# A Bridge between Laparoscopic and Open Techniques in Treatment of Pediatric Pelvi-Ureteric Junction Obstruction (PUJO) for the Beginners

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## Abstract

**Introduction:** Laparoscopic pyeloplasty is considered one of the most challenging procedures in the paediatric urology. Long operating time and steep learning curve are drawbacks of the technique. The aim of this study is to assess the feasibility of laparoscopy-assisted pyeloplasty and its outcome.

**Materials and Methods:** It's a retrospective comparative study of patient undergoing pyeloplasty in Shri Dharmasthala Manjunatheshwara(SDM) College of Medical Sciences since June 2018 till February 2020. The patients were divided into two groups based on whether patients have undergone laparoscopy-assisted approach (group A) or open pyeloplasty (group B) and both groups were followed up for one year. Laparoscopy-assisted approach constituted of laparoscopic mobilization of pelvi-ureteric junction (PUJ) followed by hand-sewn anastomosis after exteriorising the PUJ.

**Results:** There were 12 patients in group A and 16 patients in group B. Duration of surgery was longer in group A. There were 4 patients in group A, older than 3 years who

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## Keywords

- Laparoscopy-assisted pyeloplasty
- Paediatric pyeloplasty
- Minimal invasive surgery for pelvi-ureteric junction obstruction

needed conversion to open surgery. One patient had recurrence of PUJO needing re-do surgery.
There was no major complication in open technique except wound infection which required extended hospital stay up to 8 days. There were no significant differences between the two groups in analgesic usage

**Conclusion:** Laparoscopy-assisted pyeloplasty is an intermediate path for surgeons with less experience in advanced laparoscopy. The reasonable small incision without compromising outcome in ureteropelvic anastomosis is the major advantage of this technique. The procedure is useful in infants but not suitable for the age group of above 3 years.

## Introduction

Hydronephrosis is one of the most common conditions dealt by paediatric surgeons in the field of paediatric urology and pyeloplasty is the commonly performed surgical procedure for hydronephrosis.[1]Minimally invasive procedures are now widely applied in the management of pelviureteric junction obstruction (PUJO) due to their obvious advantages.[2]Laparoscopic pyeloplasty is considered as one of the most challenging procedures in the paediatric urology. Long operating time, steep learning curve and inability to place the sutures in desired place due to small working space in children compared to adults reduce the popularity of laparoscopic pyeloplasty inthe paediatric age group.[3] In the present era where there is growing awareness regarding the minimal invasive techniques in general population, parents demand for minimal invasive approach in their children without knowing the technical aspects and consequences, as their main concern is the external scar. It is the responsibility of the surgical fraternity to provide the surgical care, meeting the parents' satisfaction without compromising the surgical principles and outcome. The feasibility of laparoscopy-assisted pyeloplasty for beginners is assessed along with its outcome in our study.

## Materials and Methods

It is a retrospective comparative study of patients undergoing pyeloplasty in SDM College of Medical Sciences, in the department of paediatric surgery from June 2018 till February 2020. The patients were divided into two groups based on the approach used for the pyeloplasty. Twelve patients were designated with group A who underwent laparoscopy-assisted pyeloplasty (LAP) and 18 of them were categorised into group B who underwent open extraperitoneal pyeloplasty (OP). Twenty-four out of 30

patients were diagnosed antenatally. The patients were evaluated by ultrasonography of abdomen followed by diuretic renogram and were followed up for one year after the surgery with abdominal ultrasonography every three months. Following features were compared in both groups: age, weight, duration of the surgical procedure, antero-posterior diameter of renal pelvis, number of days of postoperative stay in the hospital and length of the incision. Following patients were excluded from the study: patients with ectopic kidney or fusion anomalies, re-dopyeloplasties, patients with percutaneous nephrostomy tube before the surgery, and patients older than 14 years.

Method of Open Anderson Hynes pyeloplasty (OP)

Patients were placed in supine position with ipsilateral side slightly elevated. Anterolateral incision was made in the flank region to approach the kidney through extraperitoneal approach. The procedure consisted of dissection of PUJ and adequate mobilization of ureters followed by opening the renal pelvis and dismembering the affected segment. Redundant pelvis was reduced and spatulation of lateral wall of ureter was performed till wide ureters were obtained. Ureteric pelvic anastomosis was done in interrupted manner using 5-0 absorbable suture materials. The perinephric drain was not placed routinely. Double J (DJ) stent was always placed in antegrade manner just before completion of anastomosis.

Method of Laparoscopic assisted pyeloplasty (LAP)

The position of the patient was similar to the above-described procedure. There was no difference in anaesthesia technique, except that the rapid sequence technique was preferred, but not made mandatory. Here, PUJ was dissected and mobilised using laparoscopic technique initially, PUJ was then delivered out through a small incision and hand-sewen anastomosis was performed. Procedure starts through a 5 mm port placed in the ipsilateral side of umbilicus to enter the peritoneal cavity. Two other 3 mm ports were introduced through the ipsilateral subcostal region and lumbar region for working purpose. The colon was reflected from its lateral border and kidney is identified. The pelvis is dissected to find and mobilise the ureter. Ten mm port was introduced into the peritoneal cavity in upper lateral region part of lumbar region to pull out the mobilised PUJ extracorporeally **Figure 1**. Muscle relaxation is provided for adequate delivery of the renal pelvis out of the incision. Care was taken not to put undue traction over the exteriorised PUJ. Rest of the surgical procedure is performed in standard fashion with extracorporeal hand sewn suturing. In case of poor exposure, the 10mm incision is widened. Standard modified Hynes pyeloplasty was performed as noted in the open procedure.

Appropriately sized DJ stent was placed in the antegrade manner just before the completion of the anastomosis. Perinephric drain was not routinely placed.

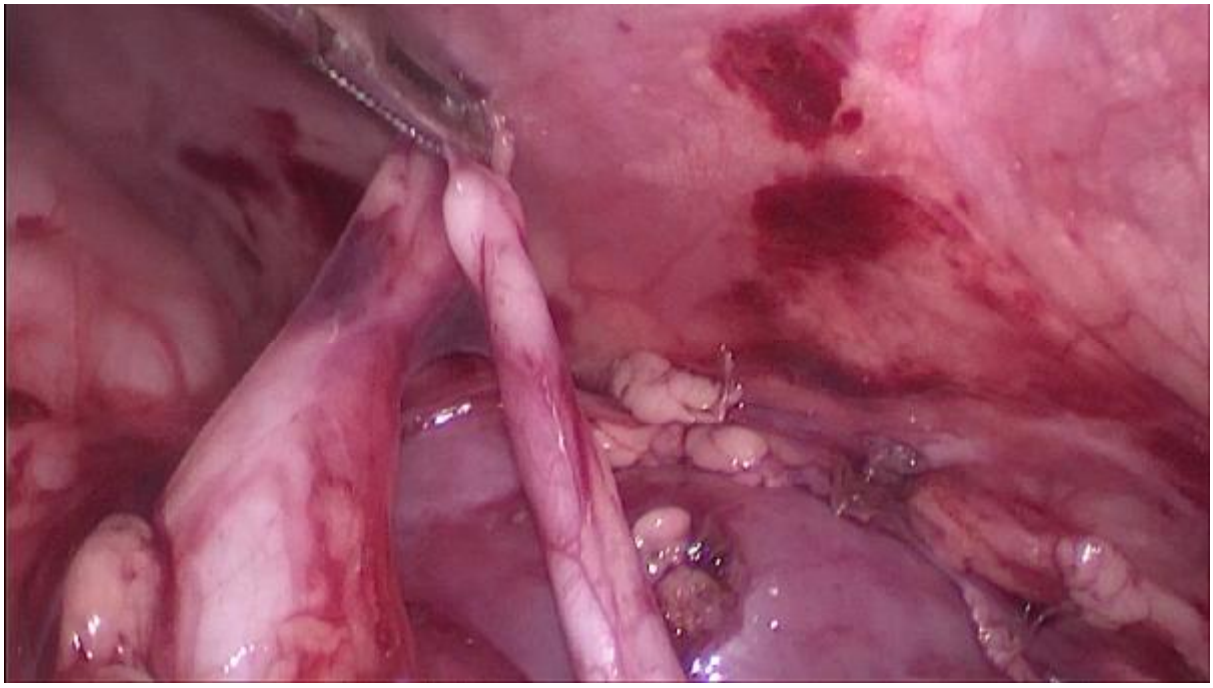

**Figure 1:** Photograph showing mobilized PUJ being pulled forward to anterior abdominal wall

Statistical analysis

Data was entered into Microsoft Excel and analysed using SPSS version 25. The categorical variables were presented using frequency and percentages. Chi square tests and student T test were used for statistical analysis. P value of less than 0.05 was considered as significant value for interpretation of results.

## Results

Total of 30 patients were included in the study. Twelve patients belonged to group A and 18 children to group B. **Table 1**. There were 7 female children in series, but among them only one girl was operated in the group B. The differential renal function was noted between 25% and 40% in our series (both the group included). The mean age of the patients included in the study was 3.61 months (1-9 months, SD 2.118 months) in group B and median age in group A was 6.5 months. Mean weight was 8.57 kg (4.6 to 13 kg, SD 2.91 kg) and 5.99 kg (3.4 to 8.9 kg, SD 1.08kgs) in group A and B respectively. The average number of hospital stay was comparable in both groups; 7.08 days in group A and 5.39 days in group B. The operative time was calculated since induction of anaesthesia till recovery from the anaesthesia which was 154 (120-210 minutes, SD 28.11) in LAP group compared to 103 (75-150minutes, SD 21.35) in OP group. Mean AP diameters of the kidneys in both groups were

comparable. One patient had complication in each group. One patient in the group A had urinary leak for which the baby was discharged on 14th day following resolution of leak after conservative management. One patient in the group B had surgical site infection who was admitted for 8 days. In the group A, the procedure had to be converted to the open technique to access the renal pelvis in 4 patients. All the above 4 patients were older than 3 years-old and weighed more than 10 kilograms. Drain was used in 2 patients in group A and in none of the patients in group B. The perinephric surgical drain was placed in 2 patients as DJ stents were not negotiable in them. The patient with urinary leak in group A had recurrent PUJO and the patient presented with hugely dilated renal pelvis after 4 months of surgery. Re-do pyeloplasty was done but patient was lost for the follow-up after the procedure. Rest of the patients had satisfactory ultrasonography findings at regular intervals and had shown good drainage in diuretic renogram at one year of post-operative period. The average length of scar was 1.12 cm in patients successfully undergoing LAP, compared to 4.3 cm in OP group **Figure 2, 3.**

**Table 1:** Comparison between patient characteristics among open surgery and laparoscopic assisted surgery

| Sl No | Variables | LAP group (n=12) | OP group (n=18) | p value |
|---|---|---|---|---|
| 1 | Age (in months) | 17.08 (2-48) | 3.61(1-9) | 0.05 |
| 2 | Weight (in KG) | 8.4 (4.6-13) | 5.9 (3.4-8.9) | 0.003 |
| 3 | Gender distribution (M:F) | 6:6 | 17:1 | 0.005 |
| 4 | Duration of surgery including anaesthesia time(min) | 154.17 (120-210) | 103.33 (75-150) | <0.01 |
| 5 | No days of post-operative hospital stay | 7.08 (4-14) | 5.39 (3-8) | 0.048 |
| 6 | Anterior posterior diameter of the kidney(in mm) | 27.25 | 28.89 | 0.725 |
| 7 | Side of the Kidney operated (L:R) | 8:4 | 11:7 | 0.757 |


**Figure 2**: Surgical scar after laparoscopic assisted pyeloplasty


**Figure 3:** Surgical scar after open pyeloplasty

## Discussion

Open Anderson Hynes pyeloplasty is the procedure of choice in management of PUJO.[4]Initially, laparoscopic pyeloplasty was attempted in adults in 1993. In 1995, and the first paediatric pyeloplasty was performed in a seven year-old child.[5]Although minimally invasive renal procedures were performed in early 1990s; it was in 1996 ,when Tann presented his experience with laparoscopic pyeloplasty in infants that was published in 1999.[6]He suggested that laparoscopy should not be performed in patient less than 6 months of age due to high level of post-operative complications. At present there are literatures which claims the laparoscopic approach to be safe in all age groups.[7] Increase in the demand for minimal invasive approach and the high expectations of the parents provoke surgeons to adapt to the new modalities of the treatment. Complications are very common in the early phases of surgeons' career which gradually fades away as more experience is gained. This suggests that there is a steep learning curve for this procedure. One of the authors has suggested that learning curve is less steep for an experienced surgeon who has recently started operating by laparoscopic route[8]. In our opinion, an experienced surgeon might not have as much intra operative complications as compared to a young surgeons but may still have physical strain and time consumption as part of learning process which needs attention, as long anaesthesia time has a detrimental outcome in neurodevelopment of young infants as well as other anaesthesia-related complications.[9] There is clear evidence of steep learning from the centres having dedicated paediatric urology team, suggesting that the complications may be high in surgeon with less experience in minimally invasive techniques. Although this situation may change over time for a surgeon, but still there is always a struggle, especially when patient is less than 5 years of age compared to adult patients.[10] Laparoscopy-assisted pyeloplasty is not a new technique. Many surgeons have tried it as a bridge between open technique and minimally invasive technique, thereby giving the procedure an advantage of small incision of laparoscopic technique and high precision of open technique without compromising the outcome and thereby reducing the complications.[11]Literatures suggest that this technique has good results in children less than a year or babies weigh less than 10 kilograms.[12]In children above 10 kilograms the incision had to be extended for proper exposure of the renal pelvis. The disadvantage of laparoscopic approach in children is long operative duration. This could be because of small working space. This difficulty may be tackled with use of screw like trocars instead of smooth-walled trocars as they have to be kept sufficiently inside to avoid slippage and good bowel preparation. Fixation of the trocar to the skin using the cut pieces of latex urinary catheter are also described in the literature.[13]We follow this technique to stabilize the trocars. Laparoscopic technique is advantageous in

adult patients as they need considerably large incisions and tissue handling is not as delicate as in infants. But in children, open pyeloplasty could be performed with a reasonably small incision, even a slight extension of the incision during the laparoscopy-assisted pyeloplasty may also put the procedure in significant disadvantage, as we could have offered complete extra peritoneal approach. A study similar to ours was published by Gahoray in 2004, with his initial experience of laparoscopy-assisted transperitoneal pyeloplasty with 5 patients.[14]He presented another study in 2012 where he compared his previous technique with retroperitoneoscopy-assisted approach. He was of the opinion that the former procedure works well for a child weighing less than 10 kilograms whereas incision had to be increased when patients are older or obese. He further suggested that, the latter procedure (retroperitoneoscopy-assisted approach) is difficult to perform in smaller individuals due to small operating space.[15]The average operating time was longer in such patients compared to transperitoneal laparoscopy-assisted technique. Minu Bajpai et al have described lumboscopy-assisted technique in children where the approach was an extraperitoneal one and the procedure was feasible in older patients as well.[16]In our technique we had to convert the procedure to open (needed larger incison) in the patients above 3 years of age or who weighed more than 10 kgs. Duration of surgery in our series was longer with LAP surgery justifying that it gave an advantage of smaller surgical scar. The majority of parents of female children opted for a LAP surgery as they were prejudiced about the scar. The average scar was three times smaller in LAP compared with the OP at 6 months follow up. The bulge noted in the lumbar region in the incison site of open pyeloplasty was not found in LAP group. There was a significant difference in the age and the weight of the patients in both groups. Patients who required the conversion to open surgery or needed bigger incisions were excluded from the group, then both groups were comparable. A similar study was performed by Parisa Saeedi Sharifabad et al where mean age of children was significantly lower in laparoscopy-assisted group. The analgesia usage and hospital stay were also lesser in laparoscopy-assisted group.[17]The study was retrospective in nature with small number of patients, the patients chosen were arbitrary, need for analgesia were not assessed; were limitations of our study. Use of transperitoneal approach, inability of reducing the renal pelvis as done in open technique, need for bigger incision in patients older than one year-old, difficulty faced in re-do and ectopic cases etc are some of the drawbacks of the procedure. Robotic pyeloplasty and robot-assisted laparoscopic pyeloplasty are well accepted modes of therapy and are going to be the future care for PUJO as mastering it is simpler than the laparoscopic surgery. Cost of treatment, availability issues and robust nature of the equipment to be manipulated in young infants are some of the drawbacks of thesemodalities.[18, 19]

## Conclusion

For an experienced laparoscopic surgeon, laparoscopic pyeloplasty is suggested to be a good technique. But laparoscopy-assisted pyeloplasty is certainly helpful for young paediatric surgeons/urologists during the initial part of their career, it reduces the duration of the procedures as well as maintains the surgical precision. However, the cases have to be chosen wisely as it is not feasible in re-do cases, kidney positional anomalies and older children. Excessive traction on the PUJ due to suboptimal exposure should be avoided.

## Ethical Consideration

This study was approved by Institutional Ethics Committee of SDM University at its meeting held on 15/06/2021 with code number "SDMCDS IEC. No. 2021/Medical/ Paediatric/02".

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## Conflict of interests

There is no conflict of interest

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