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# Laparoscopic Disconnected Pyeloplasty to Treat Ureteropelvic Junction Obstruction (UPJO) in Children

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**Background:** The aim of this study was to assess the safety and clinical effectiveness of laparoscopic disconnected pyeloplasty in treating ureteropelvic junction obstruction (UPJO) in children.

**Material/Methods:** We retrospectively analyzed the clinical data of 122 young children with UPJO treated from February 2015 to February 2018 at our hospital. According to the surgery type, the patients were divided into 2 groups: a laparoscopic surgery group (group A, n=69) and a traditional open surgery group (group B, n=53).


**Results:** The success rate of laparoscopic disconnected pyeloplasty was 100%, and none of the patients were converted to open surgery. The mean duration of use of painkillers was  $27.6 \pm 11.3$  h in group A and  $58.2 \pm 18.2$  h in group B ( $p=0.012$ ), the postoperative hospital stay was  $7.8 \pm 1.5$  days in group A and  $11.5 \pm 2.6$  days in group B ( $p=0.041$ ), and the length of the incision was  $1.5 \pm 0.4$  cm in group A and  $5.2 \pm 1.1$  cm in group B ( $p=0.007$ ). The incidence rate of poor surgical wound healing was 0% in group A and 7.5% in group B ( $p=0.020$ ). The incidence rate of ureteral stricture was 4.3% in group A and 3.8% in group B ( $p=0.874$ ) during follow-up. The 1-year follow-up showed that both the anterior and posterior diameters and glomerular filtration rate were significantly improved from the preoperation period.

**Conclusions:** Laparoscopic disconnected pyeloplasty to treat UPJO in young children has the same early clinical effectiveness and safety as open surgery, and this procedure has the advantages of minimal trauma, quick recovery, and good cosmetic effect.

**MeSH Keywords:** **Laparoscopy • Only Child • Urology Department, Hospital**

**Abbreviations:** **UPJO** – ureteropelvic junction obstruction; **GFR** – glomerular filtration rate; **CTU** – computed tomography urography; **ECT** – emission computed tomography

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## Background

UPJO is one of the most common congenital urinary malformations of infants and is also the main cause of hydronephrosis in children. UPJO can cause severe renal function damage and even endanger children's lives [1–4]. There are many methods used to treat UPJO, including pyeloplasty and antero-grade or retrograde endoluminal stenosis incision or dilation. Long-term follow-up studies have established dissected pyeloplasty as the criterion standard for treatment of UPJO due to its high success rate and good clinical effect [1,5]. The traditional open pyeloplasty technique is advanced and effective. However, open surgery has some disadvantages, including a long incision, slow recovery, and a large scar. In recent years, with the development and maturity of laparoscopic technology, laparoscopic disconnection pyeloplasty, with the advantages of minimal trauma, fine surgical control, rapid postoperative recovery, and good cosmetic effect, has become increasingly popular in clinical practice and has achieved good clinical results [6–10]. To summarize the clinical experience and evaluate the safety and effectiveness of laparoscopic disconnected pyeloplasty, we retrospectively analyzed the clinical data of 122 patients with UPJO treated in our hospital from February 2015 to February 2018.

## Material and Methods

This study was approved by the Ethics Committee of our university and strictly adhered to the tenets of the Declaration of Helsinki. All the patients' guardians signed an informed consent form before the operation.

### Patients

We retrospectively analyzed the clinical data of 69 patients with UPJO (group A) who underwent laparoscopic disconnected pyeloplasty at our hospital from February 2015 to February 2018. A total of 53 patients with UPJO (group B) who were admitted during the same time period and underwent traditional open

pyeloplasty at our hospital were selected as the control group. All the patients' preoperative clinical data are shown in Table 1. There were no statistically significant differences between the 2 groups in sex, unilateral or bilateral UPJO, age, body weight distribution, anterior and posterior diameter of the affected renal pelvis, or GFR of the affected renal pelvis, which indicated that the 2 groups were homogeneous and comparable. The diagnosis of UPJO was confirmed in all patients according to their clinical manifestations, computed tomography urography (CTU)/magnetic resonance urography, renal emission computed tomography (ECT), and urinary color Doppler ultrasonography. Although ultrasound and renal ECT are good choices for use in diagnosis of UPJO, we still perform CTU routinely before the operation because the whole ureter can be clearly displayed and the location and length of stricture can be displayed more accurately by three-dimensional reconstruction of CT, which is very beneficial to assess the location of ureter stricture during the operation, and allows us to see more accurately whether there are ureteral strictures at other sites. Magnetic resonance urography can display the same content as CTU without radiation, but it takes a longer time, which requires a higher level of sedation and the cost is much higher; when the parents asked for no radiation, we would choose it. All the patients were followed up for 1 year. The follow-up content was the result of urinary colour Doppler and renal ECT.

The inclusion and exclusion criteria were the same in both groups. Patients met the inclusion criteria if they presented with UPJO. Patients were excluded from this study if they: 1) had other urinary malformations, such as vesicoureteral reflux, ureteral stricture at other sites, or renal duplication; 2) were in a poor overall condition, such as having severe hepatic and renal insufficiency; 3) had recurrent UPJO; or 4) parents refused to sign the consent form for surgery or refused to comply with the follow-up schedule.

All surgeries in this study were performed by 1 chief physician who had performed more than 200 laparoscopic surgeries and 25 laparoscopic disconnected pyeloplasty surgeries as of February 2015.

**Table 1.** Comparison of preoperative clinical data in 2 groups.

Item	Group A	Group B	p Value
Number of patients	69	53	
Age (year)	2.8±2.1	3.1±2.9	0.536
Boy/girl	48/21	39/14	0.627
Body weight (kg)	14.6±4.7	16.9±5.1	0.703
Unilateral/bilateral	65/4	50/3	0.974
Anterior and posterior diameter of Affected renal pelvis (cm)	4.1±0.9	4.4±0.7	0.884
GFR of affected renal pelvis (mL/min)	45.7±15.8	42.7±19.4	0.612



Figure 1. The position of 3 trocars.

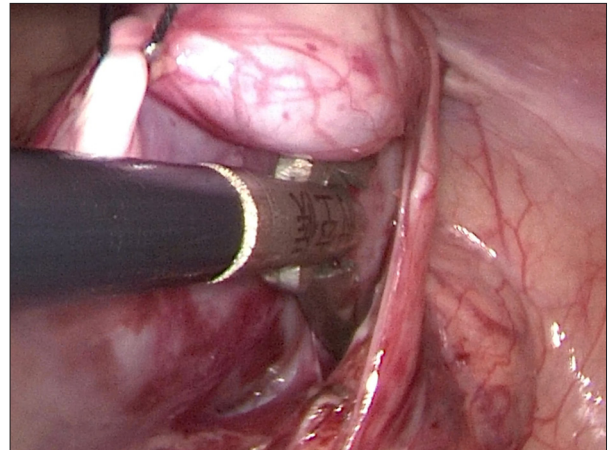


Figure 2. Exposure of the junction of the renal pelvis and ureter.

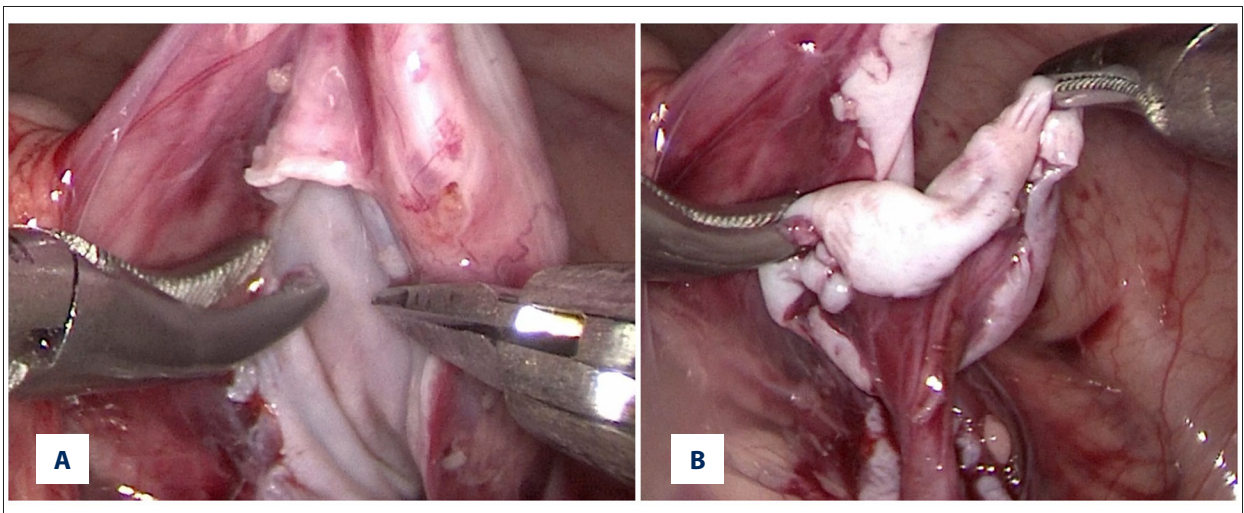
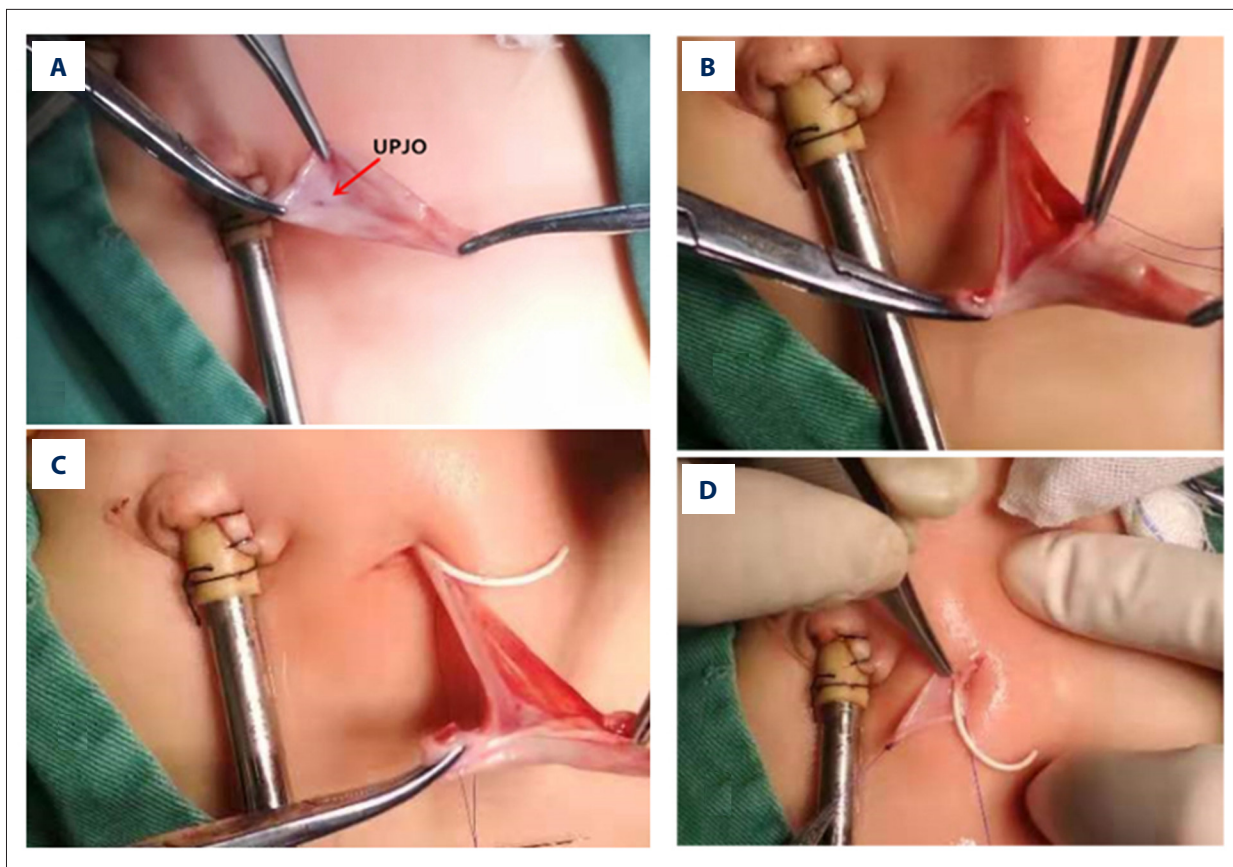


Figure 3. (A) Pruning renal pelvis. (B) Disconnecting the junction of the renal pelvis and ureter.

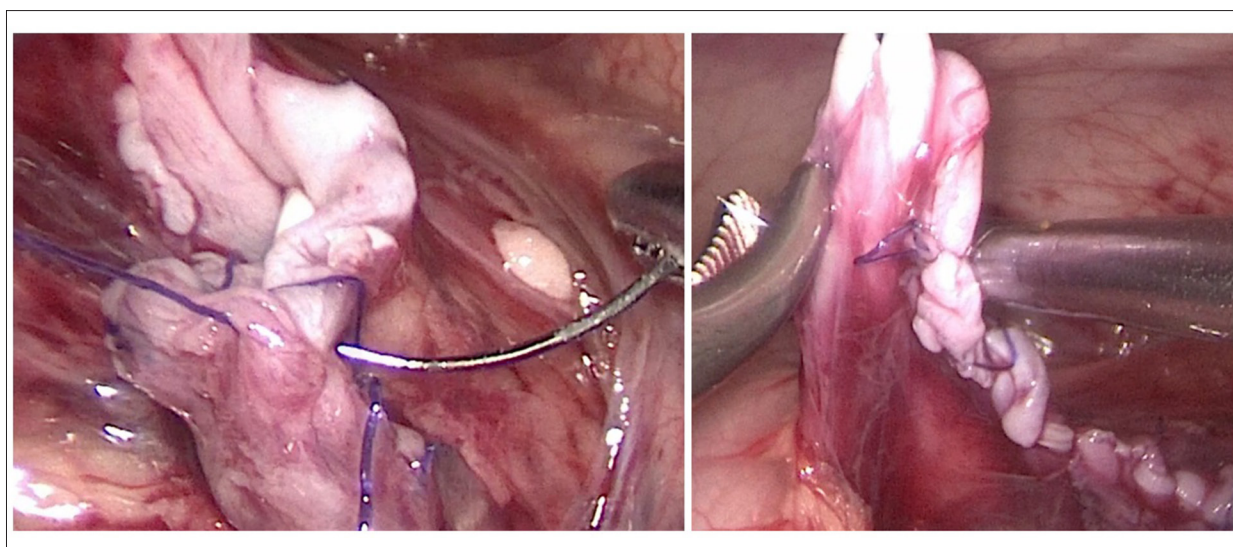
### Laparoscopic disconnected pyeloplasty

After anaesthesia, the patient was placed in supine position with the affected waist and back slightly raised (30°) using a pad, and we routinely disinfected and draped the surgical area. The umbilical skin was incised approximately 0.5 cm, layer-by-layer, and a 5-mm trocar was placed directly into the abdomen to establish a pneumoperitoneum (10 mmHg). The 5-mm trocar was placed in the area of the 4-cm lower rib margin of the midline clavicle and the lateral inferior margin of the rectus abdominis muscle of the umbilical region under the guidance of laparoscopy (Figure 1). We positioned the head high and foot low with the bed tilted at reverse 30°. Then, we explored whether the affected side's renal pelvis was oval-shaped in the retroperitoneum. The mesentery and the back peritoneum were cut by an electric hook, and the leading edge of the renal pelvis was found; then, the perirenal tissue was gradually released. After the upper edge of the anterior wall of the renal pelvis was lifted with a 2-0 Mousse line

from the abdominal wall to fully expose the renal pelvis, we found that the renal pelvis was obviously dilated. We found that the upper ureter was curled and the junction had a stricture, after fully exposing the junction of the renal pelvis and ureter (Figure 2). The renal pelvis was shaped, and the junction was cut by scissors (Figure 3). The ureter and junction were presented from the nearest trocar to the surface of the body after releasing the peritoneal gas. The narrow segment was cut from the outer side of the ureter to the distal side by a longitudinal line. An appropriately-sized D-J tube was placed into the tube. Then, we cut the narrow segment and formed a ureter with a 2-cm length of tongue flap (Figure 4). The urine dripped out of the D-J tube after the bladder was pressed. At the lowest point of the ureter, a needle was suspended on the medial side of the ureter with the line of 5-0 PDS, and the tongue flap was suspended by a needle with the line of 5-0 PDS. After reconstructing the pneumoperitoneum and sending the ureter back to the abdominal cavity, we sutured the lowest point of the renal pelvis and ureter and stitched the



**Figure 4.** (A) Placing the ureter and the junction to the body surface and finding the stricture. (B) Longitudinal clipping from the distal end of ureter. (C) Placing an appropriately-sized D-J tube. (D) The narrow segment was excised and the tongue flap was formed.



**Figure 5.** Stitching the ureter tongue flap and the anterior and posterior walls of the renal pelvis.

ureter tongue flap and the anterior and posterior walls of the renal pelvis with the 5-0 PDS line (Figure 5). We sufficiently stopped the bleeding, released the suspension line, returned

the renal pelvis and ureter to the retroperitoneal cavity, and closed the retroperitoneal incision. The abdominal cavity was washed with saline, and the drainage tube was inserted from

**Table 2.** Comparison of perioperative clinical data in 2 groups.

Item	Group A	Group B	p Value
Operative time (min)	143.8±26.7	121.3±21.1	0.486
Volume of bleeding (ml)	5.6±1.8	16.4±4.9	0.015
Time of removing abdominal drainage tube (d)	1.7±0.8	2.2±0.9	0.719
Time of removing D-J tube (week)	8.1±1.5	7.8±1.9	0.836
Time on painkillers (h)	27.6±11.3	58.2±18.2	0.012
Postoperative hospital stay time (d)	7.8±1.5	11.5±2.6	0.041
Hospital costs (10000 RMB)	3.1±0.8	2.7±0.6	0.347
The incision length (cm)	1.5±0.4	5.2±1.1	0.007
Converted to open surgery	0		

the trocar orifice near the umbilical area to drain. Then, we closed the incision layer-by-layer.

### Traditional open disconnected pyeloplasty

After anaesthesia, the patient was placed in a supine position with the affected waist and back slightly raised (30°) using a pad, and we routinely disinfected and draped the surgical area. We positioned the head high and foot low and the bed was tilted at reverse 30°. A 5-cm longitudinal transverse incision was made in the upper abdomen from the margin of the rectus abdominis muscle to the axillary front line. We cut the skin, the subcutaneous tissue, the aponeurosis of the extraabdominal oblique muscle, the musculus obliquus internus abdominis, and the transverse abdominis muscle and pushed the peritoneum inward. Then, we cut the perirenal fascia out of the peritoneum and separated the fat sac to expose the lower kidney, the renal pelvis, and the ureter. We checked that the renal pelvis was clearly dilated, and the pyeloureteral junction was strictured. The ureteropelvic junction and the expanded renal pelvis were cut. The ureter at the narrow section was cut off, and the outer side of the upper ureter was cut approximately 2 cm. A 5-0 PDS line was used to stitch the ureter and the anterior and posterior walls of the renal pelvis, and the D-J tube was placed before completion of the anastomosis. After sufficient hemostasis and rinsing the wound and indwelling drainage tube, we closed the incision layer-by-layer.

### Statistical analysis

Continuous data are presented as the mean±standard deviation and range. The normal distribution test was carried out on all data, and the non-parametric test was used for data that did not conform to normal distribution. Clinical parameters between the 2 groups were compared with the independent-samples *t* test. The  $\chi^2$  or Fisher's test was used to categorize the variables. A *P* value of <0.05 was defined as statistically significant.

## Results

The success rate of laparoscopic disconnected pyeloplasty was 100%, and none of the patients were converted to open surgery. We placed an abdominal drainage tube in all patients. Compared with group B, group A did not have statistically significant differences in operative time, time of removing abdominal drainage tube, time of removing the D-J tube, and hospital costs (*P*>0.05). The amount of bleeding, time using painkillers, time of postoperative hospital stay, and incision length were shorter (or lower) in group A than in group B (*P*<0.05) (Table 2).

No bleeding, urinary fistula, or retroperitoneal hematoma were reported in either group. The incidence rate of poor surgical wound healing was 0% in group A and 7.5% in group B (*p*=0.020). The incidence rate of urinary tract infection was 8.7% in group A and 9.4% in group B (*p*=0.888). During postoperative follow-up, the incidence rate of ureteral stricture was 4.3% in group A and 3.8% in group B (*p*=0.874). Because there were no obvious clinical symptoms, the patients with ureteral stricture were still observed but received no special treatment (Table 3).

The urinary color Doppler and renal ECT examination at 1-year follow-up showed that the anterior and posterior diameters (group A: 1.3±0.4 cm, group B: 1.2±0.6 cm, *P*: 0.891) and GFR (group A: 58.1±7.8 mL/min, group B: 56.8±9.1 mL/min, *P*: 0.785) of the affected renal pelvis were not significantly different between the 2 groups (*P*>0.05), but they were significantly improved from the preoperation period.

## Discussion

UPJO is a stricture of the junction between the pelvis and ureter due to various causes. It is a common congenital ureteral disease with an incidence of 1/600 to 1/800; it can cause various

**Table 3.** Postoperative complications compared between 2 groups.

Item	Group A	Group B	p Value
Bleeding	0	0	
Urinary fistula	0	0	
Retroperitoneal hematoma	0	0	
Anastomotic stricture	3	2	0.874
Urinary tract infection	6	5	0.888
Poor surgical wound healing	0	4	0.020

symptoms, signs, and damage of renal function [11]. There are many methods of treatment, and the main purpose of surgery is to remove the lesion site, relieve obstruction, relieve symptoms, and protect renal function [12,13]. Dismembered pyeloplasty is a classical procedure for the treatment of UPJO. At present, according to the different surgical approaches, there are many surgical methods, such as the anterior abdominal approach, subcostal small incision through the waist and 12 ribs, paravertebral mini-incision, laparoscopic approach, and retrolaparoscopic approach [14–16]. With the popularization of laparoscopic technology and the advent of laparoscopic devices for use in children, laparoscopic disconnected pyeloplasty is effective and has achieved the same success rate as traditional open surgery [17,18]. Laparoscopic surgery has the following advantages: (1) The visual field is clearer, so we can deal with tissue separation and disconnection more finely, which can reduce trauma and promote recovery; (2) Careful identification of blood vessels can avoid damage to them, and we can also clearly observe bleeding vessels so that rapid haemostasis can be achieved, reducing the amount of bleeding; (3) With the magnification of the surgical field, we can more accurately suture the pyeloureteral junction, reducing scar-induced strictures; and (4) The wound is small and the recovery speed is faster. In the laparoscopic group, we found a smaller volume of bleeding, a shorter duration of painkiller use, shorter postoperative hospital stay, and shorter scar length than those in the open surgery group (all,  $P < 0.05$ ).

Although there are many advantages, laparoscopic surgery has a certain learning curve, especially the infant laparoscopic operation in which the space is smaller, the surgical instruments are smaller, and the calibre of the ureter is smaller; as a result, the operation is more difficult. The management of pyelopelvic junctions is a difficult point in the whole operation, and it is also especially important, affecting the success or failure of the operation. Basically, the problem in all reoperation patients is management of the pyelopelvic junction [19,20]. Because the laparoscopy operation is performed using surgical equipment, there is not a high sensitivity of manual operation or accurate tactile feedback. The resistance of the distal segment of the ureter cannot be accurately detected during

the placement of the D-J tube, so the stricture of the distal segment of the ureter cannot be detected in time, or complications caused by puncture of the ureter may occur. Because the trocar placed into the D-J tube is far from the opening of the ureter, the direction of the trocar is not well-controlled, which causes the guide wire in the abdominal cavity to become longer and more tortuous. When the D-J tube is inserted into the abdominal cavity through the trocar, it is easy to slide from the proximal ureter. During the operation, we pulled the ureter out of the puncture hole, handled the narrow segment with the hands, and placed the D-J tube under direct vision, which greatly reduced the difficulty of the operation and shortened the operation time. In addition, the time required to open and close the abdomen was shorter than that of the traditional operation. Therefore, there was no significant difference in the operative time between the laparoscopy group and the traditional open group in this study ( $P > 0.05$ ). The upper segment of the ureter should be loosened properly before pulling it out, which not only makes it easy to pull out but also can effectively avoid excessive tension during the ureteropelvic anastomosis.

After both open surgery and laparoscopic surgery, the main complications are anastomotic leakage and anastomotic stricture [21]. The occurrence of anastomotic leakage is usually due to the lack of strictness of the anastomosis under laparoscopy, internal stent blockage or moving, and anastomotic restenosis, mostly caused by anastomotic paralysis scars [22]. The risk of anastomotic leakage and restenosis can be minimized by skilled suturing, avoiding clamping, and pulling the anastomotic tissue during the suturing process, using the principle of longitudinal incision and transverse suturing to ensure the anastomotic stoma is wide and smooth, good blood flow and no tension anastomosis, indwelling D-J tube use routinely after the operation, unobstructed internal stent drainage, and keeping low-pressure bladder drainage with an indwelling catheter [23]. In this study, 5 patients developed an anastomotic stenosis, and they were still followed up by observation, with no special treatment given because there were no obvious clinical symptoms.

The clinical data at the 1-year follow-up showed that the anterior and posterior diameter of the renal pelvis and the GFR improved to different degrees in both groups, but there was no significant difference between the 2 groups, which indicated that both groups achieved good early clinical effectiveness, and the clinical effectiveness was similar.

There are several limitations in this study. First, this was a single-center, retrospective study with a small sample size. Prospective randomized controlled study from multiple centers with larger samples are needed to assess the effectiveness and complications of this technique in the future. Second, the topic of the treatment for patients under 1 year of age with UPJO is very important and interesting, and we plan continue to study this topic in future research. Third, the follow-up period of this study was brief, and a longer-term follow-up period is needed.

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## Conclusions

Laparoscopic disconnected pyeloplasty to treat UPJO in children has the same early clinical effectiveness and safety as open surgery, and this procedure has the advantages of minimal trauma, quick recovery, and good cosmetic effects.

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## Conflict of interests

None.