



# Pure single-site robot-assisted pyeloplasty with the da Vinci SP surgical system: Initial experience

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**Purpose:** Laparoendoscopic single-site surgery (LESS) reduces the limited invasiveness of conventional laparoscopy while providing superior cosmetic results. However, LESS remains a challenging surgical technique, even in robotic surgery, primarily due to the lack of triangulation and limited instrument movement. The da Vinci SP surgical system (Intuitive Surgical) was recently introduced to overcome these limitations. We describe our initial experience with pure single-site robot-assisted pyeloplasty (RAP) for ureteropelvic junction obstruction (UPJO) using the da Vinci SP surgical system.

**Materials and Methods:** Three consecutive patients who were diagnosed with UPJO underwent RAP with the da Vinci SP surgical system from December 2018 to February 2019 at our institution. The surgical technique involved reproducing the steps of multiport RAP. A 30-mm umbilical incision was made and the GelPOINT was inserted. The multichannel robotic port and the assistant's port were placed through the GelSeal cap. In all patients, Anderson–Hynes dismembered pyeloplasty was performed. The ureteral double J stent was inserted antegrade, and the drain was not placed.

**Results:** The procedures were successfully completed using a pure single-site approach. There was no need for additional port placement or conversion to laparoscopic or open surgery. Total operative time in the three patients was 139, 180, and 213 minutes, respectively. No intraoperative complications occurred, and blood loss was minimal. The postoperative course of all patients was uneventful with no complications greater than Clavien–Dindo grade I surgical complications.

**Conclusions:** Pure single-site RAP using the da Vinci SP surgical system is feasible and safe.

**Keywords:** Laparoscopy; Robotic surgical procedures; Ureteral obstruction

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## INTRODUCTION

Laparoendoscopic single-site surgery (LESS) is a laparoscopic procedure performed through a single skin incision. This minimally invasive surgery was developed

to minimize port-related complications, recovery time, and postoperative pain and to achieve superior cosmetic results [1,2]. Although LESS is feasible for several urologic procedures [3], the technique is highly challenging even for expert laparoscopic surgeons.

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Since Kaouk et al. [4] reported the first series of single-incision surgeries for the upper urinary tract using the da Vinci surgical system (Intuitive Surgical, Sunnyvale, CA, USA), the use of robotic single-site surgery for urologic problems has been globally reported [5,6]. However, intracorporeal suturing and traction are difficult and technically time-consuming because of clashing of the external robotic instruments and the loss of triangulation [7,8]. These challenges are occasionally overcome by the additional placement of an assistant port [9].

The da Vinci SP surgical system was developed as a novel robotic platform for successfully performing “pure” robotic single-site surgery while overcoming the aforementioned difficulties [10]. The system recently received clearance from the Food and Drug Administration [11]. The da Vinci SP surgical system was introduced for the first time in Korea at the end of 2018.

Here, we describe our experience with our first three cases of robot-assisted pyeloplasty (RAP) performed using the da Vinci SP surgical system in Severance Hospital. We report on the technical feasibility and perioperative outcomes. To the best of our knowledge, this is the first case series on RAP performed using the da Vinci SP surgical system in Asia.

**MATERIALS AND METHODS**

**1. Patients**

Three consecutive patients diagnosed with ureteropelvic junction obstruction (UPJO) underwent RAP performed by use of the da Vinci SP surgical system from December 2018 to February 2019. The surgeries were done by a single surgeon (W.S.J) who had performed eight cases of conventional RAP in a recent year at our institution,

which is a high-volume robotic center. All patients reported flank pain on the affected side due to UPJO and signed an informed consent after the novel robotic system had been explained to them. This study was approved by the Institutional Review Board (IRB) of Severance Hospital (IRB approval number: 1-2019-0003).

**2. Surgical procedure**

RAP was performed with the da Vinci SP surgical system by using the dismembered technique with a transperitoneal approach. Patients were positioned in a semilateral position. A 30-mm umbilical incision was made to reach the peritoneal cavity, and the GelPOINT advanced access platform (Applied Medical, Rancho Santa Margarita, CA, USA) was inserted (Fig. 1). A 25-mm multichannel port containing an articulating robotic camera and two double-jointed robotic instruments and a 12-mm port for an assistant’s laparoscopic instrument were placed through the GelSeal cap (Fig. 2).

The surgical technique involved reproducing the steps of our own multi-port RAP. An incision was made along the white line of Toldt, and the colon was mobilized medially to expose Gerota’s fascia; an incision was made in the Gerota’s fascia to isolate the renal pelvis and ureter. Pyeloplasty was performed using the Anderson–Hynes technique. After excision of the obstructed ureteropelvic junction, the ureter was longitudinally spatulated. Anastomosis was performed on the posterior side with a running 4-0 absorbable, sterile suture and a double J stent was inserted antegrade. Once the stent was correctly placed, anastomosis was completed on the anterior side (Video clip, Supplementary material). A surgical drain was not inserted. Layered wound closure was

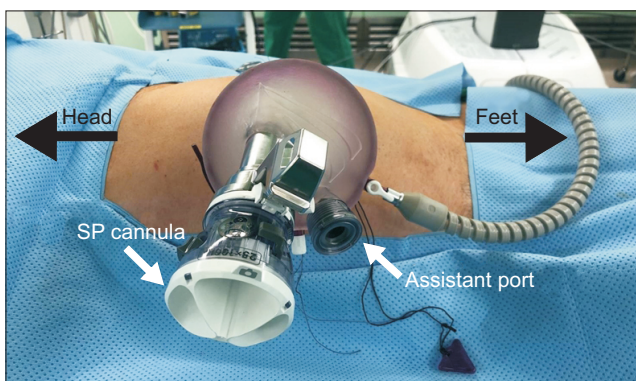


Fig. 1. Placement of the GelPOINT advanced access platform. A 25-mm multichannel port and a 12-mm assistant port were placed through the GelSeal cap.



Fig. 2. Placement of the instruments and docked single-port platform.

performed, and the skin was closed with a skin bond.

Preoperative variables, intraoperative surgical outcomes, and immediate postoperative complications were investigated. The Clavien–Dindo classification was used to grade the severity of postoperative complications [12].

## RESULTS

The procedures were successfully completed using a pure single-site approach. There was no need for additional port placement or conversion to laparoscopic or open surgery. The patients' demographic characteristics and perioperative data are shown in Table 1. Total operative time in the three patients was 139, 180, and 213 minutes, respectively. The third patient had a large parapelvic cyst and had undergone endopyelotomy with balloon dilation 3 years ago; marsupialization of the parapelvic cyst was performed at the same time, and there was a moderate adhesion near the uteropelvic joint. No intraoperative complications occurred, and blood loss was minimal. The postoperative course of all patients was uneventful with no complications greater than Clavien–Dindo grade I postoperative surgical complications. The cosmetic result was satisfactory (Fig. 3).

## DISCUSSION

We have validated the feasibility of pure single-site RAP performed using the da Vinci SP surgical system. For pyeloplasty, an elongated skin incision is not required

to collect the specimen and there are no oncologic risks associated with the procedure; thus, pyeloplasty is an option for suitable single-site surgery. Despite the technical difficulties associated with the procedures, single-site laparoscopic and robotic pyeloplasty have frequently been performed owing to the need for adequate cosmesis [6,7,13]. The main concern in single-site surgery is the loss of triangulation [7,8]; however, technologic advancements have aided in overcoming this problem.

The da Vinci SP surgical system was designed after development of the SP 999 and SP 1098 prototypes [14]. The da Vinci SP surgical system includes three double-jointed wristed instruments and a fully wristed three-

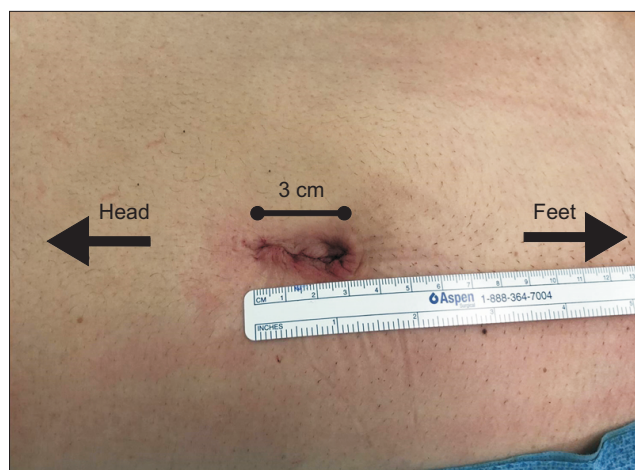


Fig. 3. Cosmetic result after skin closure.

Table 1. Patients' characteristics and perioperative data

Characteristic	Case no. 1	Case no. 2	Case no. 3
Age (y)	42	30	71
Sex	Male	Male	Female
Affected side	Left	Right	Left
Body mass index (kg/m <sup>2</sup> )	22.49	27.08	18.82
Preoperative eGFR (mL/min/m <sup>2</sup> )	91	108	43
Grade of UPJO	High	Low	High
Operative time (min)	139	180	213
Docking time (min)	5	10	10
Console time (min)	118	145	185
Suture time (min)	29	47	53
Intraoperative complications	No	No	No
Conversion to other surgery	No	No	No
Estimated blood loss (mL)	Minimal	Minimal	50
Discharge	POD 4	POD 3	POD 3
Postoperative eGFR (mL/min/m <sup>2</sup> )	105	113	81
Postoperative complications	No	No	No
Pain at discharge, NPIS score	2	2	3

eGFR, estimated glomerular filtration rate; UPJO, ureteropelvic junction obstruction; POD, postoperative day; NPIS, numerical pain intensity scale.

dimensional camera. This double-jointed instrument, called the “EndoWrist,” performs an “elbow” movement to provide triangulation. The double-jointed instruments, the camera, and the assistant’s 5-mm laparoscopic instrument are placed through a single multichannel port. The single arm enables 360° anatomic access.

Although the EndoWrist instrument provides elbow movement for achieving intracorporeal triangulation, the angle formed on curving the EndoWrist instrument is less than 90°, making proper spatulation of the ureter difficult to perform. Anastomotic suturing is not difficult. Moreover, the assistant experiences difficulty because of the limited working space, which is common with single-site surgery, and good coordination between the surgeon and the assistant is required. The surgeon should move the camera or instruments when the assistant’s instrument enters into the operation field for traction or suction. Therefore, an additional assistant port could be inserted in cases of high risk of bleeding or when many assists are required. Although an additional port was not used in the three cases described in this report, we inserted an additional port to use an EndoStapler for robot-assisted radical nephroureterectomy using the da Vinci SP surgical system.

There were some limitations to this study: namely, the small sample size and short follow-up duration. When the cases of conventional RAP performed by the same surgeon (W.S.J.) in a recent 1-year period were reviewed, the mean operative time was 136±53.0 minutes and the mean suture time was 38±9.0 minutes. If the surgeon becomes accustomed to performing surgery using the da Vinci SP surgical system, the operative time or suture time could be shortened by as much as conventional RAP. The functional outcomes of RAP using da Vinci SP surgical system are not yet confirmed because the imaging studies will be performed after removal of the double J stent 3 months after surgery according to our hospital protocol. However, the results of this preliminary study are promising. There were no cases of conversion or complications, which showed the feasibility and safety of pure single-site RAP with the da Vinci SP surgical system. Studies analyzing more patients and long-term outcomes are needed. To confirm our results, the treatment outcomes of RAP performed using da Vinci SP surgical system should be compared with those of conventional RAP or LESS pyeloplasty.

## CONCLUSIONS

Pure single-site RAP using the da Vinci SP surgical system is feasible and safe. Further studies involving more

## Robot-assisted pyeloplasty with a single-port system

patients and long-term outcomes are needed to confirm our results.

## CONFLICTS OF INTEREST

The authors have nothing to disclose.

## SUPPLEMENTARY MATERIAL

The supplementary video clip can also be accessed by scanning a QR code, or will be available on YouTube: <https://youtu.be/8WVgnxFLpAM>.



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