

Robotic Incisional Hernia Repair After Robotic-assisted Radical Prostatectomy (RARP): A 3-port Approach

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Abstract. *Background/Aim:* Incisional hernia is a complication that occurs occasionally, and surgical intervention is required to prevent more severe sequela. While there are several options for management, robotic-assisted incisional repair has not been well discussed yet. We herein report a case series of 10 patients who underwent robotic-assisted incisional hernia repair (RIHR) after robotic-assisted radical prostatectomy (RARP). The aim of the study was to examine the feasibility of incisional hernia repair with da Vinci[®] robotics. *Patients and Methods:* We recruited patients from a group of 2,000 consecutive patients who underwent RARP from December, 2005 to June, 2020 by a single surgeon. Patient characteristics included age, body mass index (BMI), PSA level, pathology Gleason score, and pathology TNM staging. The variants regarding the patients' incisional hernia included incisional hernia occurrence time after RARP, defect size, operation time, console time, blood loss, and follow-up time after the herniation occurrence. Furthermore, we established a defect size of 3x2 cm² as the cutoff value for using mesh reinforcement or not. *Results:* The mean defect area was 27.7 cm², and the average operative time was 114.8 min, with a mean console time of 87 min.

Blood loss was 32.5 ml, and the hospital stay for all patients was 3 days without complications. The mean follow-up period was 29.5 months, with no recurrence. *Conclusion:* RIHR is a feasible surgical method that is not inferior to the traditional open or laparoscopic repair. Furthermore, RIHR can possibly lessen the burden of both the surgeon and patient.

With the growing prevalence of prostate cancer (1), prostatectomy has become a vital surgery. At the same time, the use of robotic-assisted procedures has gained greater acceptance in various surgeries, and robotic-assisted radical prostatectomy (RARP) has become one of the most adopted procedures (2). The pentapecta of RARP for localized prostate cancer is excellent in experienced hands (3). However, some inevitable complications and severe sequela may occur (4, 5): for example, trocar site infection and herniation after surgery, especially at the site of the umbilical wound where the RARP specimen was removed (4).

According to previous studies, the incisional hernia incidence rate is higher after RARP than with traditional open radical prostatectomy (6). Furthermore, current studies suggest that an incisional hernia could be repaired with either an open or laparoscopic method, both of which showed similar outcomes (7). Nevertheless, there are no clinical studies discussing robotic-assisted incisional hernia repair (RIHR), which turned out to show better results than the laparoscopic repair method in a simulated model (8).

As a result, it is reasonable to state that robotic-assisted incisional hernia repair (RIHR) has the potential to become widely used in the future. The goal of this study was to propose a 3-port surgical approach using da Vinci[®] robotics and previous port locations for surgical access to lessen the patient's recovery burden. This study aims to provide preliminary results of RIHR.

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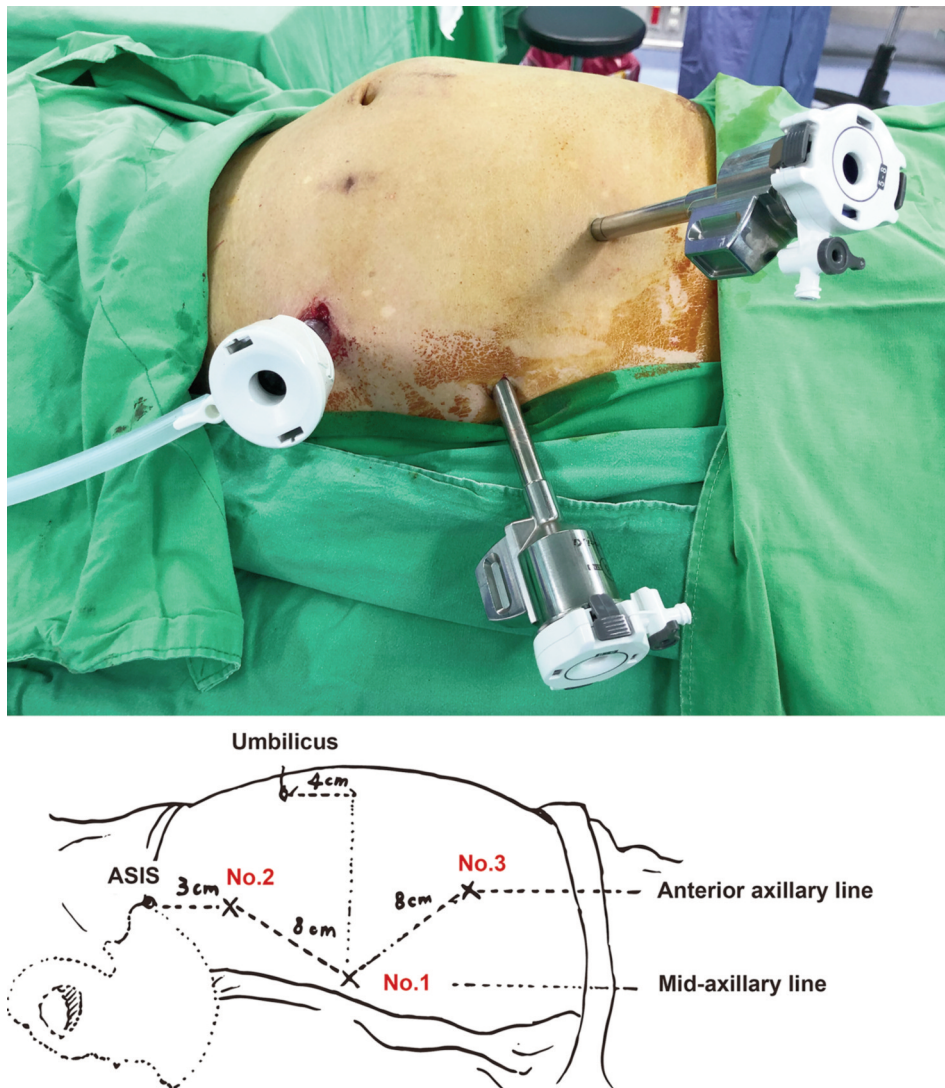


Figure 1. We sequentially located the camera site and the left and right instrument sites in a triangular position using the patient's umbilicus and ASIS as landmarks. After insertion of the camera port, a pneumo-peritoneum with pressure of 12-15 mm Hg was first created by CO₂ insufflation.

Patients and Methods

Patient recruitment. In this retrospective case series study, we focused on an observation group that consisted of 2,000 patients who underwent RARP performed by a single high-volume robotic surgeon (Y.C. OU) from December 2005 to June 2020, and the majority of patients maintained follow-up after surgery. We recruited 10 of the patients who experienced incisional herniation and underwent robotic hernia repair using the da Vinci Si or Xi robotic system (Surgical Intuitive, Sunnyvale, CA, USA) between February 2015 and June 2020.

The distinct patient variables evaluated in this study included age, body mass index (BMI), prostate specific antigen (PSA) level, pathology Gleason score, and pathology Tumor, Lymph node, Metastasis (TNM) staging. The parameters for the herniation repair included incisional hernia occurrence time after RARP, defect size,

operation time, console time, blood loss, and follow-up time after the herniation occurrence.

Surgical technique. The patient was placed in the supine position, arms tucked in to the sides. Beanbag and shoulder pads can be used to protect the patient. Trocar porting was carried out at the patient's left lateral abdominal area. We first located a point that was at the intersection of 2 lines. The horizontal line was at the level of 4 cm superior to the umbilical, and the mid-axillary line was the vertical line. We used an 8-mm trocar to set port No.1 (camera port), and CO₂ insufflation with pressure set at 12-15 mm Hg was used to create a pneumo-peritoneum. Then, we used an 8-mm trocar to set port No. 2 along the ASIS vertical line at a point that was 8 cm apart from port No.1. In fact, ports No.1 and No.2 were at the operative scar of the previous RARP. Last, we used an 8-mm trocar to set port No.3 on the anterior axillary line at a point

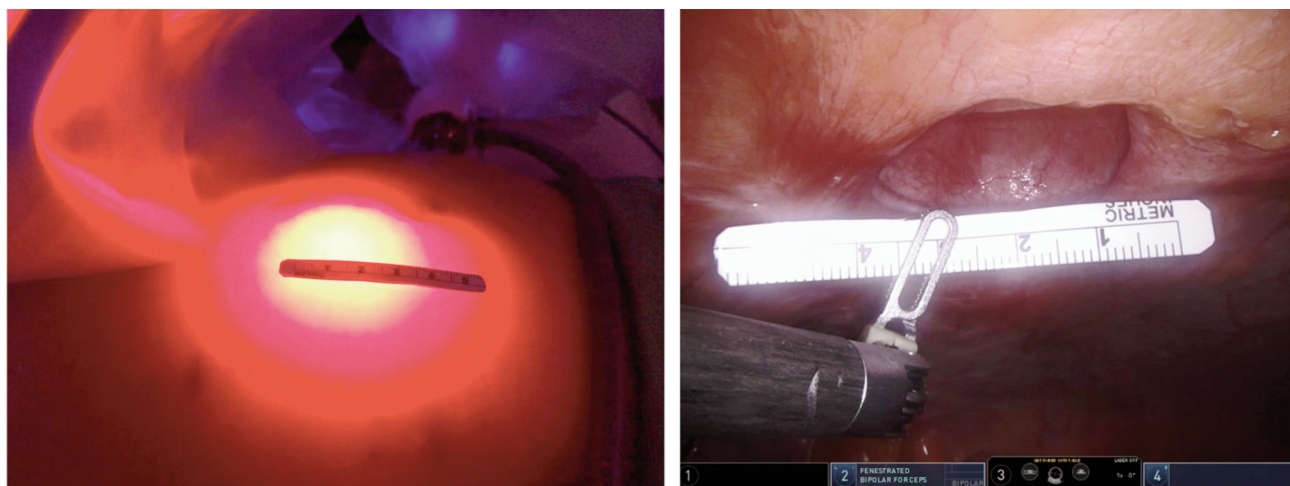


Figure 2. Measurement of the hernia defect size from the outside and inside of the patient's abdomen using a ruler.

that was also 8 cm apart from port No.1, to form a triangular position (Figure 1).

During surgery, port No.1 was the camera port. Port No.2 was the robotic left working port, and we mainly chose EndoWrist Fenestrated Bipolar Forceps for both the forceps and coagulation function. Port No.3 was a hybrid port which would accommodate both a right-hand instrument and the assistant's laparoscopic instruments. In this port, we used an Endowrist Large SutureCut Needle Driver for needle holding and cutting use, while the laparoscopic instrument could deliver mesh or suture, if needed. At the beginning, all of the patients' herniation defects were measured from both outside and inside the abdominal wall, with camera illumination (Figure 2). After identifying the fascial defect, we used the measurement of the defect to assist in further treatment decisions: if the defect was smaller than or equal to 6 cm^2 , for example $3\times 2\text{ cm}^2$, as we proposed, direct closure could be enough. However, if the defect was larger than $3\times 2\text{ cm}^2$, repairing with mesh (Bard® Composix™ L/P Mesh) was highly suggested. Moreover, we could use Covidien V-Loc™ 15 cm 2-0 sutures for re-approximation first to ensure the quality of the repair. For mesh localization in larger defects, we adopted a chandelier method that placed the Ethicon Vicryl violet CT-1 taper 2-0, approximately 12 cm in length, at the center of the mesh, and hooked the other end to the center of the defect (Figure 3). Afterwards, we lessened pneumo-peritoneum pressure to 8 mm Hg and the edge of the defect was sutured to the rim of the mesh with Covidien V-Loc™ 15 cm 2-0 sutures (Medtronic, London, UK), using a GS-21 taper needle for continuous running sutures. An optional Weck® Hem-o-lok® 2-0 (Teleflex, NC, USA) was added for stability if needed. Otherwise, as the defect was of a small size (6 cm^2), we simply used 2-0 V-Loc for circumferential suturing over the fascia to close the defect. In both situations, no drainage tube was placed and the trocar sites were closed carefully.

Results

A total of 10 patients were included in the study (Table I). The mean age was 70.3 years, and the average BMI was 26.9 kg/m^2 .

Table I. Comparison of preoperative clinical characteristics of 10 cases who underwent robotic-assisted hernia repair.

Case No.	Age	Body mass index (BMI)	Prostate specific antigen (PSA)	Pathology Gleason score	Staging
1	65	25.39	7.14	3+4=7	T3a
2	72	28.12	15.98	4+5=9	T3a
3	65	27.01	7.67	4+3=7	T2b
4	78	26.43	74.00	4+5=9	T3b
5	64	31.22	3.56	3+3=6	T1b
6	68	24.39	5.30	3+4=7	T2c
7	63	27.88	54.09	4+3=7	T3b
8	74	24.96	26.10	4+5=9	T2b
9	71	25.35	9.05	3+4=7	T1b
10	83	28.28	18.07	4+3=7	T3a
Mean	70	26.90	22.10	7.5	
Median	70	26.72	12.52	7	
SD	7	2.05	23.61	1.08	
Minimum	63	24.39	3.56	6	
Maximum	83	31.22	74.00	9	

All patients experienced incisional hernia after RARP, and all underwent hernia repair using the da Vinci® robotic system.

The average defect size of the herniation was 27.7 cm^2 . All 10 patients underwent robotic herniation repair. Seven of the 10 patients underwent repair with mesh, and 3 were sutured without mesh, as the defect size was smaller than or equal to 6 cm^2 . We chose Bard® Composix™ L/P Mesh for these procedures. The average operative time was 114.8 min, with an average console time of 87 min. Estimated blood loss during surgery was 32.5 ml. The blood loss for 7 patients was less than 5 ml, but we calculated it as 5 ml to account for the actual undetected blood loss. We

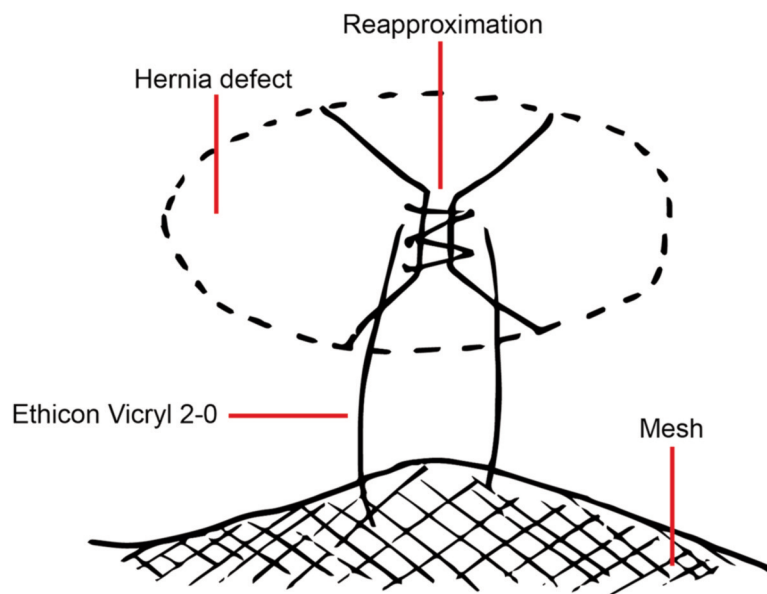
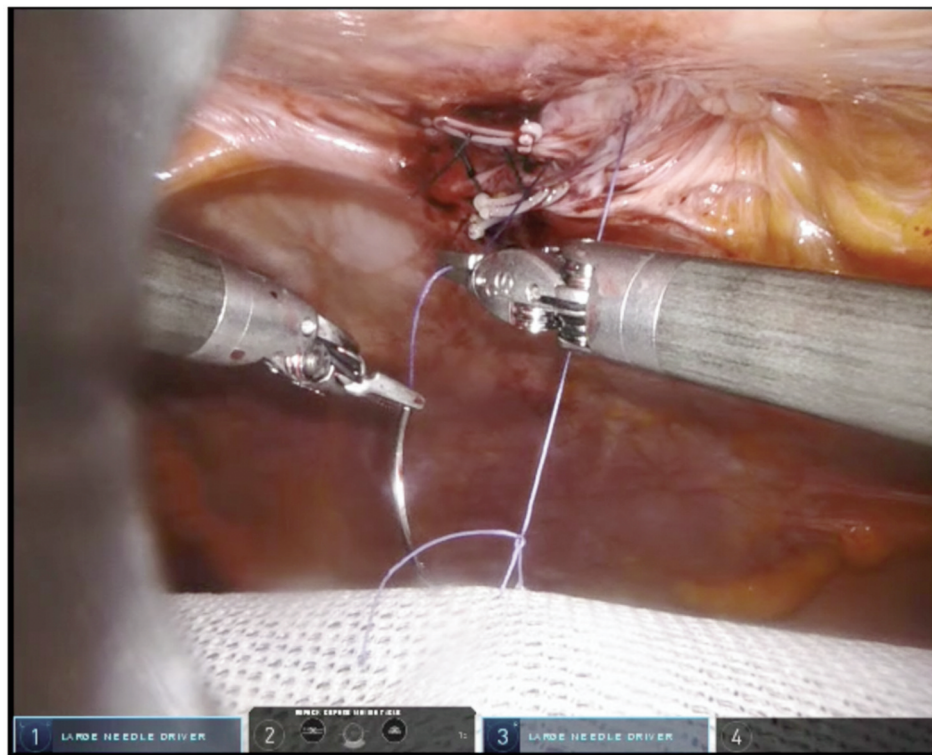


Figure 3. For a larger defect, we first re-approximated the defect. Then, we used the chandelier method to hook both the center of the defect and the mesh with Ethicon Vicryl 2-0.

encouraged ambulation as soon as possible after surgery, once the patient had clear consciousness. The mean hospital stay was 3 days with the following clinical pathway: the first day was for pre-operative preparation, the second day for the RIHR procedure, and the third day for discharge, if appropriate. All 10 patients were discharged without any

complications, such as infection, hemorrhage or urine retention, on postoperative day 1.

Before discharge, we educated the patients on activity restrictions, such as avoiding lifting things heavier than 4.5 kg for at least 6 weeks after the operation. An abdominal binder was routinely used for the patient's comfort (9). After

Table II. Characteristics of the 10 incisional hernia repair procedures.

Case No.	Defect area, length×width (cm ²)	Occurrence timing (months)	Operation time (min)	Console time (min)	Blood loss (ml)	Mesh	Follow-up time (months)
1	5×4=20	12	70	45	<5	15×10	48
2	7×5=35	4	210	180	140	15×10	48
3	3×2=6	4	218	180	100	–	38
4	5×4=20	9	150	120	50	10×15	38
5	5×4=20	6	95	65	<5	10×15	48
6	13×8=104	5	95	65	<5	15.9×21	28
7	6×5=30	5	95	75	<5	15×10	30
8	3×2=6	6	45	20	<5	–	25
9	5×6=30	6	80	50	<5	15×10	7
10	3×2=6	2	90	70	<5	–	5
Mean	27.7	6	115	87	32.5		31.5
Median	20	6	95	68	5		34
SD	28.3	3	59	55	49.1		16
Minimum	6	2	45	20	5		5
Maximum	104	12	218	180	140		48

discharge, all the patients maintained regular follow-up at the OPD every 2 months, with a mean follow-up period of 31.5 months. There has been no recurrence, as of this writing.

Discussion

This is the first clinical study to discuss the outcome of incisional repair using da Vinci[®] robotics. Our case series showed promising results with no recurrence and a relatively lower complication rate than previous studies of traditional and laparoscopic methods (10). Furthermore, blood loss and hospital stay were not significantly different from that of the 2 other methods. However, operation time was longer if the surgical port set-up time was included. Nevertheless, by dividing the patient group into first and second halves, we could see that there was a significant learning curve. Operation time for the first 5 patients was 148.6 min, and that for the second 5 patients was 81 min.

A previous study using a training model implied that RIHR could be better than the laparoscopic method in terms of reducing the mental and physical effort of the surgeons (8). We propose using RIHR as a routine method, since no significant disadvantage was found and its use could possibly provide a better working experience for the surgeon.

For the standard for mesh reinforcement, we proposed 3×2 cm² as a cutoff value for several reasons. First, as the previous literature suggests, incisional hernia repair in all patients ought to be done with mesh (11). However, other studies state that mesh usage is related to a higher rate of infection or late-onset adhesion (12, 13). As a result, we do not routinely use mesh with all defect sizes so as to lessen the overall complication rate. Second, we propose that direct closure of a smaller defect is safer when the defect is more

oval, rather than a circular shape. That is, the width of the defect should not be longer than 2 cm, based on the surgeon's experience with previous herniation repair cases and the situation each time.

And for suturing, we used the slowly-absorbable (180 days) Covidien V-Loc[™] 15 cm 2-0 sutures for fascia closure based on a previous meta-analysis of midline abdominal incisions that suggests slowly-absorbable sutures to be more preferable than non-absorbable ones (12, 14).

Moreover, the 3-port approach can be achieved using multi-functional instruments and hybrid ports with laparoscopic instruments delivering required materials such as sutures or mesh into the abdomen. With this, we reduced the number of trocar sites, wound healing time, and efforts by the patients. In our experience, this approach has not caused any additional iatrogenic surgical complications due to the fewer ports and the subsequently limited visual field.

Last but not least, previous studies revealed a higher rate of incisional hernia after RARP than after the open method (4, 13). Among the 2,000 patients who underwent RARP from a single doctor (Y.C. OU), the incidence of incisional hernia was only 0.9% (18/2000). While the 18 patients included 10 patients who underwent robotic-assisted incisional hernia repair and 8 patients opted for traditional open-method repair. Hence, we suggest that the incidence rate could be lower with RARP if it is performed by a high-volume surgeon. Furthermore, a study suggested that horizontal closure of the fascia could significantly reduce the complication rate of incisional hernia (15). However, in our study, we still followed the old way by vertically suturing the fascia, and it turned out that there was no difference in the post-RARP incisional hernia rate in when the procedure was performed by an experienced surgeon.

In this study, we reported a 3-port approach that can lessen the operational burden for the patients. All operations were performed by a single doctor, which could therefore reduce the technique bias due to individual differences. And, we presented another option for incisional hernia repair, with the hope that this could promote more studies in robotic-assisted hernia repair. Nevertheless, we acknowledge the limitations of this study, including a patient number too small to establish statistically valid evidence for the outcomes of this surgical approach. Another factor that cannot be neglected is the higher cost for da Vinci® system. However, we regard RIHR to be an effective and safe procedure that has a potential to develop its own advantages over traditional approaches.

Conclusion

In patients who have experienced post-RARP incisional hernia, the adoption of robotic-assisted hernia repair surgical approach showed fulfilling results in various aspects.

Conflicts of Interest

The Authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript. There are no conflicts of interest.

Authors' Contributions

Design and conception: YCO, HCO. Drafting of manuscript: HCO, YCO. Acquisition of data: LHH, MCT, WCW, TYT. Critical revision: CYH, YSL, CHL. Statistical analysis: KHC.

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