ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.61745/tss.1804663

Minimally Invasive Open Pyeloplasty in Children with Ureteropelvic Junction Obstruction: Is There a Need for a Perianastomotic Drain?

Canan KOCAOĞLU[1]
Department of Pediatric Surgery, Necmettin Erbakan University, Faculty of Medicine Konya, Türkiye

Üreteropelvik Bileşke Obstrüksiyonu Olan Çocuklarda Minimal İnvaziv Açık Piyeloplasti: Perianastomotik Drenaja İhtiyaç Var mıdır?

ABSTRACT

Objective: Ureteropelvic junction obstruction (UPJO) is the most common cause of obstructive uropathy or hydronephrosis in childhood. The most effective treatment for children with UPJO is open pyeloplasty. The purpose of this study was to present the possibility of minimally invasive open pyeloplasty with a double-J stent and without a perianastomotic drain as an outpatient procedure in children with UPJO.

Methods: A retrospective evaluation was performed in 46 children with a median age (IQR) of 3 (7) years who underwent pyeloplasty for UPJO between June 2007 and January 2022. Age, gender, imaging studies, surgical techniques, trans-anastomotic stent, drain applications, complications, and length of hospital stay were noted. Pre-operative studies included ultrasonography (USG), diuretic renography, and magnetic resonance urography (MRU). Indications for surgery were an increasing degree of hydronephrosis on USG, less than 40% differential renal function, and significant obstruction defined as more than 10% functional loss on serial renal scintigraphy. Minimally invasive open pyeloplasty was performed retroperitoneally by separating the muscles with a mini flank incision without pelvic reduction. No perianastomotic drain was used when the trans-anastomotic double-J stent was applied.

Results: Open pyeloplasty and minimally invasive open pyeloplasty were performed in 15 and 31 [33 renal units (RU)] cases, respectively. The median hospital stay (IQR) was 120 (48) hours in 15 cases, while this period was 22 (5) hours in 31 cases that underwent minimally invasive open pyeloplasty with a double-J stent and without a peri-anastomotic drain (P<.01). Of 31 cases, 24 were discharged after <24 (mean 21 hours) hours. All patients underwent multiple USG and diuretic renography, while 28 pati-ents underwent only one MRU. A significant positive correlation was found between USG and MRU.

Conclusion: We suggest that minimally invasive open pyeloplasty with a double-J stent and without a perianastomotic drain can be safely performed as an outpatient procedure in children with UPJO.

Keywords: Children, double-J stent, hydronephrosis, open pyeloplasty, ureteropelvic junction obstruction

ÖZ

Amaç: Üreteropelvik bileşke tıkanıklığı (UPJO), çocukluk çağında obstrüktif üropati veya hidronefrozun en sık görülen nedenidir. UPJO'lu çocuklarda en etkili tedavi yöntemi açık piyeloplastidir. Bu çalışmanın amacı, UPJO'u olan çocuklarda ayaktan tedavi yöntemi olarak JJ stentli ve perianastomotik dren uygulamaksızın, minimal invaziv açık piyeloplasti olasılığını sunmaktır.

Received/ Geliş Tarihi 16.10.2025
Revision request/Revizyon Talebi 27.10.2025
Son Revizyon/Last Revision 29.10.2025
Accepted/Kabul Tarihi 18.11.2025
Publication Date/Yayın Tarihi 11.12.2025

Sorumlu Yazar/Corresponding author:
Canan KOCAOĞLU
E-mail: drckocaoglu@hotmail.com
Cite this article: Kocaoğlu C. Minimally Invasive Open Pyeloplasty in Children with Ureteropelvic Junction Obstruction: Is There a Need for a Perianastomotic Drain? *Trends Surg Sci*. 2025;4(3):90-96. 10.61745/tss.1804663

Yöntemler: Haziran 2007 ile Ocak 2022 tarihleri arasında üreteropelvik bileşke obstrüksiyonu nedeniyle piyeloplasti geçiren, ortanca yaşı ve çeyreklik aralık (IQR) 3 (7) yıl olan 46 çocukta retrospektif bir değerlendirme yapıldı. Yaş, cinsiyet, görüntüleme yöntemleri, cerrahi teknikler, transanastomotik stent, drenaj uygulamaları, komplikasyonlar ve hastanede kalış süresi kaydedildi. Ameliyat öncesi çalışmalar ultrasonografi (USG), diüretik reno-grafi ve manyetik rezonans ürografiyi (MRU) içeriyordu. Ameliyat endikasyonları USG'de artan hidronefroz derecesi, %40'tan az diferansiyel böbrek fonksiyonu ve seri böbrek sintigrafisinde %10'dan fazla fonksiyonel kayıp olarak tanımlanan önemli obstrüksiyondu. Minimal invaziv açık pyeloplasti, pelvik redüksiyon uygulanmadan, kaslar mini flank insizyonu ile ayrılarak retroperitoneal olarak gerçekleştirildi. Trans-anastomotik JJ stent uygulanırken perianastomotik dren kullanılmadı.
Bulgular: Açık pyeloplasti ve minimal invaziv açık pyeloplasti sırasıyla 15 ve 31 [33 renal ünite (RU)] olguda gerçekleştirildi. Ortanca hastanede kalış süresi (IQR) 15 olguda 120 (48) saat iken, JJ stentli ve perianastomotik dren uygulanmayan minimal invaziv açık pyeloplasti uygulanan 31 olguda bu süre 22 (5) saatti ($P < ,01$). Bu 31 olgunun 24'ü 24 saatten (ortalama 21 saat) önce taburcu edildi. Tüm hastalara çoklu USG ve diüretikli renografi yapılırken, 28 hastaya sadece bir MRU uygulandı. USG ile MRU arasında pozitif anlamlı korelasyon bulundu.
Sonuç: Üreteropelvik bileşke obstrüksiyonu olan çocuklarda perianastomotik dren olmadan JJ stentli minimal invaziv açık piyeloplastinin ayaktan tedavi yöntemi olarak güvenle uygulanabileceğini öneriyoruz.
Anahtar kelimeler: Çocuklar, JJ stent, hidronefroz, açık piyeloplasti, üreteropelvik bileşke obstrüksiyonu

INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is the most common cause of obstructive uropathy or hydronephrosis in childhood. Surgery is considered only if there is evidence of progressive increased grade of hydronephrosis or decreased renal function.[1-3]

Open dismembered pyeloplasty is the gold standard in the treatment of UPJO. Many minimally invasive procedures for UPJO have been explored in recent decades due to the postoperative pain and morbidity caused by the large muscle incision. Some studies have compared open surgery with minimally invasive procedures such as laparoscopic pyeloplasty and robotic-assisted pyeloplasty.[4,5] However, there are certain limitations to these minimally invasive procedures, including age, more difficult techniques, a longer learning curve, and the need for expensive equipment.[6-9] Therefore, minimally invasive open pyeloplasty has come to the fore again. Minimally invasive open pyeloplasty was performed through a retroperitoneal flank mini-incision without pelvic reduction.[10-12] In addition, there has recently been a general trend toward reducing the length of hospital stays for many surgical procedures, thus reducing costs.

The purpose of this study was to present the possibility of minimally invasive open pyeloplasty with a double-J stent and without a perianastomotic drain as an outpatient procedure in children with UPJO.

METHODS

Underwent pyeloplasty due to UPJO between June 2007 and January 2022, 46 children were enrolled in the study. Demographic data, ultrasonography (USG), diuretic renography and magnetic resonance urography (MRU) findings, surgical techniques, trans-anastomotic stent and peri-anastomotic drain applications, the length of hospital stay, complications, and results of operations were retrospectively assessed. Ectopic kidneys, a differential renal function of less than 10%, and a history of unsuccessful pyeloplasty were the exclusion criteria.

It is an advantage of our study that all operations were performed by a single surgeon. In the study, the cases were divided into two groups according to the procedure developed over time based on our clinical experience. Between 2007 and 2013, patients who underwent open pyeloplasty were named as group I. Between 2013 and 2022, those exposed to minimally invasive open pyeloplasty were named group II.

Surgical technique: We performed flank incisions in all of the cases with a retroperitoneal approach to the kidney and ureter.

Group I (Open pyeloplasty): Open pyeloplasty was performed by moving the pelvis outside the body through the large muscle-cutting incision described by Andersen and Hynes.[13] The length of incisions was 4-6 cm. Percutaneous 5 Fr or 6 Fr feeding tubes or cut-down catheters with extra side holes created with scissors were passed from the anastomosis. Some of them nephrostomy stents were placed too. A perianastomotic Penrose drain was placed.

Group II (Minimally invasive open pyeloplasty): While performing minimally invasive open pyeloplasty, patients were stationed in a flank position, and 1.5-3.5 cm incisions were made off the tip of the 12th rib. Following this, the muscles were split. The peritoneum was mobilized medially. Gerota's fascia was opened, and the dilated renal pelvis was grasped with sutures. UPJO could be mobilized to the skin level almost with no failure. Further retraction was seen as unnecessary because a standard dismembered pyeloplasty was performed.[10] If UPJO was not easily seen initially, or if the pelvis was tensely distended, a 21-gauge needle was inserted, and urine was aspirated. The method involved

excising the dilated pelvis, if necessary. The proximal ureter was spatulated to a length of nearly 1.5-2 cm in a standard manner after the excision of UPJO. All anastomoses were stitched with 5-0 and 6-0 polydioxanone sutures. Before the anastomoses were completed, an antegrade ureteral double-J stent was applied. No perianastomotic drain was placed.

In our procedure, at the beginning of the operation, a Foley catheter was placed in all patients. At the end of the operation, 0.5% of local bupivacaine hydrochloride was injected into the incision region for subcutaneous nerve block of all patients for pain control, except for one patient receiving local anesthesia consisting of spinal nerve blocks as the anesthesiologist's preference. Post-operative pain management was provided with oral ibuprofen or paracetamol. Oral nutrition was started at the post-operative 3rd hour. The patients were discharged following Foley catheter removal. Double-J catheters were removed on the 30th post-operative day. All patients undergoing dismembered pyeloplasty procedures were followed up for one year. Ultrasound and urine analysis were performed on day 10 and months 1, 3, 6, and 12 after surgery. A successful outcome was described as the regression of hydronephrosis grading in the case of no clinical symptoms, while a failure was defined as no improvement in hydronephrosis after the operation or the existence of persistent clinical symptoms. Approval was obtained from the local ethical board of committee of Necmettin Erbakan University. (Registration number and date:2025/6009 and 26.09.2025). Surgical consent was obtained from the parents of the patients who participated in our study.

Statistical Analysis

Statistical analyses were performed using SPSS for Windows, release 22.0 (IBM SPSS Corp., Armonk, NY, USA). Descriptive statistics are presented using non-parametric methods. The appropriateness of variables to normal distribution rates was evaluated with visual histograms and probability graphics using analytic methods such as Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive analyses were shown using median and interquartile range (IQR) for abnormal variables and frequency tables for ordinal variables, and statistical significance was accepted as $P<.05$. The study was approved by the local ethics committee.

RESULTS

Of the 46 [48 renal units (RU)] cases that underwent the open pyeloplasty procedure, 37 (80.4%) were boys and 9 (19.6%) were girls. Median operation age (IQR) of 3 (7) years for the entire study group (min: 2, max: 156 months). The involvement of left, right, and bilateral kidneys was present in 30 (65.2%), 14 (30.4%), and 2 (4.3%) cases, respectively. The causes of UPJO were crossing vessels in 9 (19.6%) cases.

All patients were exposed to USG and scintigraphy within the pre-operative period. The anterior-posterior pelvic diameter was measured as ≥40 mm in 16 RU, between 30-39 mm in 18 RU, and 20-30 mm in 14 RU on pre-operative USG. The contributions to glomerular filtration rate were found to be ≥50 mL/min in nine, between 40-49 mL/min in 22, between 30-39 mL/min in nine, and ≤ 29 mL/min in eight RU in 48 RUs undergoing pre-operative renal scintigraphy. Of 28 RUs exposed to pre-operative MRU, grade II hydronephrosis was observed in six RUs, while grade III and IV hydronephrosis was seen in 17 and five RUs, respectively.

The increases in hydronephrosis on USG and/or the decreases in renal function on scintigraphy, as well as critical obstruction or accompanying anomalies on MRU, formed our operational indications. A significantly positive correlation was found between USG and MRU findings about hydronephrosis grading ($r=.797$, $P<.01$). However, five of nine crossing vessels were detected preoperatively through MRU. Among all cases, open pyeloplasty was performed in 15 patients, while minimally invasive open pyeloplasty was performed in 31 (33RU) cases. All cases had a urethral Foley catheter placed at the beginning of the procedure, and no narcotic analgesics were given to any patients in the postoperative period. While a trans-anastomotic feeding tube or cut-down catheter and a Penrose drain for draining out of the anastomosis were placed in 15 of the patients exposed to open pyeloplasty in group I. Five of them had percutaneous nephrostomy stents placed.

Percutaneous nephrostomy stents and trans-anastomotic catheters were removed from the patients in group I on an average of the 4.8th day, while Foley catheters and Penrose drains were pulled on the average 6.3rd and 5.8th days, respectively. Anastomotic leakage was observed only in one of the patients in group I and healed spontaneously with no intervention. In addition, during the post-operative follow-ups, it was observed that ureteropelvic obstruction was not corrected in another case in group I, and re-operation was performed for this case. Spiralization was seen in one of the other cases in group I, and this patient was re-operated on. Open pyeloplasty was successful in 13 (87%) patients.

Only double-J stents were placed in all of the 31 cases undergoing minimally invasive open pyeloplasty in group II. Foley catheters were removed from group II patients on average on the 1.3rd day. Double-J stents were seen to migrate toward the ureter in two cases, and they were removed with the help of mini URS. In another case, a displaced double-J stent was observed from the urethra to

the outside and was placed again with the help of a guide wire and pusher catheter in group II. During post-operative follow-ups, UPJO was determined to be persistent in a single case. We wished to re-operate on this case, but the patient came out of our follow-ups. UTI was defined only in one patient, while no UPJO leakage or wound infections were observed in any of the patients. Although no Penrose drain was placed, no urinoma was detected in any patient on the USG performed on the 10th day in group II. Minimally invasive open pyeloplasty was successful in 30 (97%) patients.

The median (IQR) age was 5 (8) years and 1.9 (7) years in groups I and II, respectively (*P*>.05). Seventeen of the group II cases were younger than 12 months. Mean operation times were 108.1 and 74.5 minutes in groups I and II, respectively. The operation time for the patients in group I was significantly longer than that of group II patients (*P*<.01). The median length of hospital stay (IQR) for 15 cases was 120 (48) hours (min-max 92-360 hours) in group I. However, the median length of hospital stay (IQR) for 31 cases was 22 (5) hours (min-max 16-72 hours) in group II. Of these 31 cases, 24 were discharged in <24 (mean 21 hours) hours (77%). The mean length of hospital stay for the cases in group II was significantly shorter than that of group I cases (*P*<.01) (Table 1).

Table 1. Demographic data and distribution of patients' characteristics.

	Group I	Group II	*P*
N	15	31	
No gender, male/female	11/4	26/5	
Median (IQR) age years	5 (8)	1.9 (7)	>.05
Younger than 12 months n	4 (27%)	17 (55%)	
Side Left/Right	12/6*	20/10*	
Mean operative time in minutes	108.1	74.5	<.01[a]
Mean stay of hospital days (IQR)	120 (48)	22 (5)	<.01[b]
Discharged in <24 hours	-	24 (77%)	
Success rate %	87	97	

IQR: interquartile range. [a] chi-square test. [b] Mann–Whitney U test. *One on bilaterally.

DISCUSSION

Since Anderson and Hynes[13] originally described open pyeloplasty in 1949, it has been the gold-standard procedure for surgically correcting UPJO in children. Due to the lengthy recovery period, cosmetic adverse effects, and muscle-cutting lumbar incision, open dismembered pyeloplasty is frequently associated with significant postoperative pain and morbidity.

For this reason, minimally invasive open pyeloplasty, which does not require large muscle incisions, has begun to be performed. Kajbafzadeh et al.[14] reported 373 infants treated with miniature pyeloplasty as a minimally invasive surgery with an average age of four months and a 100% success rate. They discharged the cases within 18±3 hours. On the other hand, Chacko et al.[10] performed minimally invasive open pyeloplasty on 74 children, 34 of whom were younger than 1 year old, and 100% were discharged within 23 hours. Similarly, in our study, 77% of the patients who underwent minimally invasive open pyeloplasty were discharged before 24 hours, and 17 of the 31 cases were younger than 1 year of age. On the other hand, Sharifiaghdas et al.[11] presented 109 children, whose mean ages were two years and eight months, had open pyeloplasty with a miniature incision. Despite the minimally invasive pyeloplasty, the average length of hospitalization was 3 days (2–8 days).

Because of postoperative pain and morbidity, numerous minimally invasive procedures for UPJO have been investigated in the last decades. With the further development of laparoscopic procedures and, more recently, robot-assisted procedures, minimally invasive pyeloplasty has gained popularity. González et al.[4] conducted a multicenter prospective study on a total of 332 patients. Of these, while 62 underwent open pyeloplasty, 86 and 174 underwent laparoscopic,and robotic-assisted laparoscopic pyeloplasty respectively. They found shorter postoperative hospital stays for open pyeloplasty 5 (3-13) days, laparoscopic pyeloplasty 3 (1-12) days, and robotic-assisted laparoscopic pyeloplasty 1 (1-11) day and lower morbidity in laparoscopic and robotic-assisted laparoscopic pyeloplasty patients, but operative times were longer. In our study, the patients who underwent minimally invasive pyeloplasty were discharged from the hospital in a median of 22 (5) hours postoperatively, which is even shorter than the three groups of González et al.[4] On the other hand, there are studies showing that laparoscopic pyeloplasty has a shorter hospital stay than open pyeloplasty. The primary advantage of laparoscopic pyeloplasty over open pyeloplasty, according to Bonnard et al.[15], was a shorter hospital stay (2.4 days vs. 5 days, *P*=.05). In the study by Kutikov et al.[3], in patients under six months old, this was lowered to 1.2 days with robotic-assisted laparoscopic

pyeloplasty. Additionally, Lee et al.[2] reported a shorter hospital stay with robotic-assisted laparoscopic pyeloplasty than open surgery (2.3 days vs. 3.5 days, *P*=.001). Again, Cascini et al.[6] reported a shorter hospital stay with laparoscopic and robotic-assisted laparoscopic pyeloplasty versus open pyeloplasty (2.2 days vs. 3.2 days, *P*<.01). In our study, this period was significantly shortened to 22(5) hours. Another study reported that the results obtained with the minimally invasive open pyeloplasty technique challenged the current trend in the literature that laparoscopic pyeloplasty techniques are superior in terms of length of hospital stay and postoperative narcotic use.[10] In addition, there has recently been a general trend toward reducing the length of hospital stay for many surgical procedures, thus reducing costs.[16] The advantages of outpatient operations for the family, child, and the healthcare system are well known.[17] In our study, patients were discharged in a short time of 22 hours. This reduces anxiety for both the family and the child and greatly reduces hospital costs.

Despite the popularity of laparoscopic and robot-assisted laparoscopic surgery, pyeloplasty in children younger than one year is difficult because of the small region and the requirement for appropriate surgical equipment.[2,18] Thus, it is still debatable whether open pyeloplasty is better for these infants. Vauth et al.[19] performed open pyeloplasty on 162 infants under 1 year of age and achieved successful results. The mean hospital stay was 5.2 days. In our study, 17 of 31 cases were younger than 1 year old and discharged in less than 1 day. In another study, Dönmez et al.[20] applied regional anesthesia to all patients on whom they performed open pyeloplasty. They administered acetaminophen and ibuprofen for pain control. They reported that in selected patients, outpatient pyeloplasty could be performed with a plan for oral postoperative analgesia to be applied at home. In our study, subcutaneous nerve block was performed on all patients. Post-operative pain management was provided with oral ibuprofen or paracetamol.

Whether UPJO should be diverted post-operatively and, if diversion is chosen, how the renal pelvis is drained still remains controversial. The majority of surgeons favor external drainage, the transparenchymal route for nephrostomy, or another stent drainage.[21] The best drainage technique is still controversial though, particularly for young infants whose ureters are relatively narrow. In routine practice, most surgeons prefer placing trans-anastomotic stents into the ureter, percutaneous nephrostomy tubes into the renal pelvis, and Foley catheters into the bladder following pyeloplasty.[22] We also applied the same procedure for group I patients between 2007 and 2013. However, placing a tube or an external stent has some disadvantages, such as pain for the patient, renal parenchymal injury, hemorrhage, infection, and ongoing leakage surrounding the tube and patient discomfort.[23,24] As parallel to the increase in our experience, various developments also took place in our surgical procedures. We waived the percutaneous nephrostomy, percutaneous trans-anastomotic stents, and Penrose drains after pyeloplasty performed since 2013. We used only a trans-anastomotic double-J stent to place into the ureter and Foley catheter insertion into the bladder. To date, we have encountered no complications because of not performing percutaneous nephrostomy. Although a Penrose drain was not placed, no urinoma was detected in any patient on the USG performed on the 10th day in group II. No life-threatening complications have arisen, except for migrating double-J stents toward the ureter in two cases and persistence of UPJO in a single case. We consider that minor complications, such as migrating double-J stents toward the ureter and urinary infections, are more tolerable compared to the placement of nephrostomy. In the study of Le et al.[23], where diversion techniques were assessed using feeding tubes, it was stated that urine leakage was seen as a complication in three of 122 patients exposed to both percutaneous nephrostomy and trans-anastomotic stent placement. In our series, UPJO leakage was observed only in a single patient in group I, and it healed spontaneously with no intervention. In another study, Jayasimha et al.[25] also reported that after pediatric pyeloplasty, proximal migration of double-J stents is an uncommon complication that can be successfully managed with a stepwise approach including both antegrade and retrograde techniques. Those with partial migration (meaning a migrating stent in the ureter) underwent successful ureteroscopic retrieval in three of eight cases, while those migrating into the upper tract were percutaneously removed with the help of a nephoscope. Similarly in our study, however, partial migration of the stent was observed only in two of 31 patients in group II. These two stents were easily removed by the transurethral route with the help of mini URS. No matter which pyeloplasty is performed, whether it is open pyeloplasty, laparoscopic, or robotic, in many studies a perianastomotic Penrose drain or minivac drain is placed, which prolongs the hospital stay until the drain is removed.[10-12,14,19,26-29] Percutaneously placed trans-anastomotic or perianastomotic drains both disrupt the child's comfort and cause anxiety in families. In our study, only the placement of a double-J stent and the absence of a Penrose drain allowed the patient to be discharged early.

Additionally, the following could be suggested as the limitations in our study. There are not enough cases to make definitive conclusions. The study non-randomized and retrospective. In fact, randomized trials comparing the procedure laparoscopic pyeloplasty or robotic-assisted

pyeloplasty and minimal invasive open pyeloplasty should be performed.

CONCLUSION

In light of our 15 years of experience, it can be said that outpatient pyeloplasty is possible, especially in infants younger than 1 year of age who have undergone minimally invasive open pyeloplasty. Antegrade trans-anastomotic double-J stent placement eliminates the need for a perianastomotic drain. In addition to its advantages, such as shorter hospital stays and better patient comfort, outpatient pyeloplasty also seems to have an advantage in reducing costs.

Ethics Committee Approval: Ethics committee approval was obtained from Necmettin Erbakan University Local Ethics Committee (Date: September 26, 2025, Number: 2025/6009).
Informed Consent: Surgical consent was obtained from the parents of the patients who participated in our study.
Peer-review: Externally peer-reviewed.
Conflict of Interest: The author have no conflicts of interest to declare.
Financial Disclosure: The author declared that this study has received no financial support.
Use of Artificial Intelligence: The author declared that artificial intelligence was not used.

Etik Komite Onayı: Etik kurul onayı Necmettin Erbakan Üniversitesi Yerel Etik Kurulu'ndan (Tarih: 26.09.2025, Sayı: 2025/6009) alınmıştır.
Hasta Onamı: Çalışmamıza katılan hastaların ebeveynlerinden cerrahi onam alındı.
Hakem Değerlendirmesi: Dış bağımsız.
Çıkar Çatışması: Yazar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazar, bu çalışma için finansal destek almadığını beyan etmiştir.
Yapay Zeka Kullanımı: Yazar yapay zeka kullanmadığını beyan etmiştir.

REFERENCES

1. Yeung CK, Tam YH, Sihoe JD, Lee KH, Liu KW. Retroperitoneoscopic dismembered pyeloplasty for pelvi-ureteric junction obstruction in infants and children. *BJU Int.* 2001;87(6):509-513.
2. Lee RS, Retik AB, Borer JG, Peters CA. Pediatric robot assisted laparoscopic dismembered pyeloplasty: comparison with a cohort of open surgery. *J Urol.* 2006;175(2):683-687.
3. Kutikov A, Nguyen M, Guzzo T, Canter D, Casale P. Robot assisted pyeloplasty in the infant-lessons learned. *J Urol.* 2006;176(5):2237-2239.
4. González ST, Rosito TE, Tur AB, et al. Multicenter comparative study of open, laparoscopic, and robotic pyeloplasty in the pediatric population for the treatment of ureteropelvic junction obstruction (UPJO). *Int Braz J Urol*. 2022;48(6):961-968.
5. Monn MF, Bahler CD, Schneider EB, et al. Trends in robot-assisted laparoscopic pyeloplasty in pediatric patients. *Urology.* 2013;81(6):1336-1341.
6. Cascini V, Lauriti G, Di Renzo D, Miscia ME, Lisi G. Ureteropelvic junction obstruction in infants: Open or minimally invasive surgery? A systematic review and meta-analysis. *Front Pediatr.* 2022; 23:10:1052440. doi: 10.3389/fped.2022.1052440. PMID: 36507128; PMCID: PMC9727311.
7. Jr Bennett WE, Whittam BM, Szymanski KM, Rink RC, Cain MP, Carroll AE. Validated cost comparison of open vs. robotic pyeloplasty in American children's hospitals. *J Robot Surg.* 2017;11(2):201-206.
8. Kassite I, Braik K, Villemagne T, Lardy H, Bine A. The learning curve of robot-assisted laparoscopic pyeloplasty in children: a multi-outcome approach. *J Pediatr Urol*. 2018;14(6): 570.e1-570.e10.
9. Durmus E, Ozbay E, Aydin A, et al. Our Initial Laparoscopy Surgery Experiences in Urinary Cystem: 97 Cases. *Selcuk Med J.* 2020;36(1):13-17.
10. Chacko JK, Koyle MA, Mingin GC, Furness PD. The minimally invasive open pyeloplasty. *J Pediatr Urol*. 2006;2(4):368-372.
11. Sharifiaghdas F, Mirzaei M, Daneshpajooh A, Abbaszadeh S. Minimally invasive open dismembered pyeloplasty technique: Miniature incision, muscle-splitting dissection, and nopelvis reduction in children. *Asian J Urol.* 2019;6(3):290-293.
12. Liu X, Wang X. Open Surgery in the Era of Minimally Invasive Surgery: Pyeloplasty via A Mini Flank Incision in the Treatment of Infants with Ureteropelvic Junction Obstruction. *Urol J.* 2020;17(2):169-172.
13. Anderson JC, Hynes W. Retrocaval ureter; a case diagnosed pre-operatively and treated successfully by a plastic operation. *Br J Urol*. 1949;21(3):209-214.
14. Kajbafzadeh AM, Tourchi A, Nezami BG, Khakpour M, Mousavian AA, Talab SS. Miniature pyeloplasty as a minimally invasive surgery with less than 1 day admission in infants. *J Pediatr Urol.* 2011;7(3):283-288.
15. Bonnard A, Fouquet V, Carricaburu E, Aigrain Y, El-Ghoneimi A. Retroperitoneal laparoscopic versus open pyeloplasty in children. *J Urol*. 2005;173(5):1710-1713.
16. Esposito C, Cerulo M, Lepore B. Robotic-assisted pyeloplasty in children: a systematic review of the literature. *J Robot Surg*. 2023;17(4):1239-1246.
17. Letts M, Davidson D, Splinter W, Conway P. Analysis of the efficacy of pediatric day surgery. *Can J Surg*. 2001;44(3):193-198.
18. Kim C. Robotic Urologic Surgery in Infants: Results and Complications. *Front Pediatr*. 2019;14(7):187. doi: 10.3389/fped.2019.00187.

19. Vauth F, Zöhrer P, Girtner F, Rösch WH, Hofman A. Open Pyeloplasty in Infants under 1 Year—Proven or Meaningless? *Children (Basel).* 2023;31:10(2):257.
20. Dönmez MI, Jr Carrasco A, Saltzman AF, Wilcox DT. Inpatient interventions that may preclude outpatient open pyeloplasty in infants. *Int Braz J Urol*. 2019;45(1):145-149.
21. Chu DI, Shrivastava D, Van Batavia JP, et al. Outcomes of externalized pyeloureteral versus internal ureteral stent in pediatric robotic-assisted laparoscopic pyeloplasty. *J Pediatr Urol*. 2018;14(5):450.e1-450.e6.
22. Kong X, Li Z, Li M, Liu X, D. He. Comparison of Drainage Methods After Pyeloplasty in Children: A 14-Year Study, *Front Pediatr*. 2021;13(9):779614. doi: 10.3389/fped.2021.779614.
23. Le TS, Le CT, Le TH, Nguyen TD, Huynh CN Nguyen TT. Transpelvic anastomotic stenting: a good option for diversion after pyeloplasty in children. *J Pediatr Urol*. 2011;7(3):363-366.
24. Ninan GK, Sinha C, Patel R, Marri R. Dismembered pyeloplasty using double 'J' stent in infants and children. *Pediatr Surg Int*. 2009;25(2):191-194.
25. Jayasimha S, Nagasubramanian S, Jayanth EST, Muthukrishna Pandian RJC, Kumar S. Management of proximal migration of double-J stents after Anderson-Hynes pyeloplasty in children. *J Pediatr Urol*. 2021;17(3):399.e1-399.e7.
26. Broch A, Paye-Jaouen A, Bruneau B, et al. Day Surgery in Children Undergoing Retroperitoneal Robot-assisted Laparoscopic Pyeloplasty: Is It Safe and Feasible? *Eur Urol Open Sci*. 2023;31:51:55-61. doi: 10.1016/j.euros.2023.03.004.
27. Alizadeh F, Haghdani S, Seydmohammadi B. Minimally invasive open pyeloplasty in children: Long-term follow-up. *Turk J Urol*. 2020;46(5):393-397.
28. Abdelwahab M, Abdelaziz A, Aboulela W, et al. One week stenting after pediatric laparoscopic pyeloplasty; is it enough? *J Pediatr Urol.* 2020;16(1):98.e1-98.e6.
29. Mohamed M, Hollins G, Eissa M. Experience in performing pyelolithotomy and pyeloplasty in children on day-surgery basis. *Urology.* 2004;64(4):1220-1222.