Robotic single-site myomectomy: initial report and technique

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Objective: To report the first cases of robotic single-site (RSS) myomectomy with the use of the Da Vinci Si Surgical System with wristed semirigid instrumentation.
Design: Case series.
Setting: University hospital.
Patient(s): Four patients with symptomatic uterine fibroids desiring conservative minimally invasive surgical treatment.
Intervention(s): Four RSS myomectomies were performed with the Da Vinci Single-Site platform. Data regarding patient characteristics, indication of surgery, and perioperative outcomes were collected.
Main Outcome Measure(s): Safety and reproducibility of RSS myomectomy.
Result(s): All RSS procedures were completed successfully. Median operative time was 210 minutes (range 202–254 min). Median blood loss was 103 mL (range 75–200 mL). No instrument failures were noted during the procedures. No operative or major postoperative complications occurred. Two patients were discharged on the day of surgery, and two were discharged after overnight observation.
Conclusion(s): RSS myomectomy with the use of wristed semi-rigid instrumentation is a feasible procedure. Indications, safety, and use of the technique will be confirmed by growing experience. (Fertil Steril® 2015;103:1370–7. ©2015 by American Society for Reproductive Medicine.)
Key Words: Robotic surgery, single-site surgery, myomectomy, morcellation

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Robot-assisted laparoscopic myomectomy (RM) has gained acceptance over the past decade as a safe and reproducible operation, with outcomes similar to those established for conventional laparoscopic myomectomies (LM) in terms of less blood loss, fewer complications, and shorter hospital stays compared with abdominal myomectomies (1–6). In addition, robotic assistance has allowed many surgeons to overcome some of the technical and ergonomic challenges posed by laparoscopy (6, 7). Nevertheless, there are still strides to be made in the field of computer-assisted surgery: One of these is miniaturization that can push the limits of the minimally invasive surgical approach. Currently, RM requires the placement of multiple operating channels through the anterior abdominal wall. These ports are often located higher on the abdominal wall than those used for conventional laparoscopic surgery, causing a cosmetic dilemma. Recent surveys demonstrate that conventional robotic incisions were the least preferred scar pattern by patients planning gynecologic surgery, whereas mini-lap and laparoendoscopic single-site (LESS) surgery scars were the most desired (8–10). Furthermore, given the tenuous future of electromechanical morcellation (following the United States Food and Drug Administration's (FDA's) stance against this technique for a majority of women) (11), alternate strategies for tissue extraction have become an essential component of RM. LESS myomectomy would appear to be an ideal solution to reduce the cosmetic impact of laparoscopic surgery while providing access for safe uterine tissue extraction. However, the extreme ergonomic challenges of conventional LESS in general, and of its suture-intensive applications in particular, have impeded the widespread application of this technology (12). Coaxial robot-assisted LESS myomectomy, using conventional rigid robotic instrumentation, has been described by our team as a possible alternative to conventional LESS myomectomy, but it remains a technically challenging operation with uncertain potential of widespread adoption (13). Dedicated robotic single-site (RSS) technology for the Da Vinci Si Surgical System (Da Vinci Single-Site; Intuitive Surgical) was approved by the FDA in 2013 for hysterectomy and adnexal surgery, and

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numerous teams have reported on its safety (14–18). However, owing to the absence of wristed instrumentation in the original Da Vinci Single-Site release, suture-intensive applications of this technology have never been described. We report an original technique for RSS myomectomy based on recently available wristed instrumentation.

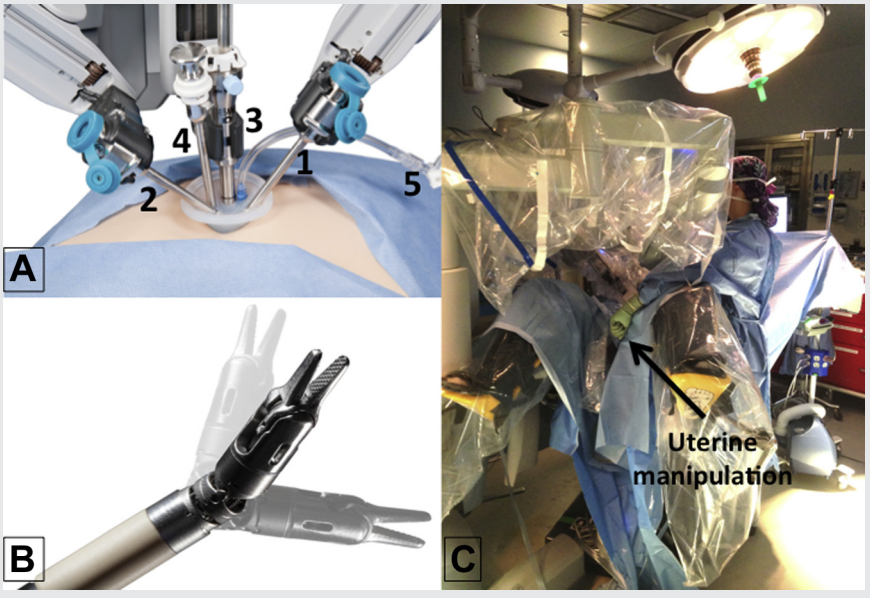
MATERIALS AND METHODS

Patients, Technology, and Surgeons

Four patients desiring a minimally invasive approach to fibroid removal with preservation of fertility underwent RSS myomectomy with the use of the dedicated Da Vinci Single-Site surgical platform for the Da Vinci Si Surgical System. The platform features a multiple-channel, single-port, silicone device that accommodates two curved cannulas for 5-mm semirigid robotic instruments, a cannula for an 8.5-mm high-definition stereolaparoscope, a 5-, 8-, or 10-mm assistant cannula, and a separate insufflation channel (Fig. 1A) The left and right robotic instrument cannulas cross each other laterally to medially within the silicone device, so that the instrument entering from the right of the patient becomes the left-sided operative instrument, and vice versa. The instruments are automatically reassigned by the robotic surgical system so that the right hand of the surgeon controls the left arm of the robot and vice versa, thereby eliminating the counterintuitive inversion of laterality. As mentioned above, the original set of dedicated semirigid robotic instruments for the Da Vinci Single-Site platform lacked two out of the seven degrees of freedom featured in conventional rigid robotic instruments. Namely, the pitch and yaw of the instrument tip were absent (whereas pitch and yaw of the instrument shaft, as well as rotation, insertion, and grip, were available). The absence of pitch and yaw at the tip of the original RSS instruments made it challenging to safely perform myoma enucleation and uterine wall reconstruction in layers. Because of this, myomectomy was never attempted on this platform by our experienced robotic team, nor have reports emerged of this procedure in the scientific literature to date. Wristed needle drivers for RSS, allowing all seven degrees of freedom, have recently become available. These instruments allow precise suturing at any angle of approach (Fig. 1B). Our operative technique for RSS myomectomy is based on the availability of these wristed instruments.

All cases were performed at Brigham and Women's Hospital's Center for Infertility and Reproductive Surgery in November and December 2014. Attending surgeons (A.R.G., S.S.S.) had >8 years of experience with the Da Vinci Surgical System and >1 year of experience with the dedicated RSS platform. Patient characteristics are summarized in Table 1. All submucosal myomata were International Federation of Gynecology and Obstetrics (FIGO) subclass 2 or 3, with the exception of a 1-cm FIGO subclass 1 myoma in patient 4, which was resected by means of concomitant hysteroscopy (19). All patients had been referred to the Center for Infertility and Reproductive Surgery to explore minimally invasive conservative surgical options for their uterine fibroids. Following our current protocol, all patients underwent magnetic resonance imaging of the pelvis, with and without gadolinium

FIGURE 1



(**A**) Final docking for Da Vinci Single-Site surgical platform. Multiple-channel single port with: 1 and 2) curved instrument cannulas; 3) cannula for 8.5-mm laparoscope; 4) assistant cannula; and 5) insufflation channel. Original image courtesy of Intuitive Surgical, used with permission. (**B**) Wristed needle driver. Original image courtesy of Intuitive Surgical, used with permission. (**C**) Demonstration of side docking during RSS myomectomy, which allows for access to uterine manipulation by a single bedside assistant.

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