Feasibility of articulating laparoscopic instrument use in laparoscopic adnexectomy: a multicenter prospective observational study

Jun-Hyeong Seo^, Chel-Hun Choi, Yoo-Young Lee

Gynecologic Cancer Center, Department of Obstetrics and Gynecology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, South Korea

Contributions: (I) Conception and design: JH Seo; (II) Administrative support: CH Choi; (III) Provision of study materials or patients: CH Choi, YY Lee; (IV) Collection and assembly of data: JH Seo; (V) Data analysis and interpretation: JH Seo, YY Lee; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Yoo-Young Lee, MD, PhD. Gynecologic Cancer Center, Department of Obstetrics and Gynecology, Samsung Medical Center, Sungkyunkwan University School of Medicine, 81, Irwon-ro, Gangnam-gu, Seoul 06351, South Korea. Email: yooyoung.lee@samsung.com.

Background: Ovarian cysts, common in women of reproductive age, often require surgical intervention, with minimally invasive laparoscopic surgery becoming the preferred method due to its reduced complications and faster recovery. Despite its benefits, challenges such as instrument collisions and operational difficulties limit the use of single- or two-port approaches. The purpose of this study was to evaluate the feasibility of laparoscopic adnexa surgery using an articulating laparoscopic instrument, which offers flexible and ergonomic movements similar to robotic systems.

Methods: This multicenter prospective observational study was conducted in South Korea and Taiwan. The electronic medical records of patients who underwent laparoscopic adnexectomy using the articulating laparoscopic instrument (ArtiSential®, LIVSMED Inc., Seongnam-si, South Korea) between October 2022 and September 2023 were analyzed. Data on patient demographics, operative and pathologic data were collected prospectively.

Results: A total of 66 patients underwent laparoscopic adnexal surgery using the articulating instrument. The median age of the patients was 43 (range, 23–76) years, and the median body mass index (BMI) was 22.5 (range, 17.1–43.4) kg/m^2. Thirty-five (53.0%) patients underwent oophorectomy or salpingectomy, while 31 (47.0%) underwent cystectomy of the ovary or fallopian tube. The final pathology after surgery was benign in 61 patients (92.4%), borderline in 3 patients (4.5%), and malignant in 2 patients (3.0%). During surgery, pelvic adhesions were found in 13 patients (19.7%) and adhesiolysis was performed. The median total operation time was 53.5 (range, 26–174) minutes, and median estimated blood loss (EBL) was 50 (range, 10–200) mL. Median length of hospital stay was 1 (range, 0–3) days. Only two patients experienced a postoperative complication, which was trocar site wound dehiscence in both cases.

Conclusions: The results of this study demonstrated the feasibility of using the articulating laparoscopic instrument during laparoscopic adnexectomy.

Keywords: Laparoscopy; articulating; adnexectomy

Submitted Dec 27, 2023. Accepted for publication May 29, 2024. Published online Jun 20, 2024.
doi: 10.21037/gs-23-533
View this article at: https://dx.doi.org/10.21037/gs-23-533

^ ORCID: 0000-0002-8044-3084.
Introduction

Ovarian cysts are commonly found in women of reproductive age, with around 4% requiring surgical intervention by the age of 65 years (1). Given the advantages of minimally invasive surgery over open procedures, such as reduced perioperative complications, decreases in postoperative pain and length of hospital stay, and improved cosmetic outcomes, it has become the standard care approach (2). Efforts to optimize these benefits have led to the reduction of ports used in conventional laparoscopic surgery and the minimization of trocar sizes (3). Recent findings suggest that reduced port usage in laparoscopic surgery offers superior outcomes in terms of pain, recovery period, and cosmetic results compared to conventional methods (4-6). However, challenges like potential collisions between instruments and the camera, as well as difficulties in manipulation and triangulation, have limited the widespread adoption of single- or two-port surgeries (7,8). To overcome these limitations, advancements in laparoscopic instrumentation have been made, such as the development of articulating laparoscopic instruments. This instrument features a multi-joint mechanism akin to robotic surgery implements, enabling flexible and ergonomic movement that enhances surgical precision and efficiency (9). While articulating instruments have been explored in various surgical fields (10-13), their utility in gynecologic surgery, particularly in laparoscopic adnexectomy, remains poorly understood. This study aims to present the safety and feasibility of laparoscopic adnexectomy using an articulating laparoscopic instrument. We present this article in accordance with the STROBE reporting checklist (available at https://gs.amegroups.com/article/view/10.21037/gs-23-533/rc).

Methods

This study, which was conducted from October 2022 to September 2023, was a multicenter, prospective observational analysis assessing the use of articulating laparoscopic instruments in adnexa surgeries. Sixty-six patients, operated on by five surgeons from South Korea and Taiwan, were included. Eligible participants were adult women aged 19 years old and above who were scheduled for laparoscopic adnexectomy, excluding those with standard laparoscopic contraindications. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and informed consent was taken from all the patients. The ArtiSential® (LIVSMD Inc., Seongnam-si, South Korea), which mirrors a robotic system’s functionality, was employed (14). Surgeons participating in this study underwent a training course using the ArtiSential® training kit provided by LIVSMD, specifically the peg-transfer task, prior to surgery (15). This task involves transferring a total of 12 pegs of various shapes and sizes from a slightly inclined vertical board to a horizontal surface, utilizing both conventional straight instruments and articulating instruments. A minimum training duration of 30 minutes was required, with the objective to match the time taken using articulating instruments to that of conventional instruments.

Data collected included demographics, operative details, and pathologic outcomes, following ethical guidelines under the approval of the Institutional Review Board (IRB) of Samsung Medical Center (IRB No. 2022-08-151). All participating hospitals/institutions were informed and agreed with the study. The study categorized surgeries into adnexectomy and cystectomy, with combined procedures classified under adnexectomy. Detailed data included age, body mass index (BMI), size of mass measured by ultrasound, computed tomography (CT), or magnetic resonance imaging (MRI), prior abdominal surgeries, and American Society of Anesthesiologists (ASA) score. Operative data including number of ports, instrument types, operative time (from skin incision to completion of skin closure), and American Society of Anesthesiologists (ASA) score.
closure), estimated blood loss (EBL; estimated from the contents of suction devices), conversion to laparotomy, and any intra- and post-operative complications were collected. Length of hospital stay was defined as the day from operation to discharge. A pathologist performed microscopic tissue examination after surgery. Postoperative complications were monitored during follow-up visits at 7 days, 1 month, and 6 months after discharge.

**Surgical techniques**

Under general anesthesia, the patient was positioned in the dorsal lithotomy and Trendelenburg position with arms abducted. In adolescents and young women without a coital history, uterine manipulators were not used. Prophylactic antibiotics were administered before anesthesia. Bladder emptying was facilitated using a Nelaton catheter instead of a Foley catheter. The surgical team comprised the operator on the patient’s left side, the first assistant with the camera on the right, and an additional assistant for uterine manipulation positioned between the patient’s legs. A vertical incision measuring 2–2.5 cm was made at the umbilicus, subcutaneous fat layer dissected, and the peritoneum opened. A wound retractor was inserted, followed by a multi-channel trocar. Pneumoperitoneum was established at 12 to 15 mmHg pressure. Additional 5-mm trocars were placed as needed based on surgical complexity. A 5-mm laparoscope, either 0- or 30-degree, was used alongside the ArtiSential® articulating instrument. Adhesiolysis was performed if necessary. The procedure included inspection of the abdomen and pelvis, and the specific surgical steps varied for adnexectomy and cystectomy. For adnexectomy, the infundibulopelvic ligament was ligated and cut using an electrosurgical device. The broad ligament was then dissected toward the uterus. The ovarian ligament was ligated and cut using an electrosurgical device. For cystectomy, the ovarian epithelial surface or cystic surface was incised using and electrosurgical device and the cyst removed. Bleeding control was then performed. Video 1 demonstrates the surgical technique involving the use of articulating instruments during the surgery.

**Statistical analysis**

Given the design of this study as a single-arm prospective observational study, there are no comparative groups, which precludes traditional statistical hypothesis testing. Therefore, the statistical approach primarily involves descriptive statistics to present the data. The results are reported using medians and ranges for continuous variables, and frequencies and percentages for categorical variables. This method provides a clear and straightforward description of the findings from the observed sample without inferring statistical significance. Such an approach is appropriate and sufficient for the exploratory and descriptive objectives of this study.

**Results**

In this study, a total of 66 patients underwent laparoscopic adnexal surgery using an articulating instrument. Patient characteristics are summarized in Table 1. They were categorized into two groups: 35 patients who underwent adnexectomy, and 31 who underwent cystectomy. The median age of the entire patient cohort was 43 (range, 23–76) years, and the median BMI was 22.5 (range, 17.1–43.4) kg/m². A considerable proportion of patients (31.7%) had a history of one or more previous abdominal surgeries. Preoperative tumor sized varied, with a median size of 61.6 (range, 0–263) mm. The majority of patients (97.0%) had an ASA score of 2 or below, indicating low anesthetic risk.

Operative data showed that most surgeries involved the use of two or more ports (Table 2). The articulating instrument was primarily used as monopolar scissors (89.4% of cases). Intraoperative adhesions were observed in 19.7% of patients. The median total operative time was 53.5 (range, 26–174) minutes, and EBL was generally low (median, 50 mL; range, 10–200 mL). No conversions to open surgery were reported. Pathologically, the majority of
### Table 1: Surgery with an articulating instrument (n=66): patient demographics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (n=66)</th>
<th>Adnexectomy (n=35)</th>
<th>Cystectomy (n=31)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>43 [23–76]</td>
<td>54 [30–76]</td>
<td>36 [23–67]</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>22.5 [17.1–43.4]</td>
<td>22.8 [19.3–36.5]</td>
<td>22.1 [17.1–43.4]</td>
</tr>
<tr>
<td>Number of prior abdominal surgeries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16 (24.2)</td>
<td>8 (22.8)</td>
<td>8 (25.8)</td>
</tr>
<tr>
<td>≥2</td>
<td>5 (7.6)</td>
<td>4 (11.4)</td>
<td>1 (3.2)</td>
</tr>
<tr>
<td><strong>Tumor size (mm)</strong></td>
<td>61.5 [0–263]</td>
<td>58.0 [0–270]</td>
<td>63.0 [28–147]</td>
</tr>
<tr>
<td><strong>ASA score</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I, II</td>
<td>64 (97.0)</td>
<td>34 (97.1)</td>
<td>30 (96.8)</td>
</tr>
<tr>
<td>&gt;III</td>
<td>2 (3.0)</td>
<td>1 (2.9)</td>
<td>1 (3.2)</td>
</tr>
</tbody>
</table>

Data are presented as median [range] or n (%). BMI, body mass index; ASA, American Society of Anesthesiologists.

### Table 2: Surgery with an articulating instrument (n=66): operative data

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (n=66)</th>
<th>Adnexectomy (n=35)</th>
<th>Cystectomy (n=31)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of ports</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>15 (22.7)</td>
<td>9 (25.7)</td>
<td>6 (19.4)</td>
</tr>
<tr>
<td>Two or more</td>
<td>51 (77.3)</td>
<td>26 (74.3)</td>
<td>25 (80.6)</td>
</tr>
<tr>
<td><strong>Articulating instrument</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monopolar scissors</td>
<td>59 (89.4)</td>
<td>30 (85.7)</td>
<td>29 (93.5)</td>
</tr>
<tr>
<td>Forceps or dissector</td>
<td>7 (10.6)</td>
<td>5 (14.3)</td>
<td>2 (6.5)</td>
</tr>
<tr>
<td>Intraoperative adhesion</td>
<td>13 (19.7)</td>
<td>6 (17.1)</td>
<td>7 (22.6)</td>
</tr>
<tr>
<td><strong>Total operative time (min)</strong></td>
<td>53.5 [26–174]</td>
<td>49.0 [26–100]</td>
<td>64.0 [34–174]</td>
</tr>
<tr>
<td><strong>EBL (mL)</strong></td>
<td>50.0 [10–200]</td>
<td>50.0 [10–100]</td>
<td>50.0 [20–200]</td>
</tr>
<tr>
<td>Conversion to open</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Pathology</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benign</td>
<td>61 (92.4)</td>
<td>30 (85.7)</td>
<td>31 (100.0)</td>
</tr>
<tr>
<td>Borderline</td>
<td>3 (4.5)</td>
<td>3 (8.6)</td>
<td>0</td>
</tr>
<tr>
<td>Malignant</td>
<td>2 (3.0)</td>
<td>2 (5.7)</td>
<td>0</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>1 [0–3]</td>
<td>1 [0–2]</td>
<td>1 [1–3]</td>
</tr>
<tr>
<td><strong>Intraoperative complications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wound dehiscence</td>
<td>2 (3.0)</td>
<td>2 (5.7)</td>
<td>0</td>
</tr>
<tr>
<td>Morbidity (CDC grade III–IV)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Data are presented as median [range] or n (%). EBL, estimated blood loss; CDC, Clavien-Dindo classification.
patient lesions were benign (92.4%), with a small number of borderline (4.5%) and malignant (3%) outcomes. The hospital stay was typically short, with a median of 1 day. Postoperative complications were rare, with only two cases of wound dehiscence reported. Table 3 presents the pathologic diagnoses after surgery. The most frequent pathologic diagnosis was serous cystadenoma (36.3%), followed by endometriosis (21.2%), and mature cystic teratoma (19.6%).

**Discussion**

This study evaluated the feasibility of using articulating laparoscopic instruments in laparoscopic adnexa surgery. Our multicenter prospective observational study, conducted in South Korea and Taiwan, demonstrated that these instruments are not only feasible but also effective in such surgeries. Advancements in minimally invasive surgery have been accompanied by the development of innovative surgical tools like the ArtiSential. These instruments offer enhanced dexterity and range of motion, akin to robotic systems, yet retain the tactile feedback essential in laparoscopic surgeries. In our study, the use of ArtiSential was associated with a low incidence of complications and an efficient surgical process, similar to the benefits reported for other surgical fields (16).

A study on laparoscopic gastrectomy using an articulating instrument found similar advantages, including shorter operation times and potential reductions in early postoperative complications, albeit these differences were not statistically significant (10). Such findings suggest a broader applicability of these instruments across various laparoscopic procedures. However, the integration of articulating instruments into laparoscopic surgery is not without challenges. A limitation of this study is its design as a prospective single-arm cohort, which did not include a comparison group using conventional laparoscopic instruments, precluding a direct comparative analysis. Also, the learning curve and the need for specialized training are notable considerations (15). Our study’s success in using these instruments can be attributed to the skilled surgical teams involved, highlighting the importance of training and experience in the adoption of new surgical technologies.

**Conclusions**

In conclusion, our study supports the feasibility and safety of articulating instrument use in laparoscopic adnexa surgery. These results align with broader trends in minimally invasive surgery, where enhanced instrument functionality can lead to improved surgical outcomes. Future research should focus on long-term outcomes, comparison with conventional laparoscopic instrument or robotic systems, and the integration of these instruments into various surgical procedures to fully ascertain benefits and limitation.

**Acknowledgments**

We thank Dr. Yu-Li Chen, Yen-Ling Lai, and Jung Chen from the National Taiwan University Hospital for providing their cases in this study (Approval No. 2308094).

**Funding:** This research was supported by a grant of the Korean Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI),
funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HI22C0767).

**Footnote**

**Reporting Checklist:** The authors have completed the STROBE reporting checklist. Available at [https://gs.amegroups.com/article/view/10.21037/gs-23-533/rc](https://gs.amegroups.com/article/view/10.21037/gs-23-533/rc)

**Data Sharing Statement:** Available at [https://gs.amegroups.com/article/view/10.21037/gs-23-533/dss](https://gs.amegroups.com/article/view/10.21037/gs-23-533/dss)

**Peer Review File:** Available at [https://gs.amegroups.com/article/view/10.21037/gs-23-533/prf](https://gs.amegroups.com/article/view/10.21037/gs-23-533/prf)

**Conflicts of Interest:** All authors have completed the ICMJE uniform disclosure form (available at [https://gs.amegroups.com/article/view/10.21037/gs-23-533/coif](https://gs.amegroups.com/article/view/10.21037/gs-23-533/coif)). The authors have no conflicts of interest to declare.

**Ethical Statement:** The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was approved by the Institutional Review Board (IRB) of Samsung Medical Center (IRB No. 2022-08-151). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and informed consent was taken from all the patients. All participating hospitals/ institutions were informed and agreed with the study.

**Open Access Statement:** This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: [https://creativecommons.org/licenses/by-nc-nd/4.0/](https://creativecommons.org/licenses/by-nc-nd/4.0/).

**References**

