

# Outcome of Dismembered Pyeloplasty in Children with Unilateral Pelviureteric Junction Obstruction: A Retrospective Observational Study

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## ABSTRACT

**Introduction:** Anderson-Hynes (AH) dismembered pyeloplasty is the standard procedure performed for the management of Pelviureteric Junction Obstruction (PUJO). Ultrasonography (USG) and diuretic renography are of great importance for the diagnosis and follow-up of PUJO.

**Aim:** To evaluate the morphological and functional outcomes of open dismembered pyeloplasty in children with unilateral PUJO and to find the correlation between functional and morphological outcomes.

**Materials and Methods:** A retrospective observational study was conducted, assessing the clinical charts of 200 children under 10 years of age with congenital PUJO who underwent open AH dismembered pyeloplasty in the Department of Paediatric Surgery at a tertiary teaching Institute, Government Medical College, Thiruvananthapuram, Kerala, India from June 2015 to June 2020. The preoperative radiological assessment included renal USG and diuretic renography for all patients. Morphological and functional surgical outcomes were measured one year after surgery. The morphologic parameters analysed were the Anteroposterior Diameter (APD) of the pelvis

and Parenchymal Thickness (PT). The functional outcome was assessed by improvements in Glomerular Filtration Rate (GFR), Split Renal Function (SRF), and drainage curve. Success was defined as improvement in function and morphology in follow-up USG and renogram after one year of surgery. Paired t-test was applied for statistical analysis using Statistical Package for the Social Sciences (SPSS) software version 23.0.

**Results:** Among the total 200 patients, 180 (90%) cases demonstrated improved renal function after pyeloplasty. Among the total 200 cases, males were 120 (60%) and females were 80 (40%). Morphologic outcome improved in 188 out of 200 (94%) cases. The overall outcome was good in 168 out of 200 (84%) patients. The results showed a moderate negative correlation for APD with respect to SRF ( $r=-0.677$ ,  $p\text{-value}=0.01$ ) and GFR ( $r=-0.430$ ,  $p\text{-value}=0.01$ ), whereas a moderate positive correlation was observed between SRF and GFR ( $r=0.423$ ,  $p\text{-value}=0.01$ ).

**Conclusion:** AH dismembered pyeloplasty is an effective treatment for PUJO in children, not only relieving obstruction but also improving renal function. The present study recommends considering both morphologic and functional parameters to assess the success of the surgery.

**Keywords:** Child, Hydronephrosis, Kidney function test, Kidney pelvis, Ureter

## INTRODUCTION

Ureteropelvic Junction Obstruction (UPJO) is one of the most common pathological conditions in Paediatric Urology. It is the most common cause of hydronephrosis in children. The frequency of UPJ obstruction has been assessed at 1 in 5,000 live births. However, with the initiation of antenatal ultrasound, the frequency of dilation is reported to be higher [1]. Insufficient drainage of urine from the renal pelvis due to UPJO subsequently causes hydrostatic distention of the pelvis and intrarenal calyces. The combination of urine stasis and increased intrapelvic pressure in the collecting ducts causes injury to the kidney [1]. In most cases, renal dilation and obstruction are noticed prenatally. Haematuria after slight trauma or dynamic exercise can be a clinical feature, which may be due to the rupture of mucosal vessels in the dilated collecting system [2].

Ultrasonographic and renographic parameters are useful in assessing the severity of UPJO. Usually, a combination of factors such as the Society of Foetal Urology (SFU) grading, APD of the renal pelvis, drainage pattern, Differential Renal Function (DRF), and GFR on diuretic renogram are used to assess the severity of hydronephrosis [1-4]. While APD and DRF have been considered as main predictive factors for surgery in some studies, others have given importance to calyceal dilatation and cortical thinning on ultrasonogram [3,5,6].

Anderson-Hynes dismembered pyeloplasty is the standard technique performed for the treatment of UPJO, either via an open, laparoscopic, or robotic approach [7]. Diuretic renography, providing information on

SRF and renal drainage, is of great importance for the diagnosis and follow-up of UPJO [8].

The success rate of pyeloplasty is nearly 98% after open AH pyeloplasty [9]. Though the failure rate is less, the criteria used to analyse the postoperative results vary from one study to another. According to one school of thought, if the pelvicalyceal dilatation decreases, it is considered a good result. For others, the result is considered good only if there is improvement in SRF [5-8]. Another group states that regardless of morphological changes, the drainage pattern is important, and there should be unobstructed drainage in the postoperative diuretic renogram [4]. In the present study, the authors retrospectively evaluated the morphological and functional outcomes of dismembered pyeloplasty for the management of unilateral UPJO in children one year after surgery.

The null hypothesis stated that there is no significant difference in morphological and functional outcomes one year after pyeloplasty.

## MATERIALS AND METHODS

A retrospective observational study was conducted in the Department of Paediatric Surgery, Government Medical College, Thiruvananthapuram, Kerala, India from June 2015 to June 2020. The study was conducted after obtaining mandatory Institutional Ethical Committee and research body clearance- (HEC no: 10/102018/MCT).

**Inclusion and Exclusion criteria:** Children under 10 years of age with Congenital Unilateral PUJO who underwent AH dismembered

pyeloplasty were included in the study. Children with PUJO in a solitary kidney, cases with bilateral PUJO, recurrent PUJO, and patients with secondary PUJO were excluded from the study.

### Study Procedure

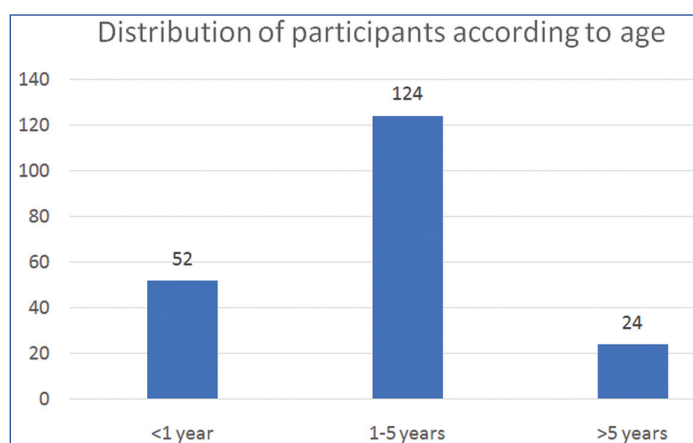
The patients were classified into three age groups- less than one year 52/200 (26%), 1-5 years 124/200 (62%), and 5-10 years 24/200 (12%) of age. The morphologic parameters analysed were the APD of the pelvis and PT. APD is defined as the Anteroposterior Diameter in the cross-sectional view of the kidney measured from its middle, from one side of the parenchyma to the other at the hilar level. Improvement in APD was defined as a decrease in pelvic APD compared to the preoperative value by 20%. Improvement in PT was defined as an increase in the maximum measurable PT by 3 mm [5]. The functional outcome was assessed by improvements in GFR, SRF, and drainage curve. Kidney function was classified as good when SRF is  $\geq 40\%$  and poor when  $< 10\%$  [6,7]. A reduction of SRF by more than 10% of the previous value was considered as deterioration, an increase of more than 10% was defined as improvement, and changes within 5% were considered as preservation [6]. Improvement in the drainage curve means a change in the pattern of the curve from upgoing to downsloping after surgery. The improvement in GFR on the postoperative renogram was defined as an increase in the value by a minimum of 5 mL/minute [3,5,6].

### STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS software version 23.0. In present study, the paired t-test was used to compare the study variables APD, PT, SRF, and GFR before and after surgery. The Pearson's correlation test was used to determine the correlation between functional and morphological outcomes (SRF and APD).

### RESULTS

Among the total 200 cases, males were 120 (60%) and females were 80 (40%). A total 124 (62%) were between 1 to 5 years, 52 (26%) were  $< 1$  year, and 24 (12%) were  $> 5$  years [Table/Fig-1]. In the age group of 1-5 years, 112 out of 124 (90%) patients had a good outcome. In the more than five-year group, 16 out of 24 (66%) patients had a good outcome. In the less than one year group, 40 out of 52 (76%) patients had a good outcome. The left side was involved in 136 out of 200 (68%) cases, while the right side was involved in 64 out of 200 (32%) cases. A total of 176 out of 200 (88%) cases were antenatally diagnosed. It was observed that 16 out of 200 (8%) presented with a preoperative mass, and four out of 200 (2%) cases had a persisting mass postoperatively. The mean preoperative SRF was 40.54, and the mean postoperative SRF was 45.77. The mean preoperative GFR was 37.40 mL/min, and the mean postoperative GFR was 41.30 mL/min. There was a statistically significant increase in postoperative SRF and GFR



[Table/Fig-1]: Age-wise distribution.

[Table/Fig-2,3]. GFR improved in 184 out of 200 (92%) cases, and SRF improved in 180 out of 200 (90%) cases.

Parameters	Mean $\pm$ SD	Paired difference	t-value	p-value
SRF pre-op (%)	40.54 $\pm$ 6.27			
SRF post-op (%)	45.77 $\pm$ 6.92	-5.230 $\pm$ 3.638	-20.332	0.001
GFR pre-op (mL/min)	37.40 $\pm$ 14.38			
GFR post-op (mL/min)	41.30 $\pm$ 15.46	-3.900 $\pm$ 2.844	-19.391	0.001

[Table/Fig-2]: Functional outcome of pyeloplasty based on pre and postoperative GFR and SRF. SD: Standard deviation

Variables	Functional outcome	Morphological outcome
Good	180 (90%)	188 (94%)
Poor	20 (10%)	12 (6%)
Total	200	200

[Table/Fig-3]: Postoperative functional and morphological outcome after pyeloplasty.

Out of the 200 patients with an upgoing drainage curve preoperatively, 180 showed a downgoing curve postoperatively, indicating unobstructed drainage. The overall functional outcome was good in 90% of cases [Table/Fig-2,3]. In 188 out of 200 (94%) cases, APD decreased postoperatively. The mean preoperative APD was 28.78, and the mean postoperative APD was 17.1. There was a statistically significant decrease in postoperative APD ( $p=0.01$ ) [Table/Fig-3,4].

Variables	Mean $\pm$ SD	N	SEM	Paired differences (Mean $\pm$ SD)	SEM	T value	p-value
APD pre-op (cm)	28.78 $\pm$ 6.125	200	0.433				
APD post-op (cm)	17.10 $\pm$ 6.122	200	0.433	11.68 $\pm$ 5.08	0.360	32.47	0.001

[Table/Fig-4]: The statistical analysis of the postoperative morphological outcome based on the change in APD of renal pelvis after surgery. SD: Standard deviation; SEM: Standard error mean

The PT improved in 72 patients, was maintained in 116 patients, and deteriorated in 12 patients. Forty-eight out of 64 patients with PT less than  $< 3$  mm had a good outcome, 60 out of 64 patients with PT 3-5 mm had a good outcome, and 60 out of 72 patients with PT  $> 5$  mm had a good outcome. The mean preoperative PT was 3.95 $\pm$ 1.213 mm, and the mean postoperative PT was 7.14 $\pm$ 1.889 mm ( $p$ -value  $< 0.001$ ) [Table/Fig-5].

PT (mm)	Good outcome	Poor outcome	Prognosis					
			Chi-square	p-value		N	Chi-square	p-value
<3	48	16	8.4	0.015	Deteriorated	12	81.76	0.01
3-5	60	4			Maintained	116		
>5	60	12			Improved	72		
					Total	200		

[Table/Fig-5]: Association between Parenchymal Thickness (PT) and prognosis.

The morphological outcome was good in 94% of cases. The overall outcome (both functional and morphological) was good in 168 out of 200 (84%) cases [Table/Fig-3]. Intraoperatively, 165 out of 200 patients (82.5%) were found to have intrinsic PUJO. Twenty-five patients out of 200 (12.5%) had lower polar crossing vessels, six patients had long-segment PUJO, and four others had nondependent PUJO. Redo pyeloplasty was required for two out of 200 patients. Both of them were in the age group less than one year, with SFU grade four hydronephrosis and initial SRF  $< 20\%$ . Both of them had good morphological and functional outcomes in follow-up.

A moderate negative correlation was observed for APD with respect to SRF ( $r=-0.677$ ,  $p<0.05$ ) and GFR ( $r=-0.430$ ,  $p<0.05$ ), whereas a moderate positive correlation was observed between SRF and GFR ( $r=0.423$ ,  $p<0.05$ ) [Table/Fig-6]. The null hypothesis was rejected, and the alternative hypothesis was accepted.

Correlations		APD post-op	SRF post-op	GFR post-op
APD post-op	Pearson's correlation	1	-0.677**	-0.430**
	Sig. (2-tailed)		0.001	0.001
	N	200	200	200
SRF post-op	Pearson's correlation	-0.677**	1	0.423**
	Sig. (2-tailed)	0.001		0.001
	N	200	200	200
GFR post-op	Pearson's correlation	-0.430**	0.423**	1
	Sig. (2-tailed)	0.001	0.001	
	N	200	200	200

**[Table/Fig-6]:** Correlation of postoperative variables.

\*Correlation is significant at the 0.01 level (2-tailed)

## DISCUSSION

The ideal outcome of AH pyeloplasty in classical PUJO is assessed by improvement in morphology, function, and clinical symptoms. The male to female ratio was 3:2, indicating that PUJ obstruction is more common in boys. This is similar to the prevalence observed in the literature, which reports a prevalence of 1 in 1000-1500 [3,9-11]. The patient's age at the time of repair is still controversial. Reduction in the grade of hydronephrosis may be better in a younger cohort. Early surgery is indicated by the development of any sign of deterioration. It is suggested that early surgery can prevent irreversible renal damage and improve renal function [12-16]. Similar to present study, other studies also do not demonstrate that the infant kidney is more likely to have resolution of pyelocaliectasis postoperatively [2,5]. The comparatively increased incidence of an unfavourable outcome in the age group >5 years compared to the others is likely a reflection of long-standing PUJO and its consequences compared to the other two groups. In 68% of cases, the side of involvement was left. This is comparable to the literature, which reports that two-thirds occur on the left side [7].

Children with clinically palpable masses were associated with an unfavourable outcome, as two of these cases required redo pyeloplasty. Risk factors associated with redo pyeloplasty are age less than one year, higher-grade hydronephrosis, and poor initial SRF [9]. Improvement in renal pelvic APD and renal PT after pyeloplasty are predictors of good outcomes, as evidenced in several previous studies [12,17,18]. Improvement in functional parameters like GFR, SRF, and drainage pattern on the postoperative renogram has been extensively used as indicators of good results after pyeloplasty in several studies [8,12,17,18]. In present study, there was found to be an excellent correlation between the improvement in morphological outcome and functional outcome after pyeloplasty. The cardinal observations of present study were correlated with similar studies in the current literature and tabulated [Table/Fig-7] [8,12,17,18].

Parameters	Salih EM [8] (2015)	Bendre PS et al., [12] (2021)	Mauya RK et al., [17] (2021)	Inugala et al., [18] (2021)	Nibi Hassan et al., (present study)
Statistically significant improvement in renal pelvic APD	-	Yes	97%	-	94%
Improvement in renal Parenchymal Thickness (PT)	47%	Yes	100%	Yes	72%

Improvement in Split Renal Function (SRF) on renogram	63.9%	95.8%	100%	70%	90%
Improvement in drainage pattern on renogram	52%	-	-	66.7%	90%

**[Table/Fig-7]:** The comparison of results of the present study with previously published similar studies [8,12,17,18].

The clinical implication of the observations of this study suggests that the assessment of postoperative results, follow-up, and prognostication after pyeloplasty should be based on the consideration and correlation of both morphological and functional parameters.

## Limitation(s)

A limitation of present study was that other important morphological parameters, such as Corticomedullary Differentiation (CMD), SFU grade, and calyceal dilatation, could not be included for analysis because these data were not uniformly available in all records.

## CONCLUSION(S)

The AH dismembered pyeloplasty is an effective treatment for PUJO in children, relieving obstruction and improving renal function. The present study emphasises the need to assess both morphological and functional parameters and correlate them to determine the outcome after pyeloplasty in children. Instead of using these parameters as independent predictors of outcome, they should be used collectively for postoperative follow-up and prognostication.

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