The Robotic-Assisted Laparoscopic Pyeloplasty
Gateway to Advanced Reconstruction

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KEYWORDS

• Ureteropelvic junction obstruction • Minimally invasive surgery • Robotic pyeloplasty
• Urinary tract reconstruction

KEY POINTS

- Robotic pyeloplasty in children with ureteropelvic junction obstruction is safe and effective.
- Robotic approaches can be tailored to the size of the child and the anatomy of the pathology.
- Knowledge of the available instrumentation and the robotic platform is critical for successful repairs.
- Future studies are needed to assess the patient centered outcomes of robotic pyeloplasty in children.

INTRODUCTION

Historically, open pyeloplasty has been the standard treatment of congenital or acquired ureteropelvic junction (UPJ) obstruction in adults and children, with overall success rates of 90% to 100%.[1–3] Although endopyelotomy[4,5] and retrograde dilation[6] are alternative methods of managing UPJ obstruction in children, the success of these two procedures is inferior to that reported for definitive surgical repair.[7] Advances in technology over the last 2 decades have led to the introduction of laparoscopic and robot-assisted laparoscopic pyeloplasty.

Kavoussi and Peters[8] and Schuessler and colleagues[9] independently reported the first successful laparoscopic pyeloplasty for adults with UPJ obstruction in 1993. With a success rate of more than 95%,[10] the magnification provided by laparoscopy improves visualization and control. However, the operative times for conventional laparoscopic pyeloplasty are higher than open pyeloplasty in most series.[11,12] Additionally, laparoscopic suturing, particularly for children, is challenging and time consuming and has a steep and long learning curve because of its technical difficulty.

Robotic surgery mitigates many of the problems of conventional laparoscopy because of the precision of the movements of the robotic arms, ease in suturing, and 3-dimensional visualization. Consequently, robotic pyeloplasty may be easier to learn than conventional laparoscopic pyeloplasty.[13] Robotic pyeloplasty is now commonly performed for children with UPJ obstruction.[14]

INDICATIONS/CONTRAINDICATIONS

The robotic platform is a surgical tool that facilitates pyeloplasty and other reconstructive

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urologic operations. The indications for robotic-assisted laparoscopic pyeloplasty are the same as those for an open pyeloplasty. These indications include

- Increasing hydronephrosis
- Progressive deterioration of renal function
- Recurrent urinary tract infection in the setting of obstruction
- Symptoms (pain, nausea/vomiting, hematuria)

Robotics increases operative efficiency compared with conventional laparoscopy and facilitates more complex reconstructive procedures, such as ureterocalicostomy for redo surgery as well as a primary modality for extreme cases of intrarenal collecting systems, which are covered later in this review.[15,16]

Although the indications for robotic pyeloplasty are the same as for open repair, the size and age of the child should be considered when using a robotic approach. When conventional laparoscopic pyeloplasty for children was first introduced, it was primarily performed on children older than 1 year, but improvements in instrumentation and surgeon experience have made laparoscopic pyeloplasty feasible in infants less than 6 months of age.[17] The robotic platform, which increases the range of motion and overcomes many limitations of laparoscopic surgery, has also been safely used to perform pyeloplasty in children 3 to 12 months old (6–11 kg).[18,19]

However, contraindications to robotic pyeloplasty exist (Table 1).

TECHNIQUE/PROCEDURE

Patient Positioning

After induction of general anesthesia, a regional anesthetic can be administered. The authors have found low-dose intrathecal morphine to be a safe and effective means of postoperative pain control.[20] An orogastric tube should be placed.

Table 1
Contraindications to robotic pyeloplasty

Absolute Contraindications	Relative Contraindications
Untreated urinary tract infection	Prior intra-abdominal operations
	Small intrarenal pelvis (see "Difficult scenarios")
	Long ureteral stricture (see "Difficult scenarios")
	Small infant <6 kg

The authors do not place a stent before the pyeloplasty; but should one elect to do so, cystoscopy and stent placement can be done at this time. A Foley catheter is placed. The child is then positioned on the operating table in a modified flank position at a 45° to 60° angle with the affected kidney side up. A beanbag is used to support patients during the operation. The bed is flexed to create maximal separation of the distance between the iliac crest and inferior border of the 12th rib. An axillary roll customized to the size of the child is placed inferior to the contralateral axilla. The downside arm is positioned at a 90° angle to the body using an arm board. The ipsilateral arm is positioned in line with the body in a neutral position so that the anterior aspect of the arm is at the midaxillary line. The upper leg is fully extended and the lower is flexed at the knee. Gel pads are placed at all pressure points, and pillows are placed between the legs. Patients are secured to the table with tape applied below the knee, at or just below the hip, and just below the nipple line.

TECHNIQUE/PROCEDURE

Port Placement and Instrument Selection

A broad-spectrum intravenous antibiotic (eg, cefazolin) is given. Intraperitoneal access is obtained through the umbilicus using the technique with which the surgeon is most comfortable (eg, Hasson vs Veress needle). An 8.5-mm port is placed; pneumoperitoneum is obtained to a pressure of 10 mm Hg and a flow of 6 L/min. Laparoscopy is performed. Two 5-mm or 8-mm robotic ports are then placed. The superior trocar is placed in the midline between the umbilicus and the xiphoid. In infants, it may be necessary to place this trocar just inferior to the xiphoid. The inferior trocar is placed lateral to the rectus in the midclavicular line or more medial in small infants or in children with large renal pelves. Adjustment of port placement is necessary based on the anatomy of the UPJ and size of the child because of the smaller working environment compared with adolescents and adults. Although the pneumoperitoneum in adults will provide a 5- to 6-L working space, a 1-year-old boy will present a 1-L intra-abdominal space.[21] Consequently, the more limited working distance can restrict the mobility of the camera and instruments, and the chance of port site conflicts or trocar headpiece collisions is greater. Additionally, the thinner abdominal wall of children, especially infants, increases the probability that the trocar can be inadvertently dislodged. The authors limit the chance