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BABY PYELOPLASTY VIA MINI FLANK INCISION- A SINGLE-CENTRE STUDY

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Abstract

Background: *Pelviureteric junction obstruction (PUJO) is a common problem in the field of pediatric urology. It is the most common cause of antenatal hydronephrosis. In those patients where surgical intervention is required, the mainstay management option is dismembered pyeloplasty.*

Objective: *To evaluate the clinical effects and safety outcomes of early open pyeloplasty in children ≤ 3 years of age for the treatment of pelviureteric junction obstruction.*

Methodology: *This prospective interventional cross-sectional study was conducted at Tabba Kidney Institute over six months during 16th August 2024 to 16th February 2025 on 50 children aged ≤3 years with clinically and radiologically diagnosed PUJO. Only primary PUJO cases without prior surgeries were included. Anderson-Hynes dismembered pyeloplasty was performed via a ≤2.5 cm mini flank incision. DJ stents were removed after four weeks. Statistical analysis was done using SPSS 23.*

Results: *The mean age was 4.92 ± 2.8 months; 72% were male. Most cases involved the left kidney. Postoperative imaging showed reduced hydronephrosis (p <0.0001), and weight increased significantly. Crossing vessels were identified in 4% of cases.*

Conclusion: *Mini open pyeloplasty is safe, effective, and minimally invasive approach for the management of PUJO in young children with least postoperative complications and successful surgical outcomes. The clinical findings that were observed from this study were consistent with pyeloplasty as the first-line surgical intervention for this ailment.*

INTRODUCTION

Pelviureteric junction obstruction (PUJO) is among the most common congenital anomalies of the urinary tract in children, the features of which lie at the renal pelvis-ureter junction.[1] This condition impairs the

passage through which urine passes from the kidney to the ureter, causing the progressive dilation of pelvicalyceal system, which, if not treated, deteriorates the renal function. PUJO accounts for vast majority of cases of antenatal hydronephrosis, and innovative techniques of prenatal ultrasonography allow for early diagnosis of such congenital anomalies.[2] The incidence of PUJO has recently risen with the help of routine prenatal screening, which leads to early diagnosis and treatment of neonates and infants.

PUJO is the second most encountered congenital urological malformation in practice.[3] According to the available statistics, the occurrence of PUJO is approximately 1 in 2,000 live births across the world.[4] This is because current prenatal anomaly screening, especially the use of antenatal ultrasonography plays a pivotal role in the detection of PUJO in its early stages due to development in technology.[5] Current literature suggests that PUJO is responsible for 10-30% of cases of antenatally diagnosed hydronephrosis, which currently affects more than one in a thousand pregnancies making PUJO the leading cause of prenatal hydronephrosis internationally.[6] PUJO is more commonly observed in males than females, with a male-to-female ratio of approximately 2:1.[7] It predominantly occurs in a solitary manner and the left kidney is more commonly involved than the right.[8] The bilateral involvement takes place in approximately 10-15% of the cases.[9]

In some cases, PUJO resolves on its own, but many patients require surgical treatment to prevent further worsening of renal function.[10] Surgical intervention is the primary treatment option when the patient demonstrates signs of progressive hydronephrosis, deteriorating renal function, recurrent UTIs, or inability to respond to conservative measures.[11] Within the context of open surgical management of PUJO, dismembered pyeloplasty has become widely accepted as the gold standard, for which favourable outcomes have been documented in the literature.[12] This technique implies restoration of the disrupted pelvic ureteric junction to eliminate the obstruction at the opening of the ureter. Mini-flank or mini-laparotomy open pyeloplasty is a common technique that offers direct visualization of the PUJ, reduced tissue damage, and subsequent complications.[13] This technique is especially useful in young children because it gives fine motor dissection and stitching without infringing on nearby tissue. Also, mini flank incision is more aesthetic and patients will likely spend fewer days in the hospital to be treated; and this appeals to parents and healthcare givers.[14]

The safety and effectiveness of open pyeloplasty in pediatric patients have been demonstrated, but there are very few studies report on open pyeloplasty in children less than 3 years of age.[15] Infant patients pose various problems because of their small stature and relatively immature physiological state and organs, as well as a higher risk for postoperative complications. Therefore, understanding the recent outcomes of this procedure on clinical conditions and its safety among this age group population must be studied in detail to enhance the management approach. Therefore, this study aimed to evaluate perioperative parameters, complication rates, and postoperative resolution of hydronephrosis and reduction in anterior-posterior pelvic diameter to offer information regarding the use of this surgical method in managing PUJO in young children. The results of this work must be helpful in the development and improvement of minimally invasive surgical techniques in pediatric urology and surely aid in the definition of treatment strategies for PUJO in children. The purpose of this study is to evaluate the efficacy and safety profile of early open pyeloplasty through the mini flank incision in children ≤ 3 years of age.

Methodology

This prospective interventional cross-sectional study was carried out in the Department of Urology at Tabba Kidney Institute, Karachi during 16th August 2024 to 16th February 2025. The target population included 50 children with a maximum age of 3 years diagnosed with PUJO based on imaging findings. The study spanned six months following approval from the Ethics Review Committee (ERC). The sample of 50 patients is justified based on the number of patients who have undergone procedures related to the study in the past six months in the same hospital. The study employed a purposive, non-probability sampling technique of participant selection.

The inclusion criteria encompassed children aged ≤ 3 years with PUJO was confirmed by radiological imaging, including ultrasound of the kidneys, ureters, and bladder (U/S KUB) and MAG-3 scans. Patients

with a solitary kidney or those with a preoperative nephrostomy tube were also included. Conversely, patients with secondary PUJO, recurrent PUJO, concurrent renal stones or those with previously operated kidneys were excluded from the study.

The process of collecting data was divided into several steps. Patient's demographic data and clinical characteristics were documented in ward preoperatively when patient admitted for surgery. Conventional investigations, including U/S KUB and MAG-3 scans, were also reported to confirm PUJO diagnosis. Pre-operatively urine culture was done and treated according to sensitivity. 2-3 doses of intravenous antibiotic (combination of Piperacillin and Tazobactam) 8 hours apart were given prior to surgery. Patients underwent standard Anderson-Hynes dismembered pyeloplasty via mini flank incision which is defined as incision size ≤ 2.5 cm in our study population. Antegrade DJ stent of 3Fr or 3.7Fr was inserted in all patients. C-arm fluoroscope is used at the end of the procedure to confirm the location of DJ stent. Foley catheter having sizes 6Fr, 8Fr, or 10Fr was inserted depending on patient's age and is removed on 4th post-operative day. DJ stent was removed 4 weeks after the surgery; prior to this U/S KUB was performed. Intraoperative observations were also documented. Details of clinical recovery after surgery, hospital stay, any complications, visits to the emergency department, or re-admissions were well recorded. The success of the procedure was measured by the resolution of hydronephrosis and a decrease in the anterior-posterior pelvic diameter (APPD) on ultrasound KUB at the follow-up visit in outpatient department on 3rd post-operative month.

The procedures in the diagnostic and investigation part focused on radiography for diagnosing PUJO. Preoperatively, KUB U/S and MAG-3 scans were used to establish a diagnosis. On ultrasound imaging degree of hydronephrosis, APPD size, cortex size and echogenicity of kidneys were noted preoperatively. MAG-3 scans were done to see the split renal function, T½ of each kidney, and clearance curves. Follow-up was done on the basis of U/S KUB imaging at 1st month before removing DJ stent and at 3rd month after the procedure. Specifically, patient data were properly dealt with by assigning every individual patient an MR# by which his or her information was safely stored in a password-secured computerized file. This database was only available to authorized personnel to minimize the risk of loss or breach of patients' information.

Data analysis was done using Statistical Package for the Social Sciences (SPSS) version 23. Quantitative data was described using mean and standard deviations for the normally distributed ongoing variables while qualitative data was summarized in the form of frequencies and percentages. A Chi-square test was used to compare the categorical data between the two study groups where the p value ≤ 0.05 was statistically significant.

Results

The study included a total of 50 children aged ≤ 3 years diagnosed with PUJO. The majority of participants i.e. 74% (37) were ≤ 1.5 years old, with a mean age of 4.92 ± 2.8 months while 26% (13) were >1.5-year-old. Male children constituted the majority, accounting for 72% (36) of the study population, while females represented 28% (14). The mean weight of the participants before pyeloplasty was 5.82 ± 1.2 kg, which increased to 6.40 ± 0.8 kg following the procedure, indicating positive growth outcomes post-surgery. Regarding the anatomical location of PUJO, 64% (32) of cases involved the left side, while the remaining 36% (18) were right-sided obstructions.

The clinical presentation of patients was variable and is mentioned in Table 1. Preoperatively, U/S KUB and MAG-3 scan were done in all patients. On the basis of U/S KUB, patients were divided in 3 groups having gross, moderate or mild hydronephrosis; moderate HDN constituted the majority of patients (60%, n=30). APPD size was also observed in each group; mean APPD size was noted to be 38 ± 7 mm in gross HDN group, 27 ± 6 mm in patients having moderate HDN and 18 ± 7 mm in mild HDN group. U/S KUB also demonstrated the mean cortex size of affected kidney was 4.7 mm and increased echogenicity was found in 32% (16) patients. MAG-3 scan showed an average split renal function of 27 ± 12%, while the mean T½ of the operated site was 38 ± 7 minutes. O'Reilly curves on MAG-3 scan were also studied which showed 86% (43) patients had Type 2 (obstructed) curve while 14% (7) patients had Type 4 (partial obstructed) curve on their imaging. Types of O'Reilly curves are demonstrated in Figure 1.

Intraoperative findings of the surgery were also noted (Table 2). The operative time for pyeloplasty in the study participants averaged 58 minutes, with a range of 55–65 minutes. The incision size was notably small, averaging 2.3 cm (range: 1.2–2.5 cm), reflecting the minimally invasive approach. (Figure 2) The mean length of the narrow segment excised during surgery was 9.5 ± 3 mm, indicating the extent of obstruction addressed. Regarding stent placement, 3Fr DJ stent was placed in 74% (37) patients while 3.7Fr DJ stent was inserted in 26% (13) patients. Difficulties during DJ stent insertion were faced in few cases. Retrograde DJ insertion was performed in 4% (2) patients, demonstrating the possibility of presence of concomitant VUJO along with PUJO; significantly emphasizes the importance of performing retrograde contrast study on operative table in specific cases which is not usually done or recommended as a routine practise.

Postoperative complications were classified using the Clavien-Dindo system. Overall, the patients recovered well and only 8% (4) patients had complications out of which 6% (3) patients had wound infection, electrolyte imbalance and febrile UTI which were managed conservatively. 1 patient presented with perinephric collection at 8th day post-operatively in whom PCN was inserted under sedation (Table 3).

Laboratory parameters demonstrated stable postoperative outcomes. The mean hemoglobin levels decreased slightly from 11.29 ± 0.8 g/dL preoperatively to 10.93 ± 0.6 g/dL postoperatively. Creatinine levels remained comparable, with a minor increase from 0.25 ± 0.1 mg/dL to 0.28 ± 0.2 mg/dL. Preoperatively, 12% (6) patients had positive urine cultures, which were treated before surgical intervention.

A significant reduction in anterior-posterior pelvic diameter (APPD) was observed postoperatively across all degrees of hydronephrosis and summarised in Table 4.

Postoperative resolution of hydronephrosis was substantial. The findings underscore the effectiveness of the procedure in alleviating hydronephrosis in young children with PUJO (Table 5).

Table 1: Presentation and Associated Features of the Study Participants

Presentation	**n** (%)
Antenatal Hydronephrosis	40 (80%)
Incidental Diagnosis	8 (16%)
Febrile UTI	2 (4%)

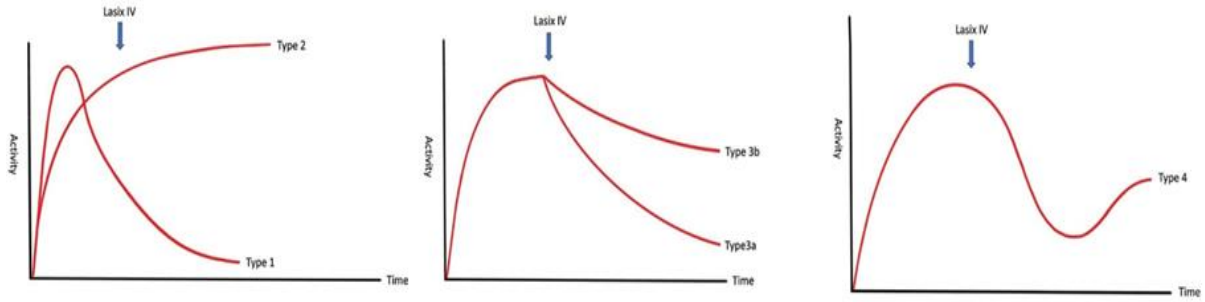

Figure 1: O'Reilly Curves

Table 2: Intra-Operative Findings of the Study Participants

Parameter	**n** (%)
Narrow stenosed segment	46 (92%)
Crossing Vessels	2 (4%)
Concomitant VUJO	2 (4%)

Figure 2: Incision size (1.8 cm)

Table 3: Post-Operative Complications (Clavien-Dindo Classification) of the Study Participants

Grade	Details	n (%)
Grade 1	Wound Infection: 1 (2%)	2 (4%)
	Electrolyte Imbalance: 1 (2%)	
Grade 2	Febrile UTI	1 (2%)
Grade 3b	PCN Placement due to perinephric collection	1 (2%)

Table 4: Reduction in Anterior-Posterior Pelvic Diameter Size of the Study Participants

Degree of Hydronephrosis	n (%)	Pre-op APPD (mm)	Post-op APPD (mm)	Mean Difference (mm)	p-value
Gross (36%, n=18)	18 (36%)	38 ± 7	20 ± 6	18 ± 1	<0.0001
Moderate (60%, n=30)	30 (60%)	27 ± 6	12 ± 5	15 ± 1	
Mild (4%, n=2)	2 (4%)	18 ± 7	11 ± 4	7 ± 3	

Table 5: Resolution of Hydronephrosis of the Study Participants (n=50)

Pre-op Hydronephrosis	n (%)	Post-op Hydronephrosis (at 3rd month)	n (%)
Gross	18 (36%)	Gross	2 (4%)
		Moderate	4 (8%)
		Mild	10 (20%)
		No Hydronephrosis	2 (4%)
Moderate	30 (60%)	Mild	8 (16%)
		No Hydronephrosis	22 (44%)
Mild	2 (4%)	No Hydronephrosis	2 (4%)

DISCUSSION

This study evaluated the outcomes of open pyeloplasty via a mini flank incision in children ≤ 3 years of age with pelvic ureteric junction obstruction (PUJO). Our findings demonstrated significant positive outcomes regarding clinical effects, safety, and resolution of hydronephrosis and reduction in APPD size postoperatively.

Our study found that the majority of participants (74%) were aged ≤1.5 years, with a mean age of 4.92 ± 2.8 months. Male children comprised 72% of the study population. These findings are consistent with

studies by Shahinoor AM, et al., 2024, Zulpi PK et al., 2021 and Mungia MM et al., 2019, which also report a male predominance in PUJO, with male-to-female ratios ranging from 2:1 to 3:1 in pediatric populations.[7, 16, 17] This is consistent with the early presentation in our cohort which is attributable to the early presentation of PUJO, diagnosed in utero or in the first year of life because of antenatal ultrasound findings. Another similar observation was made by Govind M. (2024) he noted that most cases of PUJO were diagnosed when the babies were still one year old, which is in accord with the results of this study where the mean age was 4.92 months.[18]

The prevalence of antenatal hydronephrosis in our subjects was 80% which is within the documented prevalence rate of 60-80%. The percentage of febrile urinary tract infections observed in this study is 4%, which is lower than that reported by some authors, such as Srivastava P et al who note that febrile UTIs were present in 24% of PUJO cases.[12] This suggests that, in our cohort, febrile UTIs were less common and highlights the variability in clinical presentations. Within the cohort, the cause of the obstruction was crossing vessels in 4% of children. These results conform to the anatomical aetiologies of PUJO as highlighted by Bhatt S et al., 2021 as well as Idowu N et al., 2023. Crossing vessels are implicated in the aetiology of PUJO in different studies.[19, 20]

About 4 % of the participants had concomitant vesicoureteral junction obstruction, which is slightly higher in comparison with the study by Geleta BE et al., 2024 which had VUJO up to 2.8% in PUJO.[21] These findings depict that the present study has relatively lower concurrent rates of VUJO than previously reported in the literature, which might be due to differences in the patient population and/or differences in the diagnostic criteria norms. The mean operative time in this study was 58 minutes with the SD of 55-65 minutes. This is similar to other studies that show operative times for open pyeloplasty of 45-90 minutes. Similar work done by Polok M., et al. (2020) found the mean operative time of open pyeloplasty to be 90 minutes.[21] The shorter operative time explained by the utilization of the mini flank incision technique which has been noted to have a faster recovery and shorter operating time than the traditional flank incisions.

The mean incision size in our study of 2.3 cm is comparable with other studies on using the mini-incision technique as it had been earlier documented that it decreases postoperative pain and morbidity. A study by Rickard M, et al (2021) reported an incision size of about 2 – 3 cm in children undergoing open pyeloplasty with low complication rates and early recovery.[22]

The anterior-posterior pelvic dimensions were measured preoperatively and the APPD was found to significantly decrease in the postoperative period. As in the case of patients with gross hydronephrosis, the APPD was decreased to 18 mm; the frequency of moderate hydronephrosis resulted in the decrease of APPD up to 15 mm. These results are in concordance with other research done on the efficacy of pyeloplasty in managing hydronephrosis. Wickramasekara N et al. (2023) in a study established that APPD was significantly reduced postoperatively with a relative percentage reduction between 32.6 %, 45.8%, and 51.7 % at 6 weeks, 3 months, and 6 months respectively.[23] The statistical significance of these reductions ($p < 0.0001$) further supports the efficacy of pyeloplasty in improving renal drainage and alleviating hydronephrosis.

Unlike other studies we had not performed MAG-3 scan in our postoperative period instead we followed our patients through U/S KUB to decrease the cost burden. Being the residents of developing country, most of the patients belong to low socioeconomic status. This modification of investigation in the postoperative period did not have any negative impact on the quality of treatment and patient follow-up in our study population. [24] Moreover, we observed that 44% of the patients with moderate hydronephrosis had complete resolution according to our research having similar characteristics to Kim SW. Et al., 2024, which stated that the postoperative complete resolution of hydronephrosis ranges from 30-50%.[25]

However, it is also important to acknowledge some of the limitations of the current study based on the findings of this research: First, the sample of 50 patients is rather small, and, therefore, the results obtained did not apply to more diverse populations. Furthermore, this present study was conducted in a single centre and essential cohort could potentially give rise to substantial bias due to the variation in the

healthcare environment and regions. Additional years of follow-up would also be useful in evaluating late results of pyeloplasty, concentrating on renal function and the reappearance of obstruction. In addition, the absence of a control arm makes it difficult to compare our results with the other management approaches, including those from laparoscopic or robotic pyeloplasty.

The current research discusses the outcome of open pyeloplasty in the management of pediatric PUJO indicating reduction in the anterior-posterior pelvic diameter (APPD) and improvements in the degree of hydronephrosis. These observations of reduced and negligible adverse effects, decreased incision size, and lesser operative duration, all indicate that pyeloplasty could be a safe and efficient procedure for treating PUJO in early childhood. Clinicians must employ it as the routine strategy for PUJO, especially those babies diagnosed with PUJO in utero through antenatal ultrasound. The study also emphasizes that any indication of renal disease requires early intervention to prevent long-term damage to the kidneys. Additionally, further research involving a larger number of patients and centres could offer valuable insights into refining surgical techniques, identifying patients who benefit most from surgery, and establishing an optimal postoperative care protocol.

Conclusion

The study concludes that open pyeloplasty is safe, effective, and minimally invasive approach in the management of PUJO in young children with least post-operative complications and successful surgical outcomes. The clinical findings that were observed from this study were consistent with pyeloplasty as the first-line surgical intervention for this ailment.

Authors' contribution:

Sarah, Yasra: Conception and designing of paper.
Sarah, Daniyal: Data Collection, Data analysis.
Jahanzeb, Dur Amin, Sherjeel: Critical analysis, final approval of the manuscript.

Conflict of interest:

The authors declared no conflict of interest.

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