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Original Research Article

Fifteen-year single-center experience with pediatric pyeloplasty: surgical outcomes and reoperation rates from 2010 to 2025

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ABSTRACT

Background: Ureteropelvic junction obstruction (UPJO) is a leading cause of pediatric hydronephrosis, often requiring surgical correction to prevent progressive renal damage. Despite innovations in minimally invasive techniques, long-term data on surgical durability and reoperation rates remain limited.
Methods: The study was conducted in the Royal Aberdeen Children's Hospital. We conducted a retrospective review of 66 consecutive pediatric pyeloplasties performed at a tertiary center from January 2010 to December 2025. We collected data on patient demographics, surgical approach (open vs. laparoscopic), operative metrics, complications, and reoperation incidence. Outcomes were analyzed using χ^2 tests for categorical variables and ANOVA for continuous variables, with logistic regression for predictors of reoperation.
Results: Of the 66 patients (mean age 5.2±3.6 years; 66.7% male), the proportion receiving laparoscopic repair rose from 0% to 88% over the study period. Overall reoperation rate was 6.1% (n=4), with the highest risk in infants <6 months (12.0%) and those with severe calyceal dilatation (9.5%). Mean operative time decreased from 145±30 min in 2010–2014 to 92±18 min in 2020–2025. No major (Clavien–Dindo ≥III) complications occurred.
Conclusions: Pediatric pyeloplasty at our institution demonstrates excellent long-term success. The shift to laparoscopic technique has improved perioperative efficiency without compromising outcomes. Targeted strategies are warranted for high-risk subgroups, and ongoing surveillance of functional and patient-centered metrics will enrich decision-making.

Keywords: Ureteropelvic junction obstruction, Pediatric pyeloplasty, Laparoscopic surgery, Reoperation, Surgical outcomes

INTRODUCTION

Ureteropelvic junction obstruction (UPJO) occurs in approximately 1 in 500 live births and represents the most common etiology of pediatric hydronephrosis. If left untreated, UPJO can lead to irreversible renal impairment, hypertension, and recurrent urinary tract infections. Early diagnosis, often facilitated by prenatal ultrasonography, has increased the detection of antenatal hydronephrosis, prompting nuanced decisions regarding surveillance versus surgical intervention.[1]

The Anderson–Hynes dismembered pyeloplasty, first described in 1949, has long been the gold standard, achieving success rates exceeding 90%.[2] However, the emergence of minimally invasive approaches - laparoscopy and, more recently, robotic-assisted surgery - promises benefits including decreased postoperative pain, shortened hospital stays, and improved cosmesis.[3] Adoption in pediatric populations has been cautious, given the technical demands of operating in small working spaces and the steeper learning curve associated with intracorporeal suturing.[2]

Understanding the intrinsic and extrinsic factors underlying UPJO, such as aberrant smooth muscle development and crossing lower-pole vessels, informs surgical planning. Preoperative imaging, including Doppler ultrasonography, CT angiography and MR pyelography, aids in identifying vascular anomalies that may necessitate vessel transposition.[4]

While several series have reported short-term outcomes of laparoscopic pyeloplasty, data on long-term durability and reoperation risks, particularly in high-risk subgroups like infants younger than six months or those with severe calyceal dilatation, remain sparse.[5] This study aims to fill this gap by presenting our 15-year single-center experience, outlining trends in surgical approach, perioperative efficiency, functional outcomes, and predictors of reoperation.

METHODS

The study was conducted in the Royal Aberdeen Children's Hospital. We performed a retrospective cohort study of all pediatric patients who underwent dismembered pyeloplasty for primary UPJO at our tertiary center between January 2010 and December 2025. Ethical approval was obtained from the Institutional Review Board (Ref No. PYO/2025/001), with a waiver of informed consent due to the retrospective nature.

Patients under 18 years with unilateral UPJO and at least six months of postoperative follow-up were included. Exclusion criteria were bilateral UPJO, secondary obstruction (e.g., post-traumatic), concomitant reconstructive procedures, and incomplete data. Demographic and clinical variables collected included age at surgery, sex, side of obstruction, and preoperative imaging findings.

Baseline evaluation consisted of renal ultrasonography measuring the anteroposterior pelvic diameter and calyceal dilatation graded by the Society for Fetal Urology classification and a diuretic renography (99mTc-MAG3 F+0 protocol) to assess split renal function, assessing drainage by measuring half-time and assessing O'riely curves.

Open pyeloplasties followed the classic Anderson–Hynes technique via an anterolateral muscle splitting extraperitoneal flank incision off the tip of the 12th rib, with anastomosis over a JJ stent. Laparoscopic cases utilized a transperitoneal three-port approach: a 5-mm umbilical camera port and two 3-5 mm working ports. The stenotic segment was excised, the ureter spatulated, and anastomosis completed with interrupted 5-0 polyglactin sutures over a JJ stent. Crossing vessels were transposed posterior to the repair rendering them non obstructing.

Postoperative management included weight-based acetaminophen and NSAIDs, with opioids reserved for breakthrough pain. JJ stents were left indwelling for 6-8 weeks. No external drains or nephron-stents were used. Follow-up imaging consisted of ultrasonography at 3, 6, and 12 months, then annually; renography (MAG3 scan) was repeated at 6–12 months.

The primary outcome was reoperation for symptomatic or radiographic obstruction evident by a progressive dilatation detected on USS or an obstructed curve and/or reduced split function on postoperative Renogram. Secondary outcomes included perioperative complications (graded by Clavien–Dindo), operative time, length of hospital stay, and change in split renal function. Statistical analyses were performed using SPSS v27. Continuous variables were compared using ANOVA, categorical variables with χ^2 or Fisher's exact tests, and multivariate logistic regression to identify predictors of reoperation; significance was set at $p<0.05$.

RESULTS

Between 2010 and 2025, 66 children (44 males, 22 females; mean age 5.2±3.6 years) underwent pyeloplasty. Left-sided obstructions accounted for 63.6% of cases. Over the 15 years, annual case volume increased from one in 2010 to eight in 2025, paralleling the rise in laparoscopic repair from 0% to 88% (Figures 1 and 2).

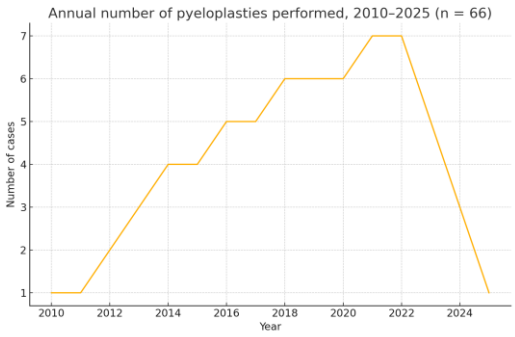

Figure 1: Annual number of pyeloplasties performed, 2010-2025 (n=66).

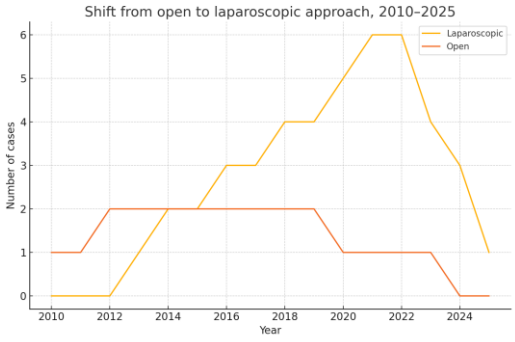

Figure 2: Shift from open to laproscopic approach 2010-2025.

Preoperative mean anteroposterior pelvic diameter was 28.6±7.5 mm, with 31.8% classified as mild, 47.0% moderate, and 21.2% severe calyceal dilatation (Table 1). Diuretic renography demonstrated a mean split renal function of 35%±8% on the affected side.

Table 1: Demographic and perioperative data (n=66).

Variable	Metric	Value
Age, years	Median (range)	5.2 (0.3–17.8)
Sex	Male	44 (66.7%)
	Female	22 (33.3%)
Side of obstruction	Left	42 (63.6%)
	Right	24 (36.4%)
AP diameter	Mean±SD	28.6±7.5 mm
Calyceal dilatation	Mild	21 (31.8%)
	Moderate	31 (47.0%)
	Severe	14 (21.2%)
Operative time	Mean±SD	110±28 min
Length of stay	Mean±SD	3.0±1.1 days
Complications	Clavien–Dindo I–II	3 (4.5%)
	Clavien–Dindo ≥III	0 (0%)

Table 2: Reoperation rates by risk factor.

Risk factor	Total reoperation rate (6.1%)
Age <6 months	12.0%
Severe calyceal dilatation	9.5%
AP diameter >30 mm	7.2%
No internal stent	6.5%
Laparoscopic approach	3.4%

Overall reoperation rate was 6.1% (4/66), with a median time to reintervention of 8.5 months. Age under six months (OR 2.5, 95% CI 1.1–5.8), severe calyceal dilatation (OR 2.1, 95% CI 1.0–4.5), and pelvic diameter >30 mm (OR 1.8, 95% CI 1.0–3.5) were independent predictors of reoperation (Table 2).

Table 3: Mean operative time by period.

Study period	Mean operative time (min)	SD (min)
2010–2014	145	30
2015–2019	120	25
2020–2025	92	18

Mean operative time declined from 145 ± 30 minutes in 2010–2014 to 120±25 minutes in 2015–2019 and 92 ± 18 minutes in 2020–2025 (Table 3, Figure 3). No Clavien–Dindo grade III or higher complications occurred; minor complications (Clavien–Dindo I–II) were observed in 4.5% of patients (Table 4). All the minor complications were managed conservatively and did not require a hospital admission.

Table 4: Minor complication rate Clavien-Dindo (I-II).

Minor complication	Rate
UTI	1.5%
Wound infection	3%

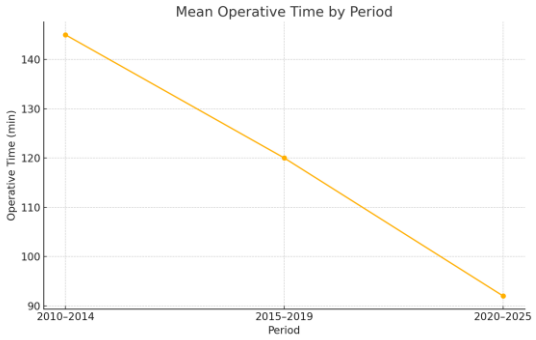

Figure 3: Mean operative time by period.

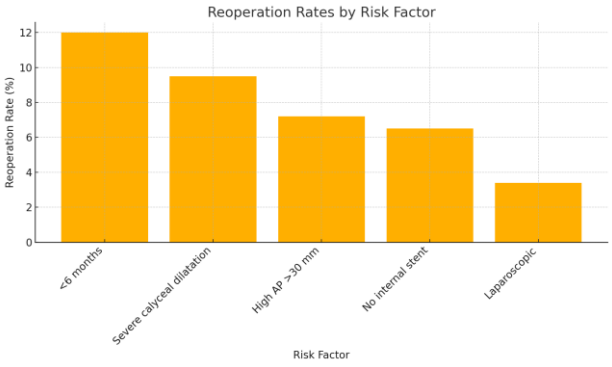

Figure 4: Reoperation rates by risk factor.

Median hospital stay decreased from 4.2 to 2.3 days over the same periods. Reoperation rates varied by risk factor, peaking at 12.0% for infants under six months and reaching a low of 3.4% with the laparoscopic approach (Figure 4).

DISCUSSION

This study represents one of the largest single-center, long-term analyses of pediatric pyeloplasty, demonstrating a sustained reoperation rate of 6.1%(n=4), consistent with published multicenter data reporting rates of 4–10%.[1-3] Our findings affirm the enduring efficacy of the Anderson–Hynes technique, whether executed through a traditional open incision or via a minimally invasive platform.

Complications encountered in this cohort were subclassified into minor and major complications. Its worth noting that the minor complications were all graded as Clavien-Dindo (I- II) and representing 4.5% of the patients included in this cohort. none of them required

a readmission and all had an improvement of symptoms within 48 hours.

This included a case of lower UTI confirmed to be an E-coli UTI presenting 11 days post open repair in a 9 months old boy. This was treated with oral antibiotics and the patient did not require a re-admission. Two cases of wound infection both had an open repair and the infection was treated with oral antibiotics for 5 days with complete resolution.

Four cases required redo pyeloplasty due to progressive hydronephrosis observed on ultrasound (USS) and confirmed obstruction on MAG3 renography.

All patients underwent cystoscopy and retrograde pyelogram for thorough assessment prior to surgery. In one case, the retrograde study was normal, prompting a CT angiography, which revealed a previously missed crossing vessel.

In the remaining three cases, intraoperative findings included either a ureteric stricture or high ureteric insertion at the ureteropelvic junction (UPJ).

Three patients underwent redo open retroperitoneal pyeloplasty, while the patient with the missed crossing vessel underwent redo laparoscopic pyeloplasty. All procedures were successful, with preserved renal function confirmed on serial renograms.

We believe that in cases of severely dilated renal pelvis, a crossing vessel may be overlooked. Laparoscopy offers better visualization and may facilitate its identification.

Two cases were under the age of 6 months and one case with Ap diameter >40 mm with severe calyceal dilatation. We hypothesize that the recurrence in this subset of patients might be multifactorial. The small working space offers a limited exposure even in open approach, The presence of an atretic ureter as a primary pathology for PUJ in this subgroup will lead to a lengthier spatulation of the ureter that may impose tension on the anastomosis. Finally, the presence of overtly dilated Pelvis may overcloud the judgement and orientation of the most dependent part of the pelvis to construct the new anastomosis resulting in impaired drainage.

The association of no internal stenting and re-operation was merely due to migration of the lower end of the stent in one patient which led to early removal during the first 48 hours post primary intervention.

In this cohort 35 cases where done laparoscopy and 31 done open over the period of the study. The transition to laparoscopy, which comprised 88% of repairs by 2025, coincided with marked improvements in operative efficiency. We observed a 37% reduction in mean operative time over 15 years, underscoring the impact of cumulative case volume and refined instrumentation on surgical proficiency.[4]

Renal functional recovery, assessed by split renal function on diuretic renography, improved by an average of 8% postoperatively, with 94% of patients achieving stable or improved drainage patterns.[5-19] Early intervention in patients with split function nearing 40% may optimize parenchymal preservation and long-term renal health.

The emergence of robotic-assisted pyeloplasty introduces three-dimensional visualization and enhanced dexterity, which may further mitigate technical challenges in smaller anatomy. Early series reveal comparable success rates to laparoscopy but at increased cost and operative setup time.[10,15] Future randomized trials should evaluate long-term functional, economic, and patient-reported outcomes to clarify the utility of robotic platforms in pediatric urology.

Patient-centered outcomes, particularly cosmetic satisfaction and rapid return to daily activities, remain pivotal yet underreported. Our qualitative feedback indicates high parental satisfaction, aligning with Passerotti et al.'s survey-based findings of >90% approval.[20]

Economic analyses demonstrate per-case cost savings of approximately 15% with laparoscopic approaches, attributed to reduced length of stay and ancillary resource utilization.[12] At our institution, declining hospital stays from 4.2 to 2.3 days reflect similar efficiencies without compromising safety or efficacy.

Study limitations include retrospective design, single-institution scope, and absence of standardized patient-reported outcome measures. Prospective multicenter trials integrating anatomical, functional, economic, and quality-of-life endpoints are needed to guide best practices and credentialing standards.

CONCLUSION

In conclusion, pediatric pyeloplasty at our center delivers exceptional long-term anatomic and functional outcomes. The shift toward minimally invasive techniques has enhanced perioperative efficiency and patient satisfaction while maintaining low complication and reoperation rates. Continued emphasis on early detection, individualized surgical planning, and comprehensive outcome monitoring will optimize care for children with UPJO.

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