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Original Article

Single-port access laparoscopic surgery using a novel laparoscopic port (Octo-Port)

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Abstract

Objective: We present our initial experience with single-port access (SPA) surgery using a novel laparoscopic port (Octo-Port).
Materials, Methods, and Results: In a prospective study, SPA surgery was carried out on 11 patients with the Octo-Port from July 2009 to December 2009 by a single surgeon (T.-J. K.). The procedures carried out were hysterectomy (seven patients), ovarian cystectomy (two patients) and salpingo-oophorectomy (two patients). In 10 cases the procedure was successfully performed without the use of additional ports. In one case the SPA procedure failed and ancillary ports were required; this patient had anatomical variations that made use of the SPA technique difficult. All procedures were performed without complications. There were no perioperative port-related or surgical problems. The Octo-Port had certain advantages such as reducing the need for long laparoscopic instruments, reducing extracorporeal instrumental crowding, and providing better deflection of smoke compared to other SPA devices that used a wound retractor and a glove.
Conclusion: Our study demonstrated that the Octo-Port allows laparoscopic surgery to be performed safely and easily with a reduced number of ports.

Keywords: Gynecology; Laparoscopy; Octo-Port; Single-port

Introduction

Single-port access (SPA) surgery was introduced to the field of gynecology for tubal sterilization about four decades ago [1]. However, SPA gynecological surgery did not gain widespread use because of the technical challenges associated with complex intracorporeal maneuvers for which there were no available instruments. Although SPA surgery has many advantages, including reduced postoperative pain, a more rapid recovery, fewer wound complications, and improved cosmetic outcomes, it has some shortcomings that have not been overcome [2]. Recent SPA surgical techniques have been introduced in the fields of gastroenterology [3,4] and urology [5] with improved instrumentation and continued investigation into better methods for the procedure. The procedures in the present study were performed with the Uni-X (Pnavel Systems, Brooklyn, NY, USA) or the TriPort (Advanced Surgical Concepts, Wicklow, Ireland) as a multichannel working port for one-port surgery. These devices have not been available in Korea until recently. We have used a wound retractor (Alexis; Applied Medical, Rancho Santa Margarita, CA, USA) and a surgical glove as an alternative [6]. Many SPA surgeries were performed using the so-called 'home-made port' [7–10]; however, this approach also has limitations. Currently, a new commercial multichannel port system, Octo-Port (DalimSurgNet, Seoul, Korea), is available for SPA surgery. We report on our initial 11 patients who underwent SPA surgery using the Octo-Port.

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Materials and methods

Octo-Port

The Octo-Port is a recently developed laparoscopic multi-channel access device that allows multiple instruments to pass simultaneously through one incision, and ensures pneumoperitoneum regardless of whether a laparoscopic instrument is present in any of the channels (Fig. 1). The device comprises a retractor component and a cap component. The retractor component has a doubled-over cylindrical sleeve made of transparent silicon, with an inner and an outer ring, and an anchor that is fixed to the rim of the outer ring. By drawing the outer ring up to the anchor, tension is developed in the retraction sleeve. This tension is required for the retraction of the incision, and creates the access for the laparoscopic instruments. A removal tag placed just above the inner ring is provided to remove the device from the incision at the end of the procedure. The cap component consists of a harbor that is mounted onto the retractor component and multiple channels that allow introduction of all standard laparoscopic instruments and scopes from 5 mm to 12 mm. An air-sealing elastomer within each channel maintains pneumoperitoneum during the surgical procedure in general and especially during instrument changes. Two tubes are present at the cap housing for the purposes of insufflation and exhaust.

Patients

All patients underwent surgery after both Institutional Review Board approval from the Ethical Committee of the Samsung Medical Center (Seoul, Korea) and informed patient consent had been obtained. From July 2009 to December 2009, SPA surgery using the Octo-Port was performed by a single surgeon (T.-J. K.) in 11 patients with benign gynecological disease. Patients were selected on the basis of ultrasound findings that indicated a need for laparoscopy according to the standard of care in our practice. Exclusion criteria included advanced ovarian and other gynecological cancers. All data were collected prospectively and were analyzed for age, body mass index (BMI, kg/m^2), chief complaint, estimated blood loss, operation time, and operative record. The SPA procedures are summarized in Table 1 and detailed in the following sections.

Operative techniques

The patients were counseled appropriately and underwent SPA laparoscopic surgery using the Octo-Port. Under general anesthesia, each patient was placed in the dorsal lithotomy position. The patient's left arm was tied to her body for the surgeon's space. The surgeon stood on the patient's left side. On the patient's right side, the first assistant handled the scope.

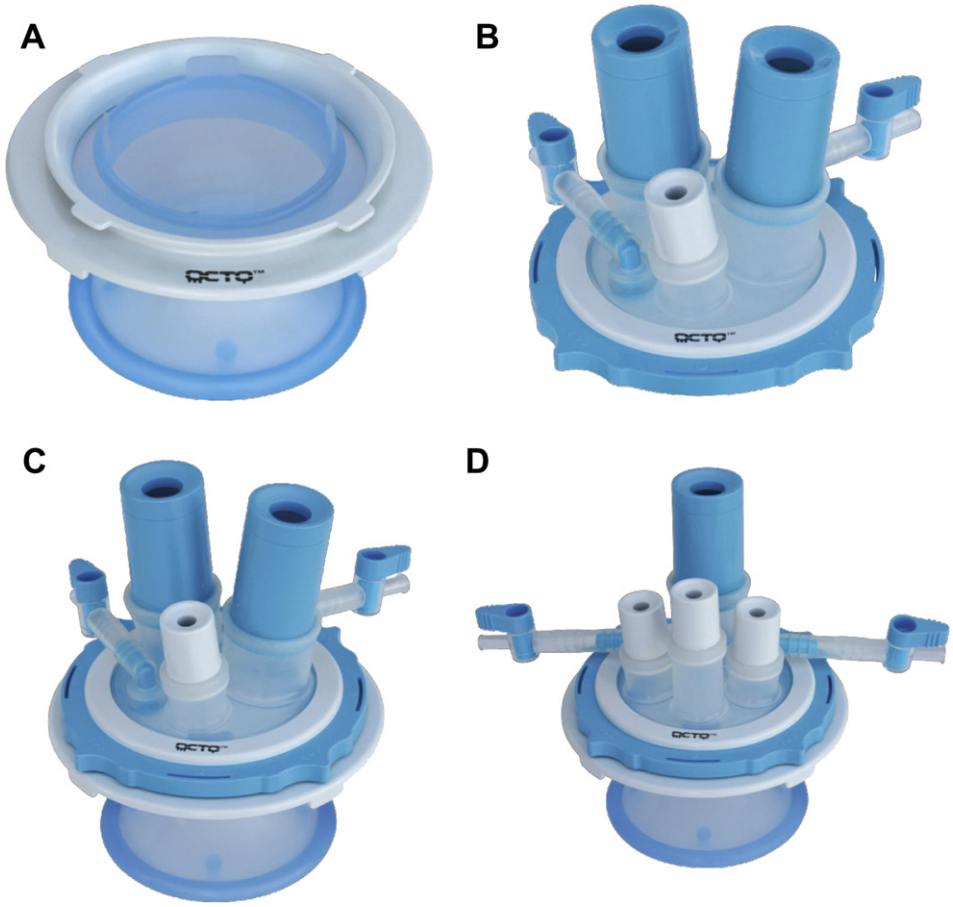

Fig. 1. Octo-Port, a single-port access laparoscopic device, showing (A) a retractor component; (B) a cap component; (C and D) two models.

Table 1
Details of four procedures performed using the Octo-Port laparoscopic port.

Patient ($n = 11$)	Age (y)	BMI (kg/m^2)	Procedure	Pathology	Ancillary port	OP time (min)	EBL (mL)	Hb drop (g/dL)
1	47	20.6	Hysterectomy	Myoma, adenomyosis	Not used	99	50	3.2
2	40	19.7	Hysterectomy	Adenomyosis	Not used	111	50	1.9
3	26	18.2	Bilateral OC, adhesiolysis	Endometriosis	One 2 mm port, One 5 mm port	120	200	3.6
4	41	24.5	Hysterectomy	Myoma	Not used	75	150	1.9
5	41	21.8	Left OC, right salpingectomy, adhesiolysis	Endometriosis	Not used	140	200	1.5
6	47	27.5	Hysterectomy	Myoma	Not used	120	300	2.7
7	74	24.5	Left SO	Serous cystadenoma	Not used	27	50	0.4
8	46	21.2	Hysterectomy adhesiolysis	Myoma, adenomyosis	Not used	137	350	2.7
9	46	20.9	Right SO, adhesiolysis	Endometriosis	Not used	125	100	1.5
10	44	20.7	Hysterectomy	Adenomyosis	Not used	89	200	2.9
11	45	25.5	Hysterectomy	Myoma	Not used	60	100	1.5

BMI=body mass index; EBL = estimated blood loss (calculated as the difference between the total amount of suction and irrigation plus the difference between the total weights of the gauzes after and before surgery); Hb = hemoglobin; OC = ovarian cystectomy; OP = operation; SO = salpingo-oophorectomy.

The second assistant, positioned between the legs of the patient, manipulated the uterine elevator to provide an effective surgical field. At the start of surgery, a 2 cm intraumbilical incision was made. After folding the inner ring of the retractor component of the Octo-Port, it was inserted through the incision, and the rim of the outer ring was drawn up to the anchor. This widened the small vertical incision, producing a rounder opening. A cap component was then mounted onto the retractor component of the Octo-Port. An average of 5 minutes elapsed between the skin incision and adequate installation of the Octo-Port. Carbon dioxide was insufflated through the housing of the Octo-Port to maintain intra-abdominal pressure at 10–12 mmHg. Through the 5 mm channels of the Octo-Port, a 5 mm, 0°, rigid, laparoscope and an articulating instrument (i.e., Roticulator, Covidien, Norwalk, CT, USA) were introduced.

In the cases of SPA laparoscopic-assisted vaginal hysterectomy (LAVH), we used a 45 mm Endo-GIA (a single-use loading unit with titanium staples made by Covidien) in order to dissect the ovarian ligaments, round ligament, and broad ligament, with the assistance of a Roticulator grasper, which retracted the ovary and the salpinx. After bleeding control by bipolar coagulation, we started vaginal hysterectomy. In the cases of SPA laparoscopic adnexal surgery, we used several flexible instruments (i.e., Roticulator, Covidien; Autonomy, Cambridge Endoscopic Devices, Framingham, MA, USA) to avoid clashing of the instruments and to optimize the range of motion. Once the laparoscope and instruments were in place, the procedure was similar to the procedure performed in multiport laparoscopic surgery. To extract the adnexal tumors, an Endo-bag (LapBag; Sejong Medical, Pajoo, Korea) was introduced into a 12 mm channel of the Octo-Port. Using an unmounted retractor component, the Endo-bag was removed easily from the Octo-Port. Surgical smoke from the electrical cutting and coagulation was easily deflected through an exhaust tube of the cap housing of Octo-Port. After all procedures were completed, the peritoneum and fascia were approximated and closed layer by layer with 2-0 Polysorb suture. To close the skin, we used skin adhesive (Dermabond; Ethicon, Somerville, NJ, USA); this was convenient for the patients, enabling them to take a shower or enjoy spa from the day after the operation, and also for the doctors.

Results

Over the study period, 11 patients underwent SPA laparoscopy using Octo-Port (hysterectomy in seven patients and adnexal surgery in four patients). Seven patients who underwent SPA-LAVH presented with dysmenorrhea, menorrhagia, or lower abdominal discomfort. Sonographic imaging revealed adenomyosis in two cases and uterine myoma in five cases. In these seven cases the SPA procedure was successfully performed without the use of additional ports. The patients' pathology reports showed myoma or adenomyosis. Four patients were scheduled for SPA laparoscopic adnexal surgery using Octo-Port (ovarian cystectomy in two patients and salpingo-oophorectomy in two patients). Of these four patients, Patient 3 presented with severe dysmenorrhea interfering with ordinary daily activities, and Patient 5 and Patient 9 with recently developed dysmenorrhea. Sonographic imaging revealed an endometrioma in all three cases. Patient 7 was referred for evaluation of an asymptomatic 7 cm pelvic mass. Sonographic imaging revealed a left ovarian cyst with septum. In the case of Patient 3, we could not insert the uterine elevator because she did not have a history of sexual intercourse. After installation of the Octo-Port, severe pelvic adhesions between the viscera and genital organs and obliteration of the cul-de-sac were noted. SPA surgery was not feasible in this patient. A 2 mm laparoscopic grasper was introduced through a 2 mm ancillary port (Covidien) to perform adhesiolysis in the right lower quadrant of the abdomen (Fig. 2C). However, we had difficulty in securing the operative field because of the low grasping force. We inserted a 5 mm port into the suprapubic region, after which adhesiolysis and bilateral ovarian cystectomy were successfully achieved. The pathology reports showed endometriosis in Patients 3, 5 and 9, and serous cystadenoma in Patient 7.

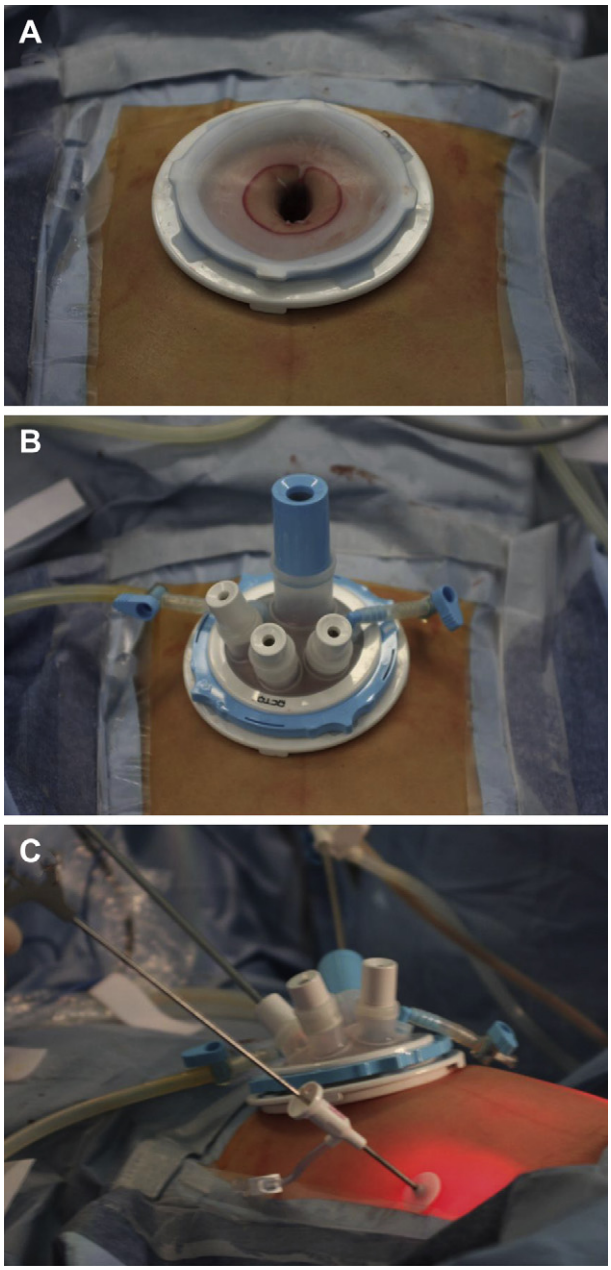

Fig. 2. Intraoperative photographs of an Octo-Port laparoscopic port placed in the umbilicus, showing (A) a retractor component; (B) a retractor component mounted with a cap component; (C) working through the Octo-Port and an ancillary 2 mm port.

Each attempt to place the Octo-Port was successful and without incident except in one case, when ancillary ports were needed. Conversion to laparotomy was not required in any of the cases. There were no cases of inadvertent port removal, vascular or visceral port injury, leakage of the pneumoperitoneum, or intraoperative port-site bleeding. After surgery there were no cases of wound hematoma, wound infection, or delayed port-site bleeding. No complications were observed during the postoperative hospital stay. The patients remained in hospital for 2 or 3 postoperative days according to our hospital policy. They were followed up in the outpatient clinic for 1 week after discharge, and no post-operative complications or early port-site hernias were observed. The patients were examined at the scheduled follow-up appointments 3 weeks after the initial outpatient visit, and none showed complications.

Discussion

In this case series, SPA surgery using the Octo-Port had a success rate of 90.9% with no conversion to laparotomy. The one failure was attributable more to the patient's anatomical variations, with severe adhesions, than to limitations of the Octo-Port design. There were no complications related to the umbilicus in the patients who underwent the SPA surgery. Potential advantages of single-port over conventional multi-port laparoscopy or robotics include better cosmesis from a relatively hidden umbilical scar and the need for fewer trocar incisions. Also there is a possible decrease in the morbidity related to visceral and vascular injuries during trocar placement, a reduced risk of postoperative wound infection and elimination of multiple trocar site closures. A 2 cm incision at the umbilicus, compared to the conventional 5 or 12 mm trocar incisions, also allows for easier specimen extraction. Another benefit of single-port laparoscopy is the reduction of postoperative pain and narcotics use, as observed in our previous study [11]. Another potential advantage of SPA surgery is that the approach may be psychologically more attractive for patients in terms of body image. Moreover, fewer incisions may result in faster recovery times and a more timely administration of adjuvant therapies in women with gynecologic cancer.

From our SPA experience (198 cases), we can suggest a number of indications and contraindications for SPA in gynecology. Regarding SPA adnexal surgery, oophorectomy or salpingectomy, the procedures do not have any limitations. Moreover, specimen removal can be easier through a large umbilical port. In the case of SPA cystectomy, a longer operation time was needed as a result of the weak grasping/dissecting force of the flexible instruments. With regard to SPA hysterectomy, we consider the indications for SPA-LAVH to be the same as those for multiport access LAVH. It is notable that SPA-LAVH can also be applied to a large uterus (weighing >500 g), because the laparoscopic procedure of LAVH is minimal [12]. SPA subtotal hysterectomy or total laparoscopic hysterectomy (TLH) would not be appropriate for women with a large uterus, because a large uterus make it difficult to gain access to the level of uterine artery and these procedures require more laparoscopic techniques than are needed for SPA-LAVH [10,13].

The currently available SPA devices are detailed in Table 2. We have used three of the ports listed: a home-made port, Octo-Port, and SILS (Covidien). From our experience, we have found these devices to have different strengths and weaknesses. First, the retraction force of umbilical incision is greatest in the home-made port, followed by Octo-Port, then SILS. The weak retraction force may need a larger incision to install SPA port. Second, extraction of a specimen is simpler with the home-made port and Octo-Port than it is with SILS. In the case of the home-made port or Octo-Port, specimens can be extracted though the port's retractor component placed in the umbilicus. In contrast, in the case of SILS we can extract

Table 2
Multichannel ports available for single-port laparoscopic procedures.

Port	Manufacturer	Channels	Fixation mechanism	Valve mechanism
TriPort, QuadPort	Advanced Surgical Concepts, Wicklow, Ireland	Differ between models; usually, one at 12 mm, two at 5 mm	Inner ring, intervening taut plastic sleeve	Gel elastomer
Uni-X	Pnavel Systems, Brooklyn, NY, USA	Three at 5 mm	Fascial suture	Rubber inlet
Octo-Port	DalimSurgNet, Seoul, Korea	Differ between models; usually, two at 12 mm, one at 5 mm	Inner ring of retractor component	Air-sealing silicon
SILS	Covidien, Norwalk, CT, USA	Differ between models; usually, one at 12 mm, three at 5 mm	No special fixation mechanism	Used with specially designed SILS Port cannulae
Home-made port	Self-made	Differ between surgeons; usually, one at 12 mm, two at 5 mm	Distal ring of wound retractor	Used with conventional laparoscopic trocar

specimens only after removing SILS from the umbilicus. Third, conventional, normal-length laparoscopic instruments can be used comfortably in Octo-Port and SILS. However, longer instruments may be needed when using the home-made port, because the latter has a long (usually 10 cm, palm to finger of glove) tube that substantially encroaches into the abdominal cavity; instruments of ordinary length may not reach the pelvic floor. Fourth, smoke evacuation is more efficient with Octo-Port and SILS than with the home-made port. Octo-Port and SILS have two tubes for insufflation and exhaust. However, in the case of home-made port, the evacuation of smoke is not very effective because of turbulent flow between the abdominal cavity and the glove camber.

In conclusion, our initial experience with SPA surgery using the Octo-Port demonstrates that it offers surgeons the option of a safe and easy SPA surgery. Further study of this device and its associated patient outcomes are needed.

Acknowledgments

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