

Comparison of outcomes in pediatric patients undergoing open and laparoscopic pyeloplasty: A single-center retrospective study

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Ureteropelvic junction obstruction (UPJO) is one of the most common causes of obstructive uropathy in children, and if left untreated, it may lead to progressive hydronephrosis (HN), loss of renal function, and recurrent urinary tract infections (UTIs). Surgical management aims to restore adequate drainage of the pelvicalyceal system and preserve renal function. For many years, the gold standard treatment has been open Anderson–Hynes dismembered pyeloplasty.^[1]

With advancements in minimally invasive surgical techniques, laparoscopic and robot-assisted pyeloplasty have become increasingly widespread, offering potential advantages such as reduced postoperative pain, shorter hospital stays, and improved cosmetic outcomes.^[2,3] However, several studies have reported limitations in younger children, including technical challenges, steep learning curves, and variability in patient selection.^[4,5]

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Abstract

Objectives: This study aims to compare the demographic characteristics, ultrasonographic findings, and functional outcomes of pediatric patients who underwent open or laparoscopic pyeloplasty in our clinic, thereby evaluating the effectiveness of both surgical techniques.

Patients and methods: Between June 2017 and September 2025 a total of 49 patients were enrolled and divided into two groups based on the surgical approach performed: Open surgery group (29 males, 4 females; mean age: 1.30 ± 3.25 years; range, 0 to 14 years) and laparoscopic surgery group; (9 males, 7 females; mean age: 5.81 ± 3.90 years; range, 1 to 12 years). Data from patients who underwent open or laparoscopic pyeloplasty for ureteropelvic junction obstruction were retrospectively reviewed. Patients were categorized into two groups according to the surgical approach. Age, sex, laterality, presence of urinary tract infection (UTI), pre- and postoperative hydronephrosis (HN) grade, anteroposterior pelvic diameter (APD), parenchymal thickness, and mercaptoacetyl triglycine (MAG3) scintigraphy findings were compared. Mann-Whitney U, chi-square, and Wilcoxon signed-rank tests were used for statistical analysis.

Results: Patients in the laparoscopic group were significantly older than those in the open group ($p < 0.001$). Sex distribution differed between groups, with a higher proportion of males in the open group ($p < 0.05$). No significant differences were observed regarding laterality of obstruction or the incidence of UTI. In the open pyeloplasty group, significant improvements in MAG3 drainage and differential renal function were observed when comparing preoperative and postoperative values ($p < 0.05$). In the laparoscopic group, statistical comparison was not feasible due to insufficient paired postoperative MAG3 data. Preoperative MAG3 renal function values were significantly lower in the laparoscopic group ($p < 0.001$). Preoperative HN grades were significantly higher in the open group ($p < 0.05$). Both groups demonstrated significant reductions in HN grades during postoperative follow-up. In early postoperative assessments, HN grades and APD were lower in the laparoscopic group. Postoperative APD was significantly smaller in the laparoscopic group ($p < 0.05$).

Conclusion: Both surgical approaches are effective in relieving obstruction and preserving renal function. Laparoscopic pyeloplasty offers advantages in terms of minimal invasiveness, early morphological improvement, and cosmetic outcomes, whereas open surgery remains a reliable option in patients with severe HN.

Keywords: Anderson-Hynes dismembered, child, hydronephrosis, laparoscopic, pyeloplasty.

In this study, we compared pediatric patients who underwent open or laparoscopic pyeloplasty at our center. The aim of this study was to evaluate and compare the clinical effectiveness of the two surgical approaches by analyzing demographic characteristics, pre- and postoperative ultrasonographic parameters, HN grade, anteroposterior pelvic diameter (APD), parenchymal thickness (PT), and functional outcomes assessed by mercaptoacetyltriglycine (MAG3) renography.

PATIENTS AND METHODS

This retrospective study was conducted at the Department of Pediatric Urology, Health Sciences University, Ümraniye Training and Research Hospital between June 2017 and September 2025. A total of 49 patients were enrolled and divided into two groups based on the surgical approach performed: Open surgery group (29 males, 4 females; mean age: 1.30 ± 3.25 years; range, 0 to 14 years) and laparoscopic surgery group; (9 males, 7 females; mean age: 5.81 ± 3.90 years; range, 1 to 12 years). The inclusion criteria were (1) radiologically confirmed diagnosis of UPJO, (2) having undergone surgical treatment, and (3) availability of preoperative and at least one postoperative ultrasonography (USG) and/or MAG3 renography evaluation. Patients were divided into two groups based on the surgical approach: open pyeloplasty and laparoscopic pyeloplasty. A written informed consent was obtained from the parents and/or legal guardians of the patients. The study protocol was approved by the Health Sciences University, Ümraniye Training and Research Hospital Ethics Committee (Date: 10.07.2025, No.: B.10.1TKH.4.34.H.GP.0.01/212). The study was conducted in accordance with the principles of the Declaration of Helsinki.

For both groups, demographic data (age, sex), side of surgery (right/left), presence of UTI, preoperative and postoperative HN grades, APD, PT measurements, and MAG3 scintigraphy findings were assessed.

Ultrasonography findings were recorded during the preoperative period and at the 1st, 2nd, and 3rd postoperative follow-up visits. Hydronephrosis grading was performed according to the Society for Fetal Urology system (Grades 1-4) and converted into numeric values for analysis (G1 = 1, G2 = 2,

G3 = 3, G4 = 4).^[6] Anteroposterior pelvic diameter and PT measurements were recorded in millimeters (mm). Differential renal function obtained from MAG3 renography was compared between preoperative and postoperative evaluations.

All laparoscopic procedures (Stryker, Portage, MI, USA) were performed via a transperitoneal approach by the same surgical team. Open laparoscopic port placement using the Hasson technique was applied to all patients. The patients were positioned in the lateral decubitus position. Pelvic reduction was performed in patients with a markedly dilated renal pelvis, and a double-J stent was placed in all cases.

During laparoscopy, a 5-0 absorbable suspension suture (Vicryl®; Ethicon, Somerville, NJ, USA) was placed on the proximal ureter. In patients in whom preoperative double-J stent placement was unsuccessful, a 4F double-J stent (Plasti-med®; Plastic Medical Products Inc. and Trade Ltd. Co., Istanbul, Türkiye) was inserted intraoperatively through a 14F branule. To prevent urine leakage into the abdominal cavity from impairing visualization during pelvic incision, intraoperative intravenous fluid restriction was recommended by the anesthesia team. A single drain was placed in the renal lodge at the end of the procedure.

In the open pyeloplasty group, surgery was performed via a retroperitoneal approach in the lateral decubitus position. Access was obtained through a flank incision according to the affected side. All patients underwent preoperative cystoscopy and retrograde pyelography, followed by double-J stent placement. In cases where retrograde stenting was not technically feasible, the stent was placed intraoperatively. The ureteropelvic anastomosis was performed using interrupted 5/0, 6/0, or 7/0 absorbable sutures. Pelvic reduction was carried out in patients with a markedly dilated pelvis. A single mini-vac drain was placed in the renal lodge.

Perioperative parameters, including operative time, incision length, time to bowel recovery, length of postoperative hospital stay, complications, and success rates, were compared between the two groups. Operative time was defined as the interval from the initial skin incision to the completion of skin closure.

Surgical success was defined as radiographic improvement, including resolution of ureteropelvic obstruction and reduction in HN.

Prophylactic antibiotics (a single preoperative dose of a third-generation cephalosporin) were routinely administered in both groups. Postoperative management was similar for both groups. The urethral catheter was removed on postoperative day one. The surgical drain was removed if there was no increase in drainage output and if the volume did not exceed 10 mL within 24 h after Foley catheter removal. Oral intake was initiated upon the return of bowel sounds. At discharge, patients received prophylactic antibiotics until stent removal (10 days postoperatively).

The follow-up protocol included USG, urinalysis, and urine culture at three months, and functional evaluation with renography at six and 24 months postoperatively.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 31.0 software (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD), and categorical variables were presented as numbers (n) and percentages (%). Comparisons of continuous variables between groups were performed using the Mann-Whitney U test, while categorical variables were analyzed using the chi-square test or Fisher's exact test when

appropriate. Paired comparisons of preoperative and postoperative values within the same patient were conducted using the Wilcoxon signed-rank test. A two-tailed p -value < 0.05 was considered statistically significant.

RESULTS

Regarding the clinical and demographic characteristics of the study cohort, the mean age was significantly higher in the laparoscopic group than in the open surgery group (5.81 ± 3.90 years vs. 1.30 ± 3.25 years, $p < 0.001$). Sex distribution differed significantly between groups, with a higher proportion of males in the open group ($p = 0.0337$). No significant differences were observed between groups in terms of laterality of obstruction or the incidence of UTI ($p = 0.6263$ and $p = 0.5230$), as shown in Table 1.

In the open pyeloplasty group, statistically significant improvements in MAG3 drainage and differential renal function were observed when comparing preoperative and postoperative values ($p < 0.05$). In the laparoscopic group, statistical comparison was not feasible due to insufficient paired postoperative MAG3 data. Preoperative MAG3 renal function values were significantly lower in the laparoscopic group ($p < 0.001$), as shown in Table 1.

Preoperative HN grades were significantly higher in the open group ($p < 0.05$). Both groups

TABLE 1
Demographic characteristics and comparison of pre- and postoperative outcomes in patients undergoing open and laparoscopic surgery

Variables	Open surgery (n = 33)			Laparoscopic surgery (n = 16)			<i>p</i>
	n	%	Mean $\pm$ SD	n	%	Mean $\pm$ SD	
Age (year)			1.30 ± 3.25			5.81 ± 3.90	< 0.001
Sex							< 0.05
Male	29	87.9		9	56.3		
Female	4	12.1		7	43.7		
Preoperative AP diameter (mm)			29.7 ± 18.4			25.1 ± 13.6	0.42
Postoperative AP diameter (mm)			11.5 ± 9.8			5.9 ± 4.2	0.03
Preoperative PT (mm)			4.2 ± 2.3			9.7 ± 4.8	0.01
Postoperative PT (mm)			9.0 ± 5.1			9.5 ± 3.9	0.71
Preoperative MAG3			1.53 ± 0.41			0.47 ± 0.29	< 0.001

SD, standard deviation; AP, anteroposterior, PT, parenchymal thickness; MAG3, mercaptoacetyltriglycine.

demonstrated significant reductions in HN grades at the first and second postoperative follow-up visits. In early postoperative evaluations, the laparoscopic group exhibited lower HN grades and smaller anteroposterior (AP) pelvic diameters compared to the open group. While preoperative AP pelvic diameter did not differ significantly between groups ($p = 0.42$), postoperative AP diameter was significantly smaller in the laparoscopic group ($p = 0.03$) (Table 1).

Preoperative PT was significantly greater in the laparoscopic group ($p = 0.01$); however, postoperative values were comparable between the two groups ($p = 0.71$) (Table 1).

All laparoscopic-assisted procedures were completed successfully without conversion to open surgery. All open procedures were performed as planned.

The mean follow-up duration was 24 months in the laparoscopic group and 32 months in the open surgery group.

The mean operative time was 116.15 ± 29.37 min in the open surgery group and 158.63 ± 39.27 min in the laparoscopic group.

Complications occurred in one of 16 patients (6.2%) in the laparoscopic group and in two of 33 patients (5.8%) in the open surgery group.

In the laparoscopic group, one patient developed an allergic reaction presumed to be related to the double-J stent, presenting as a rash on the left abdominal wall. The symptoms resolved following evaluation and treatment by the pediatric allergy clinic. Follow-up USG at one month demonstrated regression of HN, and the stent was removed at postoperative month one. The patient's clinical symptoms completely resolved thereafter.

In the open surgery group, two complications were observed. The first complication was distal migration of the double-J stent through the urethra. Radiographic evaluation confirmed that the proximal end remained in the renal pelvis, and the stent was repositioned retrogradely into the bladder under sterile conditions using a Foley catheter. The second complication was hematuria, which was managed conservatively.

The median length of hospital stay was 2.5 days (range, 2-4 days) in the laparoscopic group and five days (range, 4-7 days) in the open surgery group.

DISCUSSION

In this study, we compared the demographic characteristics, perioperative parameters, and postoperative outcomes of pediatric patients undergoing open and laparoscopic pyeloplasty. Our findings support previously reported comparable success rates between open and minimally invasive approaches, while also highlighting the impact of patient selection and baseline morphological differences on postoperative outcomes.^[3,6,7]

All laparoscopic procedures were completed without conversion to open surgery, underscoring both the technical feasibility of the approach and the experience of the surgical team. The fact that all procedures were performed by the same surgical team represents a methodological strength, minimizing operator-dependent variability. Our analysis demonstrated that patients in the laparoscopic group were significantly older and had a more balanced sex distribution, whereas no significant differences were observed regarding laterality or UTI rates. The older age distribution in the laparoscopic cohort likely reflects selective application of minimally invasive techniques in older children due to technical challenges in younger patients, thereby introducing potential selection bias.

Operative time was significantly longer in the laparoscopic group (158.63 ± 39.27 min vs. 116.15 ± 29.37 min), a finding consistent with previous comparative studies.^[2,7] This difference is likely attributable to the technical demands of laparoscopic dissection, intracorporeal suturing, and operative setup. Despite longer operative times, the laparoscopic group demonstrated a significantly shorter hospital stay (median 2.5 days vs. 5 days), suggesting an advantage in early postoperative recovery. Importantly, postoperative management protocols were standardized between groups, indicating that differences in hospitalization are likely related to reduced tissue trauma, postoperative pain, and faster functional recovery associated with minimally invasive surgery.^[2,8]

Technical considerations merit further discussion. Operative time was significantly longer in the laparoscopic group in our cohort, which is consistent with contemporary comparative studies reporting prolonged operative duration during the learning curve of minimally invasive pyeloplasty.^[9]

The requirement for intracorporeal suturing, port placement, and advanced laparoscopic skills may contribute to this difference, particularly in pediatric populations where anatomical working space is limited.

Patients in the open surgery group exhibited significantly higher preoperative HN grades, reflecting a clinical tendency to preferentially assign more severe cases to open repair. Similar selection patterns have been described in prior studies.^[4,10]

Despite the longer operative time, multiple recent studies have demonstrated that laparoscopic repair is associated with improved postoperative comfort, decreased analgesic requirements, and a shorter hospital stay compared with open surgery.^[9,11] These advantages are generally attributed to reduced tissue trauma, magnified visualization, and smaller incisions. In our series, although hospital stay was not markedly different, early postoperative morphological recovery appeared more favorable in the laparoscopic group.

Consistent with published cohort data,^[2,8] we observed marked reductions in HN grades during follow-up in both groups, particularly at early postoperative evaluations, confirming that both techniques are effective in relieving obstruction. Similar selection patterns have been described in prior comparative cohorts, where more advanced obstruction or complex anatomy was preferentially managed with open repair.^[9] This factor should be considered when interpreting postoperative morphologic outcomes such as renal APD and PT. Assessment of renal APD and PT revealed higher values in the open surgery group at the third postoperative month. This difference likely reflects the more advanced baseline HN and the potentially longer morphological remodeling period following open reconstruction.

Functional evaluation using MAG-3 renography demonstrated significant postoperative improvement in the open group. However, it may suggest a potentially faster morphological recovery following minimally invasive repair in recent comparative series.^[11] However, the limited availability of paired MAG-3 data in the laparoscopic cohort precluded a robust functional comparison. This limitation is clinically relevant, as radiographic improvement does not always correlate directly with functional recovery. Accordingly, our conclusions

are primarily based on morphological parameters, and no claims of functional superiority between techniques can be made.

Complication rates were low and comparable between groups (6.2% vs. 5.8%), aligning with the safety profiles reported in the literature.^[3,7] All observed complications were managed conservatively or with minimal intervention. The allergic reaction in the laparoscopic group was likely related to the stent material rather than the surgical technique itself. Similarly, stent migration and hematuria in the open group represent recognized early postoperative events rather than approach-specific complications. These findings suggest that complication profiles may be more closely associated with stent-related and perioperative factors than with the surgical approach *per se*.

The longer mean follow-up duration in the open group (32 vs. 24 months) introduces an additional interpretative limitation, particularly regarding late recurrence detection. Unequal follow-up durations may lead to underestimation of late failures in the laparoscopic cohort. Longer and standardized follow-up periods are necessary to draw definitive conclusions regarding long-term durability.

Although robotic surgery was not evaluated in this study, recent meta-analytic evidence comparing robot-assisted and conventional laparoscopic pyeloplasty suggests that robotic platforms can reduce technical difficulty, shorten the learning curve, and potentially reduce complication rates in selected pediatric populations.^[12]

Overall, our findings confirm that both open and laparoscopic pyeloplasty achieve high success rates in pediatric UPJO. However, the preferential selection of more severe cases for open repair and milder cases for laparoscopic treatment limits direct superiority comparisons. Potential confounders, including age, baseline HN severity, and follow-up duration, must be carefully considered. Larger, prospective studies with matched cohorts or propensity-score adjustment are warranted to better delineate true comparative effectiveness.

This study is limited by its retrospective design, which inherently restricts control over selection bias. Its single-center nature and the relatively small sample size, particularly in the laparoscopic group,

reduce statistical power. The unequal distribution of paired MAG-3 evaluations limits functional comparisons between techniques. Furthermore, differences in follow-up duration may affect long-term outcome assessment.

Future prospective multicenter studies with age- and severity-matched cohorts are necessary to more objectively determine comparative effectiveness between surgical approaches. Ideally, randomized or propensity-matched designs would help mitigate selection bias and clarify whether minimally invasive techniques confer true functional advantages beyond cosmetic and early recovery benefits.

In conclusion, the results of this study demonstrate that both surgical approaches are effective in relieving obstruction. While laparoscopic pyeloplasty offers advantages in terms of earlier morphological improvement and superior cosmetic outcomes, open surgery remains a reliable option for patients with advanced HN. Ultimately, the experience of the surgical team appears to be the most critical factor influencing both operative success and long-term outcomes.

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