single institution, retrospective case series [6]. This study was in accordance with the ethical standards of the institution and the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh 2000). Written informed consent was obtained from the patients for the information to be included in our manuscript.

### 2.2. Clinical settings

We retrospectively analyzed 86 consecutive patients who underwent SILA between August 2010 and August 2016 at Kinki Central Hospital. Appendicitis was diagnosed based on physical findings, blood tests, abdominal ultrasonography and CT scan.

### 2.3. Patients and surgeons

During the study period, 9 residents and 6 board-certified attending surgeons performed SILA. The staff surgeons in this study had completed fellowship training in advanced surgical techniques and had been routinely performing laparoscopic procedures. The resident doctors in the study were years 3–6 post-graduates. All SILAs performed by the residents were performed under the guidance of fully trained staff surgeons. The staff doctors were scrubbed in as camera operators and verbally directing the residents if necessary when the resident doctors performed SILAs.

### 2.4. Surgical technique

Fig. 1 shows the operative settings. The skin incision was made intraumbilically. A single access system enclosing three working channels was introduced into the abdominal cavity via an incision in the muscular aponeurosis under visual control. Depending on the operating surgeon's choice and hospital supplies, several types of single access systems were used in this study, including: EZ access and Lap-Protector, Hakko Co., Ltd., Nagano, Japan; SILS™, Covidien, Dublin, Ireland; and a surgical-glove technique that involves the use of a small plastic wound retractor inserted transumbilically with an attached surgical glove to prevent CO<sub>2</sub> leakage, with the fingers functioning as multiple ports. Typically, we used EZ access on the Lap Protector for insertion of trocars for the 5-mm flexible scope and instruments during the operations (Fig. 2). A

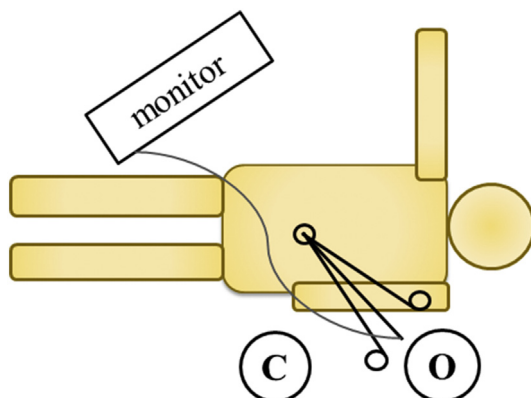


Fig. 1. Operative settings for SILA. O: operator, C: camera operator.

carbon dioxide pneumoperitoneum was then created, and the pressure was maintained at 10 mmHg. After the operating table was positioned, the ileocecum was mobilized with conventional straight forceps and laparoscopic coagulation shears. The appendix or mesoappendix was grasped, and the pneumoperitoneum was deflated. The appendix was then delivered through the umbilical wound. In the extracorporeal portion of the procedure, the appendix and mesoappendix were dissected and ligated extracorporeally. The stump of the appendix was inverted with a purse-string suture, as in open appendectomy. Depending on the operating surgeon's choice and the surgical field, Endo GIA™ Universal Stapling System, Covidien, Dublin, Ireland, was used to resect the appendix intraperitoneally instead of the extracorporeal procedure. Drains were placed as required. The umbilical wound was closed in two layers in a routine fashion (Fig. 3).

### 2.5. Data collection

Data on the patients' age, sex, body mass index (BMI), American Society of Anesthesiologists-physical status (ASA-PS) grade, previous history of abdominal surgery, presence of a fecolith or abscess, operative time, blood loss, conversion rate, postoperative hospital stay, and perioperative complications were collected from their medical records. All patients were followed up at least until the day of discharge. When comparing resident-performed and staff surgeon-performed SILAs, the rates of appendicitis complicated by gangrenous appendicitis or perforation of the appendix were also evaluated, in addition to the baseline demographic data.

### 2.6. Statistical analysis

Student's *t*-test, Fisher's exact probability test, and the Mann-Whitney *U* test were used for analysis of parametric and non-parametric data, as appropriate. Differences of  $p < 0.05$  were considered significant. All statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The Foundation for Statistical Computing). More precisely, it is a modified version of R commander, designed to add statistical functions frequently used in biostatistics [7].

## 3. Results

Table 1 lists the characteristics of the patients in each group. The resident doctors operated on 55% (47/86) of patients undergoing SILA at our hospital. There were no significant differences between the groups with regard to patient age, sex, BMI, ASA-PS grade,



Fig. 2. The three ports secured to the EZ access for the operation.

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